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Audio

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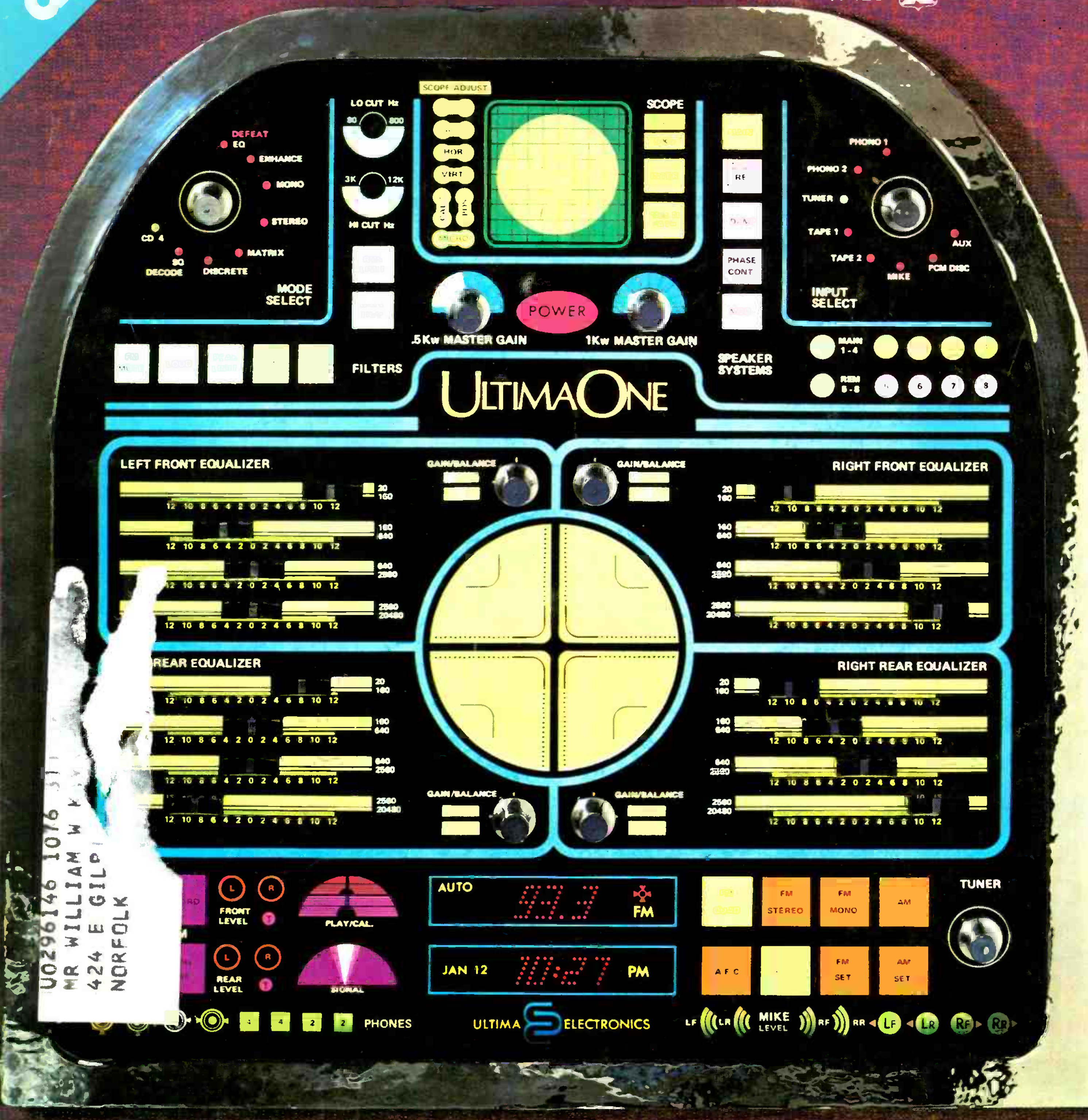

The best way

to find out how well a receiver performs is to listen to it. The next best way is to listen to the opinions of qualified critics who *have* listened to it. Pioneer quadraphonic receivers have earned the unanimous praise of the critics. Visit a Pioneer dealer and listen to these receivers. Once you've heard them yourself, we're confident you'll agree.

STEREO REVIEW: "The QX-949 has built-in decoding circuits for all the major types of four-channel records — SQ, RM *and* CD-4 . . . electrical performance of its tuner and amplifier rivals some of the finest separate component systems."

AUDIO: "(The QX-949 is) one of the most impressive receivers (visually and technically) we have ever tested . . . It would be very difficult to come up with any features in a four-channel receiver that Pioneer hasn't already thought of in this powerful unit."

POPULAR ELECTRONICS: "The Pioneer Model QX-747 receiver is clearly a superb unit when judged by all normal performance standards. In fact, its power capabilities in the 2-channel mode make it a fine value even as a stereo-only receiver."

MODERN HI-FI & STEREO GUIDE: "The QX-949 is commensurate with all the fine receivers we have learned to expect from Pioneer and it stands as the model for present-day quadraphonic receivers."

HIGH FIDELITY: "The tuner section is one of the best we've seen in a quadriphonic receiver . . . All told, the QX-949 strikes us as typical of Pioneer's relatively uncompromising approach to receiver design."

Complete reprints available upon request.

Four-Channel Level Indicator — See what you hear. Make instant adjustments with left/right, front/rear level controls.

electronic trigger relay system is used to protect the speakers from DC leakage or overload.

New and exclusive Power Boosting circuit

When switching from four-channel to two-channel reproduction, power is substantially increased with the new and advanced Power Boosting circuit, as described above. This exclusive circuit is built into both the QX-949 and QX-747 models.

Another plus feature attributable to the Power Boosting circuit is simplified switching from four-channel to two-channel operation. It can be instantly achieved without the usual re-connecting of speaker wires. This, too, is a Pioneer exclusive.

A tuner section the equal of separate components

The FM tuner section of the QX-949 is truly an engineering accomplishment. It incorporates two dual-gate MOS FET's in the front end, plus three ceramic filters and 6-stage limiters in a monolithic IC in the IF stage. The result is superb sensitivity and selectivity, and excellent signal to noise ratio.

Advanced circuitry includes Dolby adaptor input/output and 4-channel broadcasting multiplex output terminal

In anticipation of the future use of discrete quadraphonic broadcasting, the QX-949 and QX-747 include a quadraphonic multiplex output terminal. Depending on the system finally approved, all that ever will be required is a simple adaptor unit. And speaking of adaptor units, both the QX-949 and QX-747 highlight an input/output for a Dolby noise reduction adaptor unit.

Unique 4-channel level indicator

Regardless which quadraphonic source is in operation, the sound level of each channel can be monitored by viewing the large scope-type level indicator on the top two models. Left and right front/rear controls permit instant adjustment. Indicator sensitivity controls allow for a maximum of —30dB adjustments at any sound level. The level indicator may also be used to view CD-4 channel separation adjustments made with the CD-4 separation controls.

Inputs/Outputs for total versatility

Pioneer has endowed these models with terminals for a wide range of program sources. The only limitation is your own listening interests and your capability to experiment with sound.

Convenient features increase listening enjoyment

Along with the total capability of these receivers, Pioneer has incorporated a wide array of additional, meaningful features. All three instruments include: loudness contour, FM muting, an extra wide tuning dial, two sets of bass/treble controls for front and rear channels, function and mode selector with multi-colored indicator lights. Further refinement is offered with the QX-949's multiplex noise and high/low filters, plus signal strength and center tuning meters in one housing.

Admittedly, these new Pioneer quadraphonic receivers, like fine sports cars or cameras, are not inexpensive. However, they represent the high fidelity industry's most outstanding value. We have built them with the same quality, precision and performance you've come to expect from Pioneer stereo equipment. We offer them to you with the same pride and conviction that has always compelled you to say — "Pioneer, the very best."

QX-949 — $749.95; QX-747 — $649.95; QX-646 — $499.95. Prices include walnut cabinets.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074
West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007
Canada: S. H. Parker Co.

Specifications

Amplifier	QX-949	QX-747	QX-646
*4-ch. minimum continuous power per channel, 8 ohms	40 watts/ channel (20Hz-20kHz)	20 watts/ channel (20Hz-20kHz)	9 watts/ channel (40Hz-20kHz)
*2-ch. minimum continuous power per channel, 8 ohms	60 watts/ channel (20Hz-20kHz)	40 watts/ channel (20Hz-20kHz)	13 watts/ channel (40Hz-20kHz)
*Maximum total harmonic distortion	0.3% (20Hz-20kHz)	0.5% (20Hz-40kHz)	1% (40Hz-20kHz)
FM Tuner FM Sensitivity (IHF) (the lower the better)	1.8uV	1.9uV	2.2uV
Selectivity (the higher the better)	80dB	60dB	40dB
Capture Ratio (the lower the better)	1dB	1dB	3dB
S/N Ratio (the higher the better)	70dB	70dB	65dB
Inputs Phono	2	1	1
Tape Monitor	2 (4-ch.) 1 (2-ch.)	1 (4-ch.) 1(2-ch.)	1 (4-ch.) 1(2-ch.)
Dolby adaptor input	1 (4-ch.)	1 (4-ch.)	—
Auxiliary	1	1	1
Outputs Speakers	2 (Front) 2 (Rear)	1 (Front) 2 (Rear)	1 (Front) 2 (Rear)
Headset	1 (Front/Rear)	1 (Front/Rear)	1 (Front)
Dolby adaptor output	1 (4-ch.)	1 (4-ch.)	—
Tape Rec.	2 (4-ch.) 1 (2-ch.)	1 (4-ch.) 1 (2-ch.)	1 (4-ch.) 1 (2-ch.)
4-ch. MPX output	1	1	—

*In accordance with F.T.C. regulations

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Audio

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Record Reviews

Audio in General

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BENEATH THE SURFACE OF EVERY B·I·C TURNTABLE BEATS THE HEART OF A SIMPLE MACHINE.

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Look underneath the finest, the most expensive automatic turntables from other makers and you'll find more machinery than you see here.

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A modern multiple-play turntable is a complex electro-mechanical device, manufactured to tolerances that turn engineers' hair grey. To give acceptable performance it must operate at levels which approach perfection.

Every gear, cam, lever, pivot, spring, and moving part that can be eliminated eliminates a point of stress, wear, and possible malfunction.

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As so often happens, simplification has bred a more effective, more durable system.

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The low-speed 300 RPM motor is quieter than 1800 RPM motors standard in other automatics. In life tests it has operated for the equivalent of 14 years without faltering.

So, the 980 and 960 operate with silent dependability and generate wow, flutter, and rumble numbers any manual would be proud of.

Before you buy any turntable, regardless of price, find out all there is to know about the B·I·C Programmed Turntables. We'll send more information if you write to British Industries, Dept. 1A, Westbury, L.I., N.Y., 11590. Or better yet, see your audio dealer.

When you see the 980 and 960 in action, we think you'll be impressed by what simple machines can do.

B·I·C™

This is the 980 with solid state speed control and strobe. About $200. The 960 is identical except for these two features. About $150.

UL approved.

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Audioclinic

Joseph Giovanelli

Pink Noise Revisited

In the September issue, Mr. Giovanelli's answer to Mr. Paul Lutz's letter concerning pink noise was wrong. In the first paragraph Mr. Giovanelli states:

"If one devises a filtering system, however, this noise could be produced over a portion of the spectrum only. It is this reduced noise bandwidth which we refer to as 'pink noise.'

"The 1/3-octave 'pink noise' is a special case of such pink noise, where the spectrum is divided into very narrow segments, each of which is 1/3-octave wide."

Random noise produced by a noise generator (which Mr. Giovanelli referred to) is normally what is called "white noise," as it is similar to white light having an equal energy level at all frequencies within the portion of the spectrum being utilized. This portion of the spectrum can be many octaves or any small amount desired, such as 1/3 octave, and it is still white noise. If this white noise is filtered through a network which gives a 3-dB-per-octave attenuation as frequency is increased, you then have pink noise which has equal energy within any octave or fraction thereof, such as 1/3 octave, 1/4 octave, etc. It is this difference between equal energy at all frequencies and equal energy within an octave or fraction thereof, which is of significance. I feel that Mr. Giovanelli's statement was not only incorrect but could very badly mislead someone who is starting in the audio field as a professional and who has not had formal instruction which would make him aware of the inaccuracy of this statement.

S. Blair Hubbard
Chief, Branch Audio
Production Services
Dept. of the Interior
National Park Service
Harpers Ferry, W.V.

A Problem of Boominess

Q. My speakers perform quite well through the upper mid-range and high end. They are plagued, however, by a mid-bass peak which seems to place the male voice "in a barrel." Lower strings are likewise hollow and overly resonant sounding. Reduction of the settings of the bass tone controls on my preamplifier by about 8 dB removes the problem, but thins the low bass too much. I know I could opt for different speakers or employ a frequency equalizer, but I wish to avoid undue expense.

Can you suggest a modification to my present system which would solve or ameliorate my problem?—Ralph L. Price, Jr., Woodbridge, N.J.

A. A possible approach to your problem is to place your speakers in different parts of the listening room, with the hope that a location for each speaker can be found which will minimize this condition. The listening room often contributes more to boominess than do the speakers themselves.

Paralleling Power Amp Inputs

Q. Can I use a "Y" connector in each channel of my preamplifier to drive a pair of mono amplifiers per channel. I have four Advent speakers, and I would like to power each one with a separate amplifier.—C.T. Lewis, Morrisonville, N.Y.

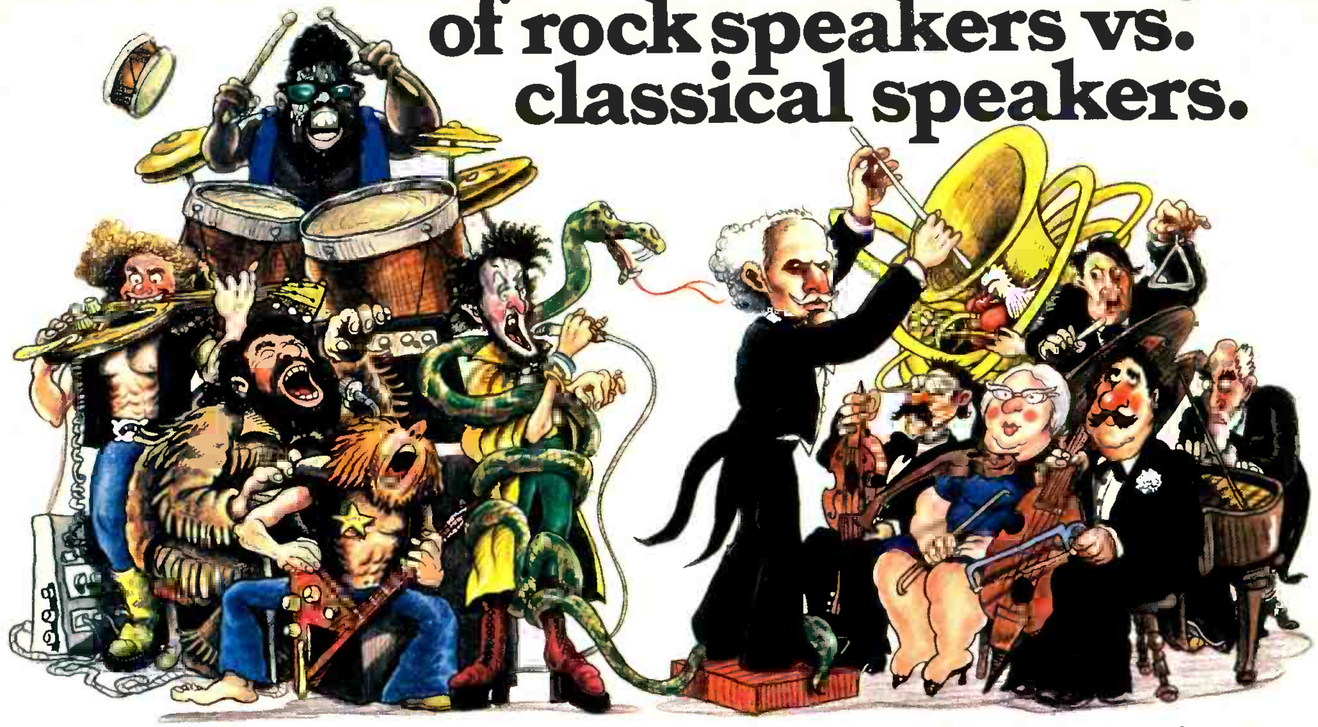
A. You should be able to use the "Y" connectors to feed two power amplifiers from one channel of a preamplifier, provided that the total input impedance represented by the two power amplifiers does not fall below the minimum recommended by the manufacturer of the preamplifier.

Where two power amplifiers are identical, the combined impedance of their two input circuits will be one half that of a single power amplifier.

About the cover: The latest in receivers, the Ultima One is from Ultima Electronics and was engineered by Karl Kofoed.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

The Rectilinear 5: end of the myth of rock speakers vs. classical speakers.



The new Rectilinear 5 is capable of playing very, very loud. Rock-festival loud. Even with a medium-powered amplifier.

At the same time, it's uncannily accurate. It sounds sweet, unstrained and just plain lifelike at all volume levels.

The temptation is great, therefore, to one-up that prestigious manufacturer who some time ago announced "The first *accurate* speaker for rock music."

But we refuse to perpetuate that mythology. It's perfectly obvious that the Rectilinear 5 reproduces classical music just as accurately as rock. We could never see how a voice coil or a magnet would know the difference between Jimi Hendrix and Gustav Mahler.

So we'd rather use this opportunity to set things straight once and for all.

Thus:

There's no such thing as a rock speaker *or* a classical speaker. Any more than there's a late-show TV set or a football-game TV set.

There are, however, speakers that impose a hard, sizzling treble and a huge bass on *any* music. And others that round off the edges and soften up the transient details of *any* music. That's the probable origin of the myth; but these aren't rock and classical speakers, respectively. They're *inaccurate* speakers.

It's true that an aggressive treble and a heavy bass are characteristic of most rock music, even when heard live. It's also true that some record producers exaggerate these qualities, sometimes to a freakish degree, in their final mix of the recorded sound.

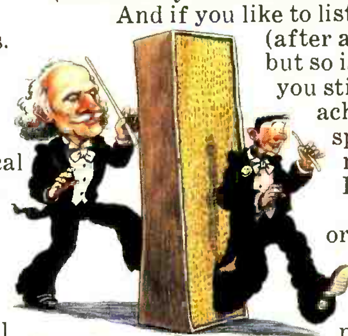
Wrong: Freaky sound made even freakier by the speaker.

But that doesn't mean the speaker can be allowed to add its own exaggerations on top of the others.

A loudspeaker is a conduit. Its job is to convey musical or other audio information unaltered. If the producer wants to monkey around with the natural sound that originally entered the microphones, that's his creative privilege. He'll be judged by the musical end results. But if the speaker becomes creative, that's bad design.

By the same token, if some classical record producers prefer a warm, pillowy, edgeless string sound, that doesn't mean your speakers should impart those same qualities to cymbals, triangles or high trumpets. (Stravinsky's transients can be as hard as rock.)

And if you like to listen at very high volume levels (after all, that's what rock is about—but so is *Die Götterdämmerung*), you still don't need a speaker that achieves high efficiency through spurious resonances. What you need is something like the Rectilinear 5.



Equally wrong: Classical sound made vague and spineless by the speaker.

Everything in this remarkably original design was conceived to end the trade-off between efficiency and accuracy. The four drivers are made to an entirely new set of specifications. The filter network that feeds the drivers is totally unlike the traditional crossover network. Even the cabinet material is new and different.

Of course, those who feel threatened by all this fuss about accuracy and naturalness will point out that the monitor speakers preferred by engineers and producers in recording studios are usually of the zippy, super-aggressive variety.

That's perfectly true, but the reason happens to be strictly nonmusical.

"I use the XYZ speaker only as a tool," a top producer explained to us. "I wouldn't have it in my house. It really blasts at you when you crank up the volume, so that any little glitch on the tape hits you over the head. After eight hours in the studio, that's what it takes to get your attention. I know how to deal with those unpleasant highs; they're in the speaker, not on my tape."

It's easy enough to find out for yourself. Any reputable dealer will let you hear the Rectilinear 5 side by side with a "rock" or "monitor-type" speaker. Adjust each speaker by ear to the *same* high volume level, making sure the amplifiers are of good quality. Then listen. To rock *or* classical.

Then and there, the myth will crumble.

Rectilinear 5 Contemporary Laboratory Series bookshelf/floor speaker system, $299.00 Rectilinear Dispersion Base (patent pending) optional.

RECTILINEAR®

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Tape Guide

Herman Burstein

Changing to Non-portable

Q. I own a General Electric portable stereo recorder. Recently I began to think about converting my machine into a non-portable model by building a wooden case. I also thought that I would add another VU meter as well as revise the controls so that I may vary the bass, treble, and volume for each channel. The necessary connections seem to be simple enough. But I was wondering if you foresee any difficulties.—William K. Vinson, Kingsley Field, Oregon

A. There is scarcely an electronic project on which one does not encounter some bugs. But I don't foresee any major or unconquerable ones in your case. So long as you don't tamper with such things as record and playback equalization, bias, amount of signal fed to the record head, and amount of signal to the record level indicator, and so long as you take the usual precautions against hum pickup and against treble loss due to excessive capacitance in your leads, your project should be successful.

Tape Deck and Amplifier Hook-up

Q. I would like to play my tapes through my stereo system, which would mean connecting the putputs of my tape recorder to the inputs of my stereo amplifier. I am concerned that feeding an already amplified signal into another amplifier might do some damage. Please advise me if this set-up would cause harm to my components.—Robert Grip, Chestnut Hill, Mass.

A. The proper connection is to feed the outputs of your tape recorder into the high level inputs of your audio amplifiers. Such inputs would be marked Tape (*not* Tape Head), Auxiliary, etc. Then there is no danger of overloading the amplifier. I gather that your recorder has a self-contained amplifier and speaker. The output of your recorder should be taken, if possible, from a point prior to its power amplifier—namely from a jack marked External Amplifier. If your recorder has no such output jack, then you will have to take its output from the jack marked External Speaker.

Dolby Unit Placement

Q. I have been to three dealers of the Advent Dolby 101 Noise Reduction System, and each has given me a different answer as to whether or not I can use the 101 unit with my tape recorder. Dealer #1 says I can, Dealer #2 says I can't unless I have some modifications made to my tape recorder, and the third dealer says I would have to buy a unit and try it. I have a Sony Auto-Reverse 660 tape recorder with a self-contained amplifier, a Shure M-65 Stereo Conversion Preamplifier, and a Dual 1019 changer. I have no separate amplifier. To record I plug the Dual into the Shure preamp, and plug the preamp into the line input of the tape recorder. For recording, Dealer #1 says that I just have to insert the 101 between the Dual changer and the Shure preamp. In the case of playback, Dealer #1 says that I can use the 101 with my Sony if I hook it up as follows: line output of the tape recorder into the 101, and the 101 output into the line input of the Sony. Dealer #2 says I can use the 101 with my Sony in playback if I have some modifications made to the Sony. If Dealer #2 is right, is it worth the expense and the trouble to have it done?—John Deysher, Towanda, Pennsylvania

A. The Dolby should be used between the Shure M-65 and the Sony 660 in recording. So Dealer #1 is wrong there. In playback, Dealer #1 is wrong again. In playback the Dolby should be used between the preamp and power amplifier sections of your Sony. Therefore Dealer #2, who says you have to make a modification to your tape recorder, is correct. The modification is not a very complex one. Consult a local audio technician as to what he will charge. Also consult Dealer #2 (assuming he has the facilities for making the necessary change). And then decide for yourself whether the modification is worthwhile.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

This is what makes the Sansui 771 so great:

Specs. Features. Looks. And Price.

Sansui, already famous for quality and value has again outdone itself with the 771 receiver. Look at the specs: 35 watts per channel, min. RMS both channels driven into 8 Ohms, 20 Hz to 20 kHz, at below 0.5% Total Harmonic Distortion – more than enough to power two pair of speaker systems. FM sensitivity of 2.0μV(IHF).

Look at the features: two tape monitors, two auxiliary inputs, three pairs of speaker selectors, two filters (hi & lo) and more – even a microphone circuit. Visit your nearest Sansui franchised dealer and listen to the tremendous Sansui 771. Then listen to the price.

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Dear Editor:

DeVries & Lampton Speaker: Crossover & Large Enclosures

Dear Sir:

The comments by deVries and Lampton ("Build an ES Tweeter/Cone Woofer System," AUDIO, Aug., 1974) on crossover design require comment, since their proposed crossover design is demonstrably non-optimal.

The authors correctly point out the conflict between "constant voltage sum" crossover, where the "total woofer voltage plus tweeter voltage is constant with respect to frequency," and the "constant power sum," where the sum of the radiated powers from the woofer and tweeter is constant with frequency. What the authors apparently don't realize is that this conflict can be resolved by several circuits which meet both criteria simultaneously. Unfortunately, the second-order Butterworth configuration specified by the authors meets only the constant power requirement.

However, if slightly lower "Q" filters are used, then we can meet the constant voltage requirement (although the sum of the voltages is phase-shifted with respect to the input). Unfortunately, the constant power requirement is now violated.

But all is not lost. As Ashley and Henne (J. Robert Ashley and Lawrence M. Henne, "Operational Amplifier Implementation of Ideal Electronic Crossover Networks," J. Audio Eng. Soc., Vol. 19, No. 1, p. 7) have observed, the third-order Butterworth configuration seems to offer the best of all possible worlds: it is constant-power; it is constant voltage (although there is a frequency-dependent phase shift in the voltage sum with respect to the input); it offers maximally-flat magnitude characteristics (thus minimizing strain on the individual drivers), and it offers very sharp cutoff characteristics, which minimizes the need to make woofer and tweeter responses well-behaved beyond the crossover frequency. For these reasons, the third-octave Butterworth is arguably the single optimal crossover network design.

It can be mentioned in passing that a pair of first-order (6 dB/oct passive RC filters) can also meet the criteria. Unfortunately, this circuit has insufficiently sharp cutoff to be of interest in most cases. In fact, *any* odd-order Butterworth pair will meet the criteria.

I have included a practical circuit (Fig. 1) to realize the third-order low-and-high-pass Butterworth filters. The unity-gain feedback circuit used by the authors to realize the lowpass filter is not optimal because its characteristics have higher sensitivity to resistor and capacitor tolerances and drift than does the "multiple feedback" circuit of the type illustrated. Unfortunately, a practical high-pass version of the multiple feedback circuit does not exist, so the high-pass filter is best realized with a unity-gain feedback circuit of the type that the authors specified. The specified opamp, the RC4558, is a Raytheon device.

Robert Orban
Menlo Park, Calif.

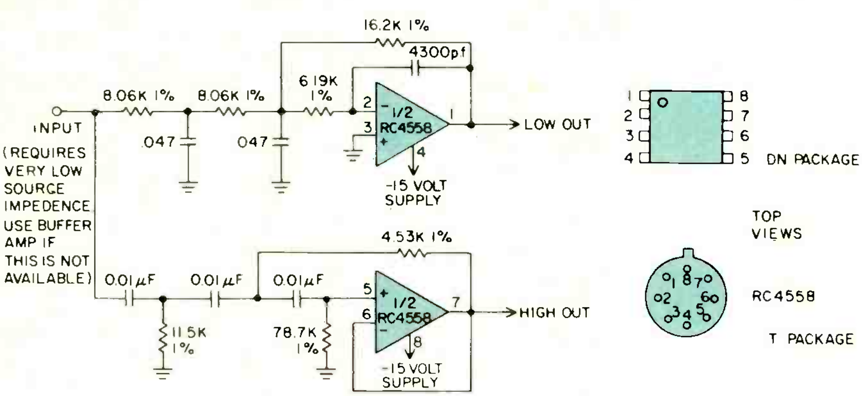

Fig. 1—Orban crossover for Lampton/deVries speaker system.

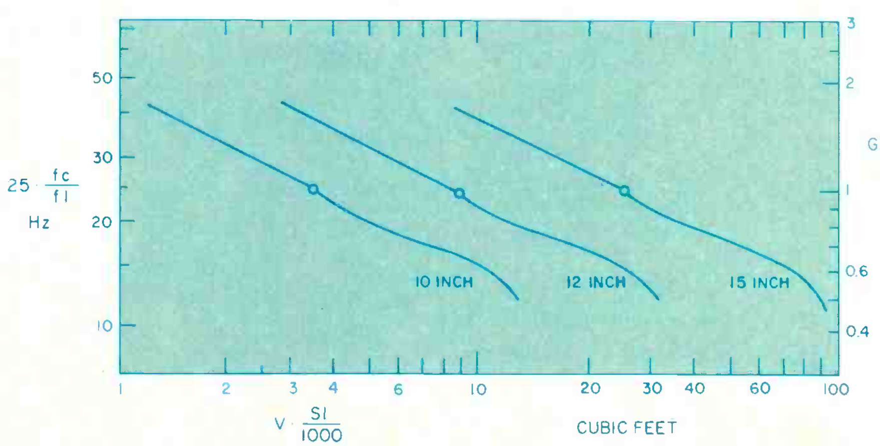

Fig. 2—Relationships of cutoff frequency and volume for three woofers.

The author's reply:

In view of the gratifying response to the loudspeaker design articles by myself and L.M. Chase (AUDIO, Vol. 57, #12, p. 40, December, 1973) and G.J. deVries (AUDIO, Vol. 58, #8, p. 28, August, 1974), we would like to expand upon some of the technical matters raised by readers.

We have received a number of helpful comments from readers, such as Mr. Orban and Prof. Ashley, concerning our suggested use of second-

THE ONLY THING WE DON'T GUARANTEE ABOUT A MIRACORD IS THAT YOU'LL FIND ONE.

We're so particular about the quality that goes into every Miracord, we guarantee all parts and service for one full year. But we're also so particular about what stores sell our equipment, we can't guarantee you'll find one.

That's somewhat of an exaggeration. It's just that you don't find a Rolls Royce dealer on every corner. The way we figure it, anything worth listening to is worth looking for. And when you hear your records on a Miracord automatic turntable, you'll hear what we mean.

For instance, the Miracord 760 is engineered with our unique "jostle-proof" push-button control system. It tracks with dead accuracy at as low as 1/2 gram stylus pressure, even if the shelf you put it on isn't level! And one of the leading magazines in the field reported that the Miracord 760 had the lowest rumble figure measured (report available on request).

Pitch control? You can vary the speed over a 5 percent range. That's about a semi-tone in pitch. And a built-in stroboscope allows you to return to the standard speeds simply and accurately. The Miracord 760 naturally has a built-in anti-skate control.

The precision continues: The twelve inch, one-piece die-cast turntable platter is a work of art in itself. It's dynamically balanced for smooth, steady performance and speed that will not vary. And it is run by a specially designed asynchronous motor whose speed constancy is just about unsurpassed in its class.

The details about the Miracord 760 go on and on. If you'd like the full story on our full line, just drop a line to: Miracord Products, Benjamin Electronic Sound Co., 40 Smith Street, Farmingdale, N.Y. 11735.

After you find your Miracord, we'd like to make this one last promise: We doubt you'll ever have to use its guarantee.

THE MIRACORD 760.

Damn hard to find. Damn hard to beat.

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order Butterworth high- and low-pass filters as loudspeaker crossover circuits. The comments are generally that third-order filters offer a number of advantages with regard to their transient response and on-axis frequency response.

Accordingly, we breadboarded such a circuit—specifically, the one given by J.R. Ashley and A.L. Kaminsky (J. of the Audio Eng. Soc., Vol. 19, No. 6, p. 494, June, 1971)—and find through listening tests that there is indeed an improvement in the clarity of the reproduced sound. We therefore recommend the use of the third-order filters in crossover applications, and invite the comments of other experimenters who have the opportunity to try them.

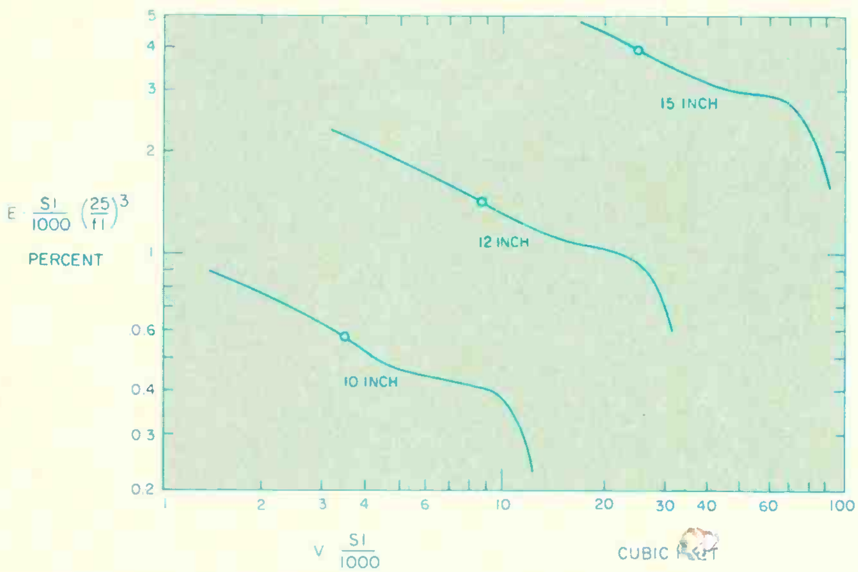

Fig. 3—Relationships of efficiency and volume for three woofers.

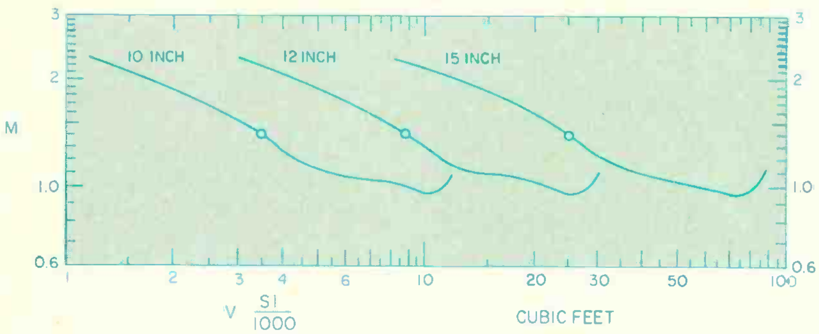

Fig. 4—Relationships of duct-to-cone-mass ratio and volume for three woofers.

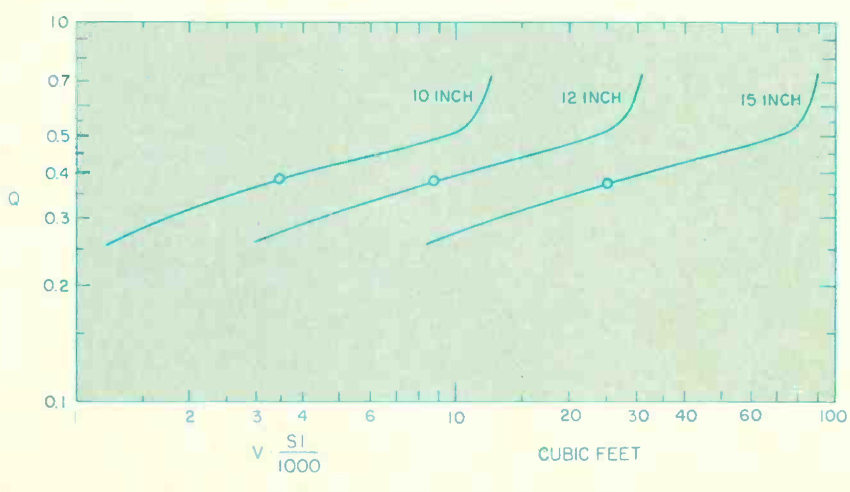

Fig. 5—Relationships of required speaker Q and volume for three woofers.

Also we would like to emphasize that there are infinitely many possible tuning and damping combinations for bass reflex loudspeaker enclosures. Most of these combinations do not perform very well: They exhibit poor frequency response curves and do not get the best possible performance from a loudspeaker in terms of distortion. The quantitative foundations for predictable designs were established by the pioneering works by Novak and by Thiele, who identified a variety of practical combinations of tuning and damping ratios which give precisely characterizable performance curves.

Three key parameters principally govern this performance: (1) the stiffness ratio S which is the ratio of the enclosure air spring stiffness to the stiffness of the suspension of the loudspeaker cone; (2) the mass ratio M which is the ratio of the vent air mass to the speaker cone mass, and (3) the speaker's Q factor, which is the ratio of its reactance to its motional resistance. Once the speaker is chosen, the stiffness ratio is fixed by the box volume. For values of S greater than 1.414, a good choice of response curve shape would be any of the quasi-Butterworth or "double-point" alignments. In larger enclosures where S is less than 1.414 a good choice would be the appropriate symmetrically bounded ripple tuning. For the value of S equal to 1.414, it is possible to achieve a maximally flat or Butterworth response, provided again that M and Q are properly set.

In Fig. 6, these various possibilities are illustrated in the form of the values of M and Q necessary when a given value of S has been chosen. To the left, the bounded ripple alignments are shown; to the right, the quasi-Butterworth alignments; and in the center, marked by small circles, the maximally flat tuning and damping ratios. The curve marked G is an interesting measure of performance: It is the ratio of the complete system's low-end 3dB cutoff frequency to the woofer's free air resonant frequency. When G is less than one, the system goes deeper than the FAR. To achieve this requires a big box.

Some readers have inquired as to how to design reflex enclosures for multiple drivers. As long as the drivers are alike, a straightforward procedure is to use for design purposes a fake speaker having the total effective cone piston area, cone mass, and cone stiffness of the members of the collection. The FAR and Q are essentially unaffected.

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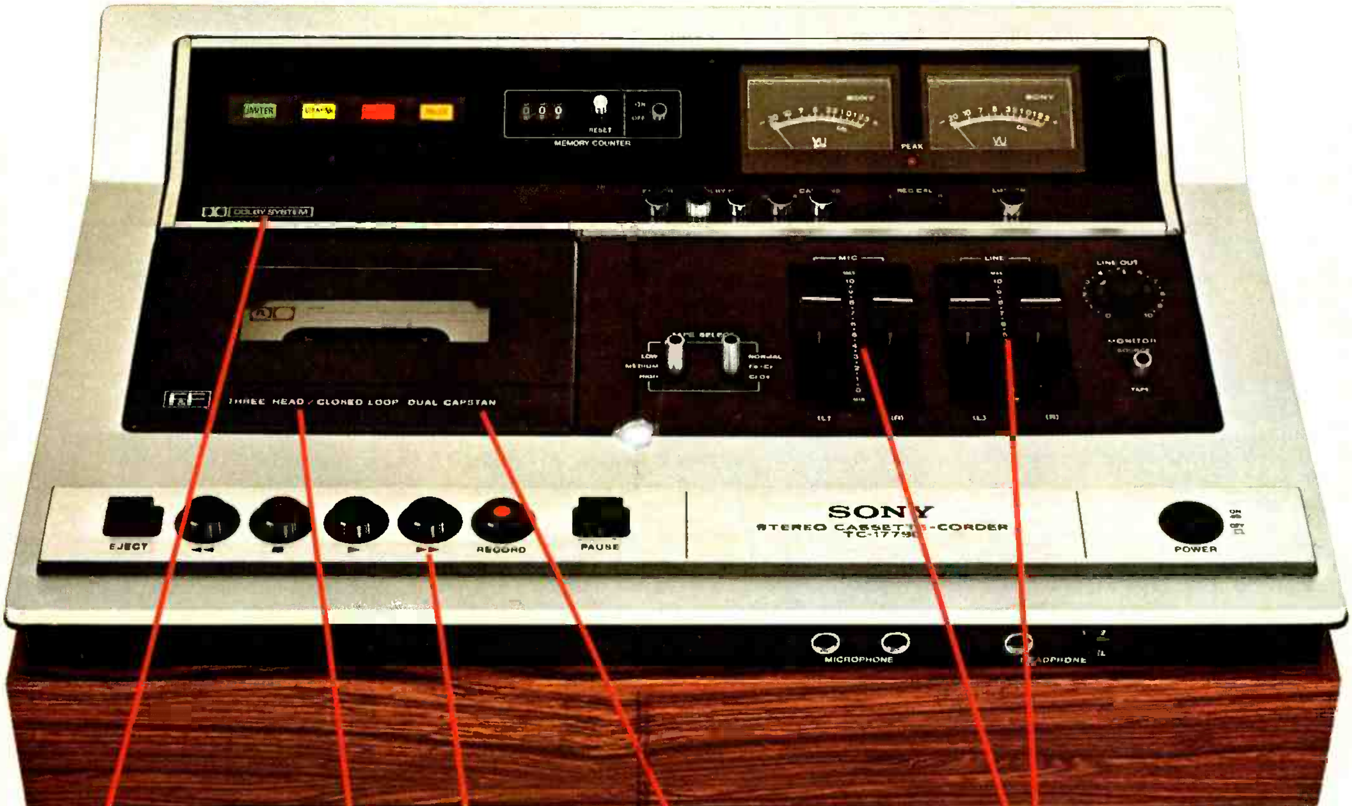
Sony's New 3-Head Stereo Cassette Deck.



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Three ferrite heads.

One ferrite erase head. Two separate ferrite and ferrite record and playback heads. Inside: core and pole pieces are solid ferrite. Outside: another precisely machined layer of ferrite. Ferrite and ferrite heads last up to 200 times longer than standard permalloy. They give you wider frequency response and dynamic range and better tape-to-head contact. And Sony's exclusive three-head system provides the added advantage of Tape/Source monitoring.

0.07% wow and flutter and at 1⅞ ips.

The TC-177SD features the same Closed Loop Dual Capstan Tape Drive system as Sony's finest reel-to-reel decks. Isolates the tape path in the tape head area from external vibration and abnormal tape movement. Eliminates the cause of modulation distortion and optimizes tape-to-head contact.

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Provides smooth, precise and immediate response for all tape travel modes.

Mic/Line Mixing.

Previously available in reel-to-reel only. Records two different sources simultaneously: microphone inputs and line inputs (receivers, turntables, other tape decks). Provides precise fade-in/fade-out and cross-fading techniques.

The Sony TC-177SD Stereo Cassette Deck also features separate 3-position bias and EQ selector switches, peak limiter, dual VU meters with LED peak indicators, memory counter, stereo headphone monitor jack and echo capability with the optional SB-200. This top-of-the-line Sony goes for $699.95 at your Superscope dealer.

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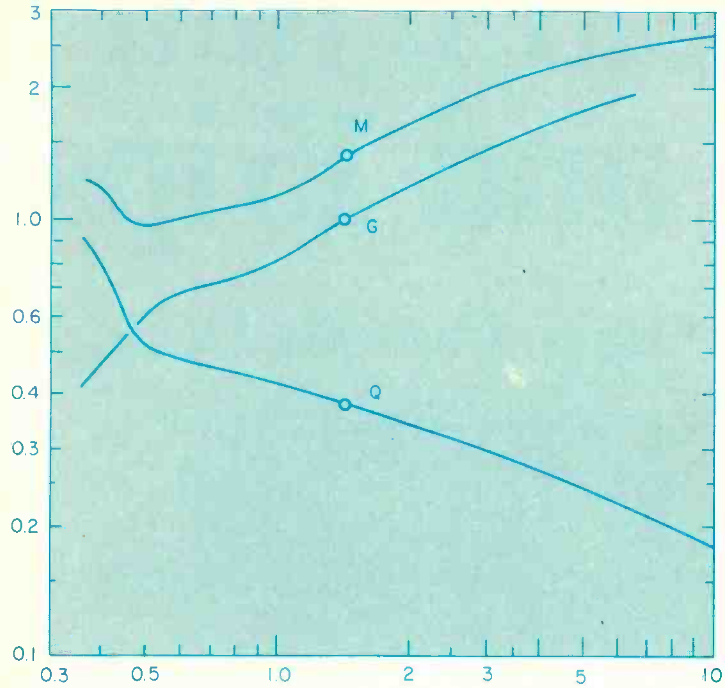

Fig. 6—S, ratio of enclosure air stiffness to cone suspension stiffness.

Many readers have requested that Figs. 2, 3, 7, and 9 of the Chase article be extended to much larger values of volume stiffness products. I have done this in the accompanying Figs. 2, 3, 4, and 5. These have all been derived from Fig. 6 for loudspeakers having effective piston areas of .032 square meters (typical for ten-in. frame diameter loudspeakers), .050 square meters (12-in.), and .085 square meters (15-in.). Because of variations in actual piston areas among various manufacturers and models, the frame diameter is only a rough guide to the effective piston area. Using Figure 6, these curves can be generated for any size speaker.

On each of the curves, a small circle indicates the location of the maximally flat tuning; the portion of the curve lying to the left of this point will give a quasi-Butterworth characteristic, and to the right a bounded ripple design results.

Michael Lampton
Jan deVries
Lee M. Chase
Berkeley, Calif.

Pardons, Amnesty, & Lennon

Dear Sir:

In this time of pardons and amnesty and in the light of our national self re-evaluation, isn't it also time we consider the deportation of John Lennon an injustice—not only to him, but to us and to America.

Bernie Mitchell
President
U.S. Pioneer Electronics
Moonachie, N.J.

Gee whiz, Bernie, I always thought what made America great was its ability to be a melting pot, to be able to handle—within its tolerant borders—just about anyone and anything, to have room enough for nearly any point of view. I'm enough of a believer in the fundamental paradox of life to think that a person can have both dangerous and worthwhile qualities, but I see little or none of the former in Lennon. And if he does have them, they are quite outweighed by the latter. —Ed.

Organ Servicing

Dear Sir:

I have enjoyed your magazine's fine articles since I stumbled on it in the Engineering Library Stacks at the University of Illinois during my freshman year. I am wont to find each issue both thorough and readable. However, your November issue's article on organ servicing seemed dangerously over-simplified.

I am a professional organ-repair specialist. I am not just trying to keep jobs for myself, as many items in Mr. Turino's article seem quite useful and simple enough for the average owner. However, I would like to offer a few warnings, using the Lowery organs as examples, since they are excellent instruments and rather typical of most electronic organs.

In regard to annual vacuuming, I have seen a heart-sinking number of organs with damaged contact springs and busses, broken leads, and disconnected wires as a result of well-intended but slightly careless vacuuming. And I have never known any amount of dust or cobwebs to interfere with proper operation of an organ. (Mice are another story.)

The modern Lowerys contain a number of coils, easily accessible and very attractive for VOM testing. The first and only time I tried one, I destroyed it. Also present on many boards are regular and large-scale integrated circuits, along with MOSFETs, some of which can be damaged by static charges on the fingertips, and are impossible to really test without a 'scope or an advanced logic probe.

Contact cleaning I recommend heartily, it being a messy and boring job for me. Watch out for tube organs though, as keying voltage is 430 volts on some models. Also, it takes me between an hour and an hour-and-a-half to clean contacts on some Lowerys, most of which is spent gaining access to the contacts themselves. And remember that I know how to take them apart too. Few service manuals have opening instructions, and I must confess I felt horrible scratches on a few organs before I got my methods perfected.

If I may question one last point, regarding the ease of dealing with ninety percent of organ problems: On evaluating my records on my last 100 Lowery organ calls, which included a large percentage of tube organs up to 20 years old, only 12 had contact trouble and I changed only five tubes.

David R. Shaddock
Meyers Music
Streator, Ill.

Dear sir,

Allow me to add my plaudits for Richard Heyser's new speaker analysis program. I have read with interest his articles in the *JAES*, and I am especially interested in his findings with regard to phase linearity. Phase response has become a subject intensely probed by psycho-acousticians (a spinoff of quadraphonic research), and I am sure that many other readers would appreciate some articles by Mr. Heyser on the physical aspects of non- and minimum phase response networks. Not only transducers, but purely electronic links in the high-fidelity chain should be studied in this light.

Tom Tollefsen
Olympic Valley, CA

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Behind The Scenes

Bert Whyte

WHEN THE Revox A77 tape recorder was introduced to the American market some years ago, it received generally enthusiastic reviews from the hi-fi press. Since then it has undergone several updatings and refinements to the basic design. These included a special A77 incorporating Dolby B noise-reduction and the HS77, a "high-speed" (7½ or 15 ips) unit with half-track stereo heads. You may recall I reported on the high-speed type as part of a lightweight, portable recording system.

The Revox A77 has kept pace with its competition and still answers the needs of many audiophiles. However, in line with current trends, it was obvious there was a need for a more sophisticated recorder incorporating the technological advances of recent years. Willi Studer, manufacturer of Revox recorders, was aware of this and of the fact that his "encore" would have to be something quite special. I think it is safe to say that his new Revox A700 tape recorder is special indeed. This A700 has been shown at past AES conventions and I have given you a brief description of the unit. Revox furnished me with an A700 recorder with half-track stereo heads, and now that I've lived with it for some time, herewith are my observations and impressions of this important new recorder.

The A700 is bigger than the A77, a bit more than 19 inches wide by 18 inches in height by 7 inches in depth. The weight has increased too, and portable use will require more muscle. The increase in size and weight is understandable in light of the new features and functions built into this machine.

Let's take a look at the tape transport section. The A700 is a three-motor unit operating at 3¾, 7½, and 15 ips. There is a servo-control system for all 3 a.c. motors, which is integrated with the tape-motion full-logic system. The capstan motor is a high torque, asynchronous unit. Some 120 teeth are milled into the circumference of the rotor and are inductively scanned by a ring-coil around the motor. This constant 360-degree scanning is an improvement on the single-point scanning found in the Revox A77. There is less translation error for one thing, but the big advantage is in the quietness of the motor. When I say quiet, I mean you have to put your ear right up to the capstan shaft before you hear any whir. For any recording situation where the tape machine must be in the same room as the microphones, the A700 takes top honors. The signal produced by the inductive tacho-generator is fed into the servo-control system. This is a new Studer development, using special Large Scale Integrated (LSI) circuits which contain a quartz crystal-stabilized oscillator of 1.638400 MHz, along with the comparators, frequency dividers, and other functions of the servo circuit. The capstan motor is thus phase-locked to the quartz clock frequency. However, there is also provision to override the reference frequency with a variation control (soon to be available) which will give plus or minus seven half-tones of any selected speed. An external oscillator variable from 1 kHz to 10 kHz will enable continuously variable tape speeds from 2½ to 21½ ips. The three tape speeds are selected by pushbuttons on the right side of the tape transport. A nice touch is that these buttons are of the illuminated type, but will not light up until the selected speed is in full synchronous mode. As you might expect, it takes a tiny bit longer to "lock-in" the slower tape speeds.

The A700 has a tape motion sensor in its right idler roller, which feeds signals into the logic circuits controlling power to the reel motors, the pinch roller, and the tape-lift solenoids. On each side of the idler rollers is an idler wheel which is on a progressively-sprung tension arm. This is part of the tape tension control system of the A700, where the tension is constantly measured and maintained at optimum value by two closed-loop servos, each consisting of both the tape tension sensors, motor control circuit, motor control amplifier, and the reel motors themselves. All this adds up to fail-safe tape handling logic and very smooth spooling. The system is so good that on fast forward and rewind the tape pack is as free of "ridging" as normal play winding.

Located with the speed change buttons on the right side of the unit is a tape timer of the type found on the professional Studers. The readout is in minutes and seconds, with real-time indication at 7½ ips. Accuracy is stated to be within 0.5%, and when I checked it against my stop watch, it was only 14 seconds fast in a half-hour program. A central grouping of five illuminated pushbuttons comprises the normal tape motion controls. On the left of the machine are illuminated pushbuttons for special operation controls. The pause button remains in effect as long as it is depressed and operates on all main transport modes. After release, the control logic switches automatically to the previously selected mode. By pushing the repeat button, the transport switches for rewind, releasing it selects the play mode. Using tape with translucent leaders at both ends and pressing the auto button enables the tape to be played, then rewound and played again, endlessly.

How good is the Revox A700 tape transport? The specs state a weighted peak flutter of less than plus or minus 0.06 percent, but a friend with a quality flutter bridge measured it consist-

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Think of it this way:

A phonograph record doesn't know and doesn't care what kind of mechanism is spinning it,

as long as it's spinning properly. If your hand could turn it at exactly 33⅓ RPM, without the slightest fluctuations in speed, and keep it moving in the horizontal plane only, without the slightest jiggling or vibrations up-and-down or sideways, you could expect perfect reproduction.

Similarly, a phono cartridge has no idea what's holding it in the groove, as long as it's properly held. If your other hand were holding it, correctly aligned, with the right amount of downward force and without resisting its movement across the record, it would perform faultlessly.

That's really all there is to it.

The basic point is that the turntable and tonearm have exceedingly simple and purely mechanical functions, just like a chemist's analytical balance or a gyroscope. That's why turntable manufacturing is, above all, a matter of precision and integrity, with the emphasis on perfect operation rather than hi-fi pizzazz or features for features' sake.

Of course, theoretical perfection in an actual mechanical device is an unrealizable ideal. But even though 100% is impossible, there's a big difference between 99.9% and 98%.

It's in this most fundamental sense, we feel, that Garrard turntables are in a class by themselves.

For example, in the case of the Zero 100c changer and the Zero 100SB single-play automatic, tracking error has been reduced to a virtually unmeasurable quantity (in effect, zero) by the geometry of the tonearm design. Rumble, wow and flutter figures are also coming ever closer to theoretical perfection in these and other top Garrard models. (The Zero 100c and the Zero 100SB are both priced at $209.95.)

To a less spectacular degree, the lower-priced models, from $49.95 up, also come quite close to the theoretical ideal because of this emphasis on fundamentals.

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And so you can do that for as *long* as you like, it's a typical TEAC. We've been building 3 motor tape recorders like the 4300 for over 20 years now. Any group of persons who work together for that long develops traditions. One of our's is to make our products work well — for a long time.

It's uncommon in a plastic world to design a product to be repaired rather than replaced — even more so to make it worth repairing. But another tradition we have developed is to keep replacement parts in stock for at least five years after any product is no longer made. Your 4300 may be the last tape recorder you'll ever buy.

But we can't describe most of the reasons we think you'll like the 4300. The performance. The solid precise feel. The effortless operation. You really have to experience these for yourself.

You can do that by calling (800) 447-4700 toll-free to locate your nearest TEAC Retailer (in Illinois, call (800) 322-4400). But fewer than 10 percent of the hi fi stores in the country are authorized to sell TEAC, so please call. The persons there will provide you with specifications and a demonstration, and be helpful in general. They want you to enjoy your music without aggravation too — that's why they're a TEAC Retailer.

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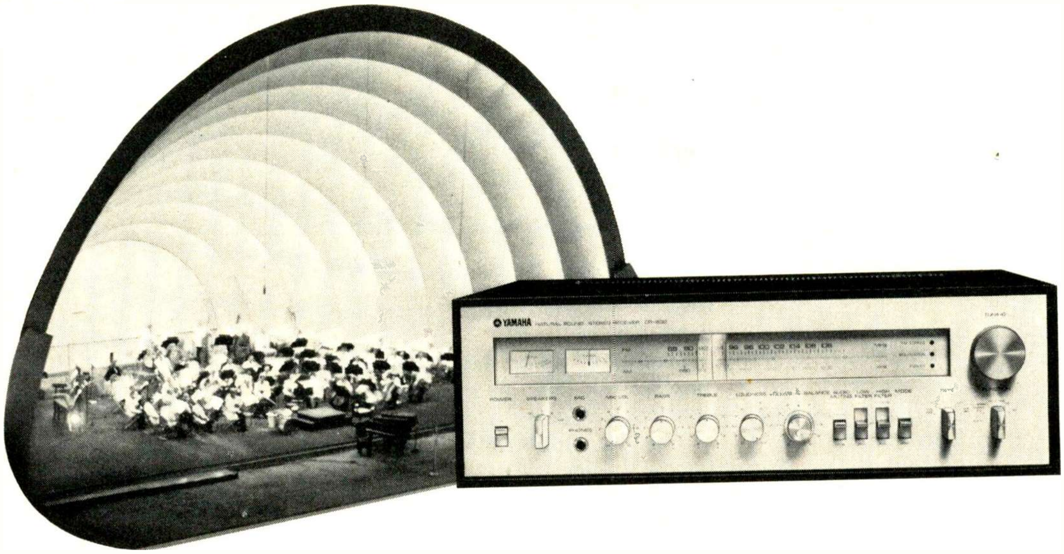
ently around .02- .03 percent. All in all, the tape transport of the A700 is one of the most advanced yet offered to the public and I found that it operated flawlessly.

As with most of the tape transport controls, the record and play electronics, and all special function (such as stereo multiplay and echo effects) electronics are on PC boards. The bias oscillator frequency is a high 150 kHz. Studer has kept to the use of metal-laminate heads, and with the servo tension system gets a good tape head wrap for smoother low frequency response and extended high end response. It is interesting to note two other things about the heads. One is that Revox states there is room in the head/electronic complex for "extra electronics as necessary in later models." The other is that the die-cast head support is quickly interchangeable. One can but speculate that all this is in anticipation of a four-channel model.

The A700 input and output controls consist of both rotary switches and slider-type mixing pots. The entire mixing/electronics chassis is removable for servicing. There are four balanced 50-600 ohm microphone inputs with high- and low-level switching. A phono input preamp for magnetic cartridges with RIAA equalization is provided as well as two high-level line inputs. The four slider faders are under the control of a stereo master slide fader. Also unusual for this kind of recorder is the provision of bass and treble controls. Main reason for them is that there is an output controlled by a slide fader for connection to a fixed gain amplifier, such as Revox's A722 model. Line outputs A and B on the A700 have a fixed output level at plus 6 VU corresponding to 1.55 volts.

The VU meters are horizontally opposed, and unlike previous Revox machines, the meters read the playback output. In addition to the regular ASA VU indication, there are two red LED overload monitors, set to peak at plus 6 VU. I hooked up an external meter, and fed some signal to the recorder and sure enough, the LED's blinked on at exactly plus 6 VU!

As to performance, the Revox A700 is a winner. We have already covered the wow and flutter figures. The frequency response from tape is specified as 30 to 22,000 Hz, plus 2, minus 3 dB at 15 ips; 30 to 20,000 Hz plus 2, minus 3 dB at 7½ ips; 30 to 1600 Hz, plus 2, minus 3 dB at 3¾ ips. I copied some wide-range master tapes on the A700, and the copy was literally a mirror image of the master. I checked the playback frequency response with my Magnetic Reference Library alignment tape, and the A700 was flat within one and a half dB from 30 to 20,000 Hz. Distortion is stated as less than 2 percent at plus 6 VU. I made some live recordings and deliberately activated the LED monitors without hearing anything approaching distortion. I used Ampex 406 tape in recording, which is close enough to the 3M 206, for which the unit was biased. With a claimed minus 65 dB S/N (ASA, A weighting), the tape copies I made had the slightest extra whisper of hiss compared to the very quiet master. Well, noise has to increase 3 dB, but I think the S/N claims are reasonable. All the controls acted smoothly, and it is a joy to see such precision tape handling. The recordings I made were beautifully clean and there is no question in my mind that the Revox A700 is a very strong competitor for leader in its price range.



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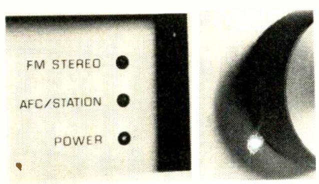

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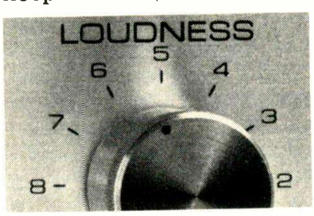
The CR-800's FM tuner section is the first to utilize negative feedback around the multiplex demodulator. This achieves superb separation (45 dB) and reduces MPX distortion to 0.05%. And Yamaha Auto Touch tuning allows the electronics to fine tune the station for minimum distortion (and keeps it there).



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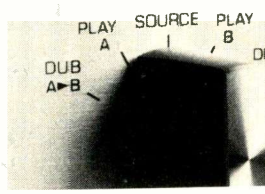

Multiples and Mixes.

For the multiple tape deck owner, the 800 has a five-position tape monitor selector to easily control two stereo tape record/playback circuits for recording on one or both decks simultaneously, for copying from one recorder to another, or for reproducing or monitoring on either.

Other features include a separate microphone preamp and volume control, a two-position low filter (20 Hz–70 Hz) and a two-position high filter (8 kHz-blend). And L E D's for critical indications.

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Edward Tatnall Canby

HINDSIGHT: Nothing is quite so dramatic as hindsight—when it suddenly reaches a moment of maturity. To my way of thinking, our most recent hi-fi revolution, quadraphonics, has now reached that moment. And do we need hindsight! We aren't doing too well.

Hindsight, of course, requires time. We've had more than five years of it now, and things are getting hinder and hinder. Everybody's now talking hindsight and so, me too. It's the quadraphonic news for 1975 and we'd better read all about it if we want to survive.

Well, we can't do one little thing for the past that is passed. But we can talk future; since I'm traditionally the kibitzer on the sidelines, here I go. Granted, I didn't do any of the heavy work that got quadraphonics out of the mind into the lab and from there, painfully, onto the bumpy road to market. So I bow to those who did and trust that they won't get all het up at what follows. Fantasy! As of the past, anyhow, totally impractical and you don't have to tell me so. Nevertheless, I sense a usefulness at this point, in terms of the still wide-open future. Suppose we could do it again with all the insight (hindsight) of 1975 and none of the restraints, practicalities, and what-not that held us to what we actually did. Here's what I think we "should" have done or not done. Brace yourself.

1. *No basic disc quadraphonic system should ever have been launched until the circuitry involved had been reduced to chip form, the chips themselves were developed, in production and ready to roll straight into equipment.*

(*Utterly* impossible! Well, of course. That's what I mean. Still, if it only had been possible. . . .)

2. *No matrix disc system, whatever type, should have been launched without a completely developed logic circuitry AS A PART OF THE SYSTEM, both the basic matrix and the logic reduced to IC chips. The plain non-logic-assisted matrix should never have been considered acceptable for hi-fi equipment.* The unadorned matrix, indeed, should have been reserved strictly for minimum-cost use where severe compromise was a necessity.

(Sorry, fellas! It had to be said. It ought to be said, it's now totally clear that logic assistance, in one form or another as presently developed, is essential to the 4-2-4 matrix concept if the product is to keep its competitive position. *With logic,* in all its 1975-plus maturity, matrix remains a formidable system for the home.)

3. Turning to an ancillary but crucial area, *no quadraphonic home equipment should have been introduced before a new Single four-channel cable and connector system had been agreed upon as an industry standard for this country.* ONE cable, ONE connector at each end, for each quadraphonic signal.

Problems? Of course. But the present super-spaghetti cable system, born too hastily out of mono and then stereo, is an abomination. For each quadraphonic signal we now use FOUR cables and EIGHT connectors! Multiplied to the Nth as between whole groups of componentry, you have a snarl-up that shouldn't have happened to a hi-fi dog. Unbelievable. And enough to put an enormous dent into customer good will. It put dents into mine, I tell you. I positively dread making major reconnections.

4. In a further vein of simplification (and here subject to engineering opinion in detail), I feel that *no quadraphonic equipment should have been launched until a maximum range of really subminiature, totally updated amplifier/pre-amp elements had been developed especially for quadraphonic—maybe chip-type and/or op-type—and these made ready for mass production,* so that from the very beginning, four channels of operative circuitry could replace the two of stereo with, if anything, a saving of space and of cost.

Now we get to a real nub. You see, from the start we should have been ready to counter those pat arguments that we knew would surface immediately—four channels are twice two, and twice too much, too big, too expensive, too clumsy, too complicated etc. etc. The whole point of "four-channel" should be that, with up-to-date technology, multiple circuits are now smaller, cheaper, simpler, etc. etc., than single circuits once were. Space technology. Computer technology. What else? We should have been onto this right at the beginning, both as a goal for development and as a point for crucial public relations.

We still today seem to think that quadraphonic equipment should *look* big, look impressive and complex. Maybe it has to, in order to enclose all those snarls (pardon me!) of parts inside. Maybe it has to look that way so we can charge the big prices that we must charge. (There's a vicious circle for you.) Couldn't we have managed better? Think of the mini-calculator. Now there's a splendid example of the new electronics in a proper package. And the public is wild abut it. So tiny! So much inside! *And,* of course, so easy to use. There's the clincher. Now our own field admittedly isn't that simple in the functioning. No aesthetics for them, no compatibilities, and so on. Yet there in miniature is the sort of image we should have worked for, right from the earliest stages of quadraphonic development. We didn't. Our product, still, is monstrously huge for its essential content, and the public knows this and doesn't much like it. So far, we have missed our chance to promote the small image.

Foresight

So we edge into foresight, born out of hindsight. Though I know my suggestions are after the fact, I am serious in that it isn't too late to turn past into present/future. Yes, I am aware that, for instance, the idea of logic assistance to a matrix wasn't even concievable for most of us back five years ago—so how could we have developed a logic chip? And if we had, then the facilities for chip production would have been notable for their absence. I expect, too, that under the intense pressure to get along with yet another major overhaul in our "system," most engineers and designers just had to make do with whatever ingenuity they could

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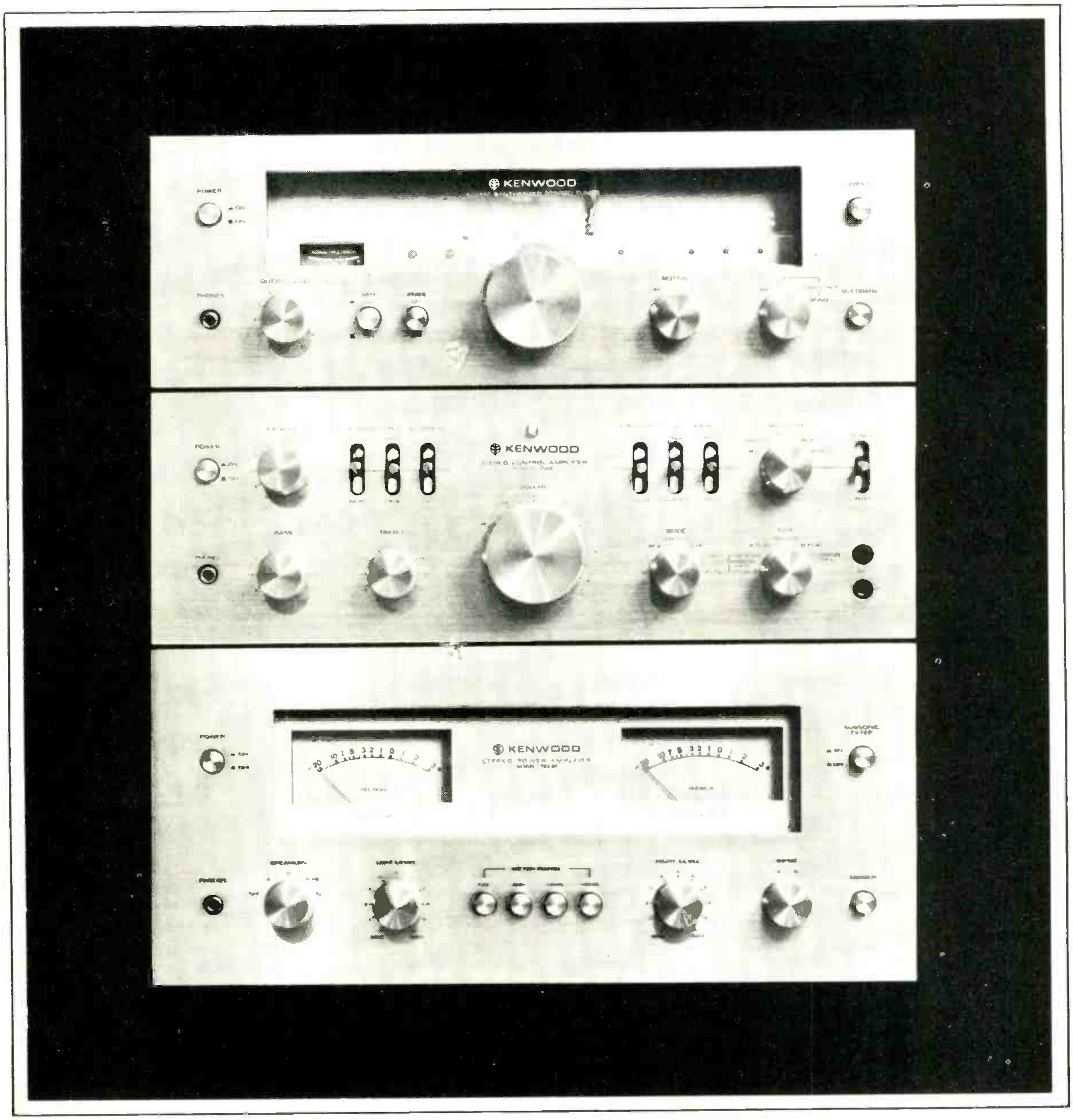

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muster up, and to heck with the ideal. The pressure hasn't let up for an instant, so I expect we are still doing the same. Believe me, I am profoundly in sympathy with those on top who are at the bottom of this pile. (It's that mixed up, after all.) But—onward and upward we go. Hindsight, then, into foresight and about time.

Look further into that past. A lot of heavy thinking has gone into quadraphonics in these last five years. This thing has been a monster, riding its very creators onward with a rush into constant new perceptions, new vistas. We can remember the steps, as basic matrix after basic matrix appeared, all fuzzy, then ever more clear and precise; and then we moved onward into the modifiers, the logic circuits, at first crude (and nobody thought they would amount to much), then astonishingly more sophisticated. And meanwhile, over in CD-4, those monstrously big incidental problems and the same sort of enforced hurry and pressure—let's get things on the road (and fix them up en route)—that plagued the matrix rivals. And the equipment makers, never knowing which way to jump or whether to jump—it was really awful and a wonder we all survived.

Meanwhile down in the lab the possibilities opened up astonishingly. Here, the pressure was good. The people who were working well ahead of the market, into basic primary concepts, had enough corporate insulation around them to protect them from hysteria. The speed at which every aspect of disc quadraphony opened up in those years is to me one of the miracles of human accomplishment. Good people, working with adequate means and at top brain efficiency. But, can you have hindsight ahead of time?

Today, we have reached the point of consolidation. True, the more advanced logic circuits and wider—capability CD-4 demodulations are still "breadboard" and may not reach practicality and into saleable equipment for quite some time. Yet, we are reaching into the area of diminishing returns. The basic approaches are pretty much set. Modifications will be increasingly a matter of refinement and simplification. That's why we can now turn hindsight, impracticality, into foresight and practicality. We are ready.

Our logic thinking is now mature enough, in the several approaches, to consign to those essential chips. The matrices themselves are already in the "frozen" state and into chip format. The CD-4 demodulator circuits are at the same stage, already into their first chips, again "frozen" into a hopefully workable mass-production form at really low cost—once things get going. We are now safely beyond the stage where extremely flexibility is essential. We had to go through it. All in all, we did it in a remarkably short time. A triumph, no less, in spite of the rival systems and corporate battles. Let's be positive.

The whole key to the rescue (I use the terms advisedly) of quadraphonic sound on the market, then, is in this update *simplification,* from stem to stern, via every known twist and trick of the new technologies for manufacture. Now, we *can* freeze our varying circuits. Now, we really are in a position to convert quadraphonic equipment into what it ought to be, and must be, a line of products that is in every way simpler, less clumsy, even (relatively) less expensive, than former stereo equipment. We are ready for an avalanche of IC chips, which will be the main-stay in a remarkable conversion, if all goes well. And, surrounding the chips, everything else that I wouldn't even know about which would contribute to, shall I say, circuit coagulation—making the inherently complex four-way signal message act more and more like the *one* signal that it really is, and yet, of course, still sounding like four.

We've been talking of matrix techniques as the 4-2-4 approach. Four channels of sound into two (on disc) then back to four. Let's modify that thought and say that what we want now, in the entire system and especially in the home equipment, is 4-1-4. Yes, we start with four channels. Then, in terms of the equipment itself, in terms of its home use by our listeners, we treat those four channels as though they were one—and as simple and as cheap as one. We can always dicker with them separately when we want to, *if* we want to. Let us relegate as much as possible of the four-way adjustments to the "automatic" or standardized situation—so the listener doesn't have to think and diddle with knobs and connectors. Four into one! That's for practicality.

And then, of course, back into four in the listening, with all the power of four that we have been rightfully trying to promote. 4-1-4.

Our present equipment, you see, is absolutely right—for one special segment of our market, the confirmed gadgeteer. Ideal! He is a very real part of the hi-fi business, and no complaints. People who like hi-fi gadgetry have lively minds and vivid bank accounts. The more sophisticated is our production for them, the happier they are. Why else $1,000 FM tuners and cassette players? Why else our present immensely impressive control panels for quadraphonics with those rows and rows of switches and buttons? We are courting the super-gadgeteer, the brainiest, wealthiest, most knowledgeable gadgeteer, and we are getting him, too. But are these people all we need?

Please, what about that very large percentage of stereo users—you know the percentage—who now stick obstinately to stereo because, thank you, it is entirely adequate for *them.* They are the bigger market. As we all know, they are not convinced. They have those feelings, that quadraphonics is twice too much, too complicated, and so on. . . . . We ask for it. Our present equipment mostly *looks* it, and is priced for it. Our stereo equipment is just fine as a counter-productive argument! Get stereo—it's reliable and right.

But note that we were able to convert these very people from mono to stereo, back a dozen years. Not merely to stereo equipment but, more important, to a real faith in the stereo system. That was something. Now we have the same problem again, in remarkably similar terms. Quadraphonics must be like stereo only better. Which does NOT mean more complicated. Thus—we must make some quick changes, now when the time is ripe.

Send the big stuff, the fancy stuff, back to the gadget people where it belongs. (And think, with the new ICs inside, how many *more* switches you can put in.) Concentrate on a radically different and new sort of quadraphonics, *quadraphonics simplified*—bend every effort and every last IC towards the maximum advantage, use every conceivable technology, space, computer, what have you, to make four channels work like one, so that quadraphonics will seem to the large public as easy, as simple, as inexpensive (we hope) as stereo, or even more so. And therefore a better, newer bargain. It can be done, I think.

So let me rephrase my four points of hindsight into points of foresight.

1. In the upcoming future there must be a new kind of qudraphonic equipment, radically simplified, smaller, inexpensive and, first of all, making use of advanced-model IC chips for the major disc systems. (And, when & if) for the tuner elements, as possible.)

2. All matrix decode systems must include AS A PART OF THE SYSTEM the appropriate advanced logic, also in IC form, the matrix and its logic to be considered as one. No more plain matrices! The sooner they depart, the better. With chips, we can afford the "works," with logic.

3. All manufacturers should convert to an agreed SINGLE cable connector system for the quadraphonic signal. ONE cable, ONE connector at

Hi-Fi Ho-Hum

Competing with the giants in a giant industry is no small task. Which should explain why we at Sherwood feel a sense of accomplishment.

After all, we can't invest as much in advertising as the larger manufacturers. Nor produce as many different types of equipment. So we certainly can't come close to matching their total sales volume.

Yet, we've steadily gained leadership status in the field of high fidelity electronics. For one simple reason:

Dollar-for-dollar, Sherwood provides more power and greater performance in its products than anyone else.

You can prove this by comparing our products with others in the same price categories. The S-7210 is a case in point.

It has minimum RMS power output @ 0.8% total harmonic distortion, both channels driven, of 26 watts per channel @ 8 ohms, 20-20,000 Hz. FM Sensitivity (IHF) of 1.9 uv. Alternate channel selectivity of 65 db. Front panel switching of 4-channel decoder (which doubles as second tape monitor). FM muting switch. And a Tape Dubbing feature.

What's more, the S-7210 is built with the most advanced componentry. Integrated circuits, FET circuitry, solid-state ceramic FM IF filters.

All for under $300.

So although it's easy to be impressed by the sheer size of a company or the weight of its advertising, when you get right down to it, performance-per-dollar makes it all hi-fi ho-hum.

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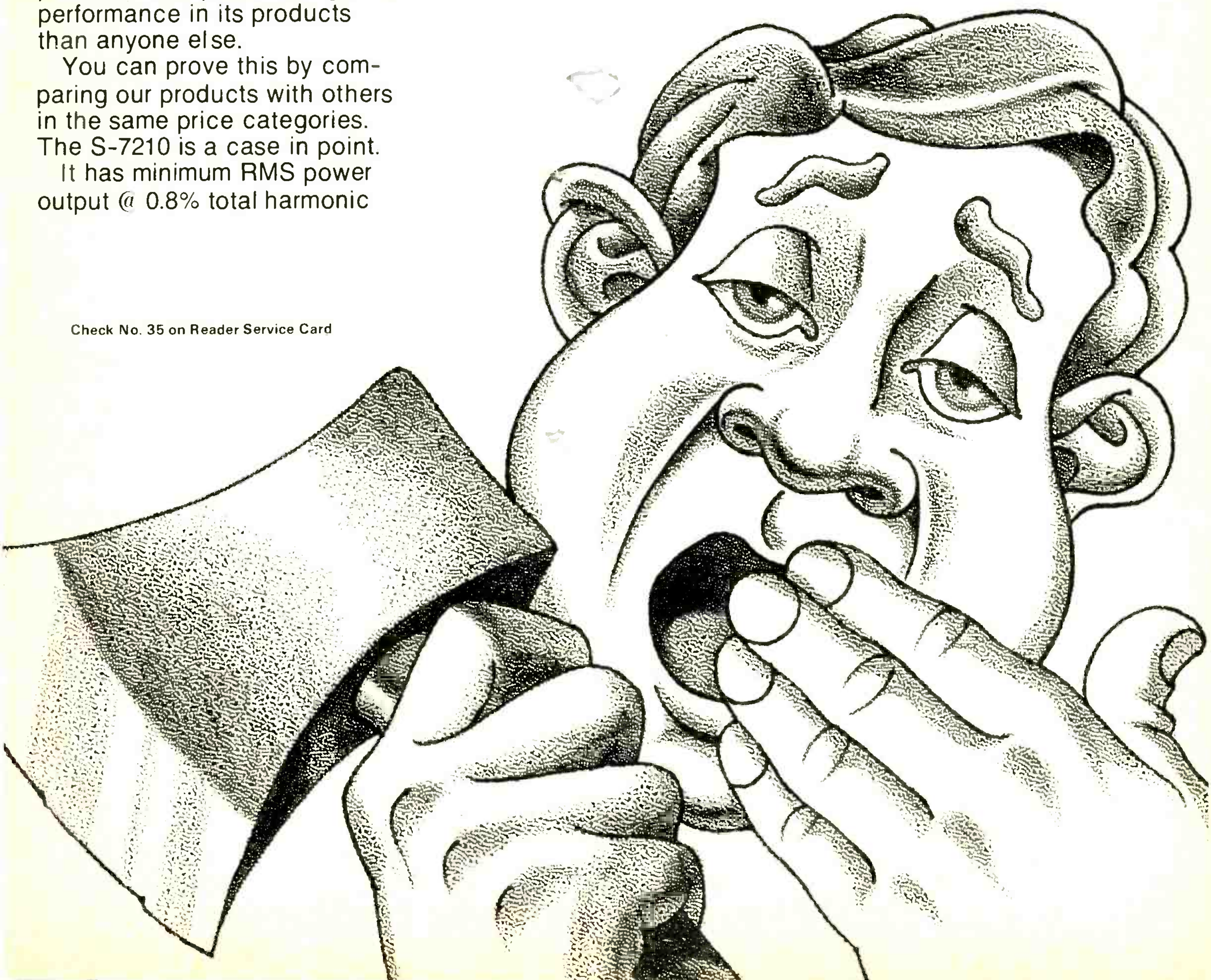


each end, for the four-way path. Conversion cables should be available for hooking into older equipment, perhaps at cost to bolster consumer confidence.

4. Simultaneously with the above, the main amp/preamp circuitry should be overhauled for radical miniaturization and/or IC configuring, so that four channels can go into even *less* space, and hopefully at less cost, than ONE channel in former days. Not to mention two. Again, the intent is to outdate stereo—to make stereo look big, clumsy, expensive. A tough goal, but a shiny one! Keep the mini-calculator in mind. The mini-quadraphonic amplifier?

And mind you, no more of those "composer" circuits. Educate the public to understand that both SQ and QS with their logics can do magnificent things for stereo discs, and differently enough to satisfy 99 percent of the listening clientele.

Now surely is the time to get going on all these things, if & where we haven't already. All the elements are coming into place, primed and ready to go, technically speaking. It is now or never, if quadraphonic sound is to evolve as a major part of the whole of our business. So easy for *me* to look ahead, of course! I'm like the cheerleaders—*team, team, team!* But just take the proverbial gander at all the lovely stuff I see in my mind's eye.

Neat, handsome little boxes (I see them decorously black, for some inner reason), maybe two thirds the size of corresponding stereo components. Modest controls, consciously simple in aspect, deliberately so. On the rear, *very* few sprouting cables, *fewer than in most stereo*—more like the old mono (see point 3). That will inspire confidence! On the function switch, a full and *equal* choice of major disc systems, all on a maximum of three switch points (leaving out the upcomers for the moment). QS, SQ, with their built-in logics. CD-4. All three in chips. Or maybe only two switch positions—so simple! CD-4 switches in automatically when the recorded "pilot tone" begins.

These whole systems, on display (and in the home) would intentionally look simpler and less cluttered then stereo and I can think of nothing more vital than that to promote the glories of quadraphonics to the larger audience. It's just a matter of getting it done—which (bless me), is your problem, not mine. Be hopeful.

Loudspeakers for these new systems? A separate subject. The aesthetics of quadraphonic recording via matrix and via CD-4? But definitely, another subject and a big one. See future issues.

Editor's Review

IT HAS BEEN several months since we last published an editorial, and if this month's Editor's Review seems rather fragmented, it's because we've got a lot of ground to cover in catching up with events.

First and foremost, we need to issue an apology to M.P. Moller, Inc., of Hagerstown, Maryland, and to the Curtis Institute of Music here in Philadelphia for what one reader—apparently fond of mixed metaphors—called "visual hoof-in-mouth disease." In our blithe ignorance, we set about looking for the prettiest organ in Philadelphia to photograph for the cover of our November issue, which was devoted to electronic organs. As you might guess at this point, the handsome five-manual organ on that cover is a Moller and located at the Curtis Institute. What we were ignorant of, and here we'd best quote a Moller representative, was "the incongruity of the console of a very important pipe organ being used to feature a special issue on electronic organs." Our sincere apologies, therefore, go to both the Moller and Curtis folks, with a footnote that we still think the photo made a very handsome cover.

Anniversary

Would you believe that the Schwann Record Catalog is 25 years young? You'd best, 'cause last October's issue was the Silver Anniversary number for that fantastically detailed compilation of LPs, 8-tracks, and cassettes. That first edition, from October, 1949, say the Schwann folks, contained 26 pages, was hand typed by William Schwann himself, and listed 674 records from 11 record companies. The monthly *Schwann-1* presently lists more than 47,000 recordings on 773 labels, and is printed using computer techniques. Our belated congratulations.

Reader Service Cards

Many readers apparently believe that the brochures, spec sheets, and other items of product information offered through our Reader Service Card are actually stored here in the editorial offices, and that we are physically responsible for sending the data on to the reader. Not true, though we do generally receive one of two samples of this sort of material by way of press releases.

What actually happens is that the cards go to a special post office box, where they are collected regularly by representatives of a firm specializing in reader service card work. The names and addresses are typed from each card onto a computer tape and then printed on individual mailing labels placed together on large sheets. Each of these sheets represents all of the people who have ticked off Number XYZ on the card to show they want data on the Ultima One receiver. This process is performed many times each month, and cards are accepted for two months beyond the issue date.

The sheets containing the names and addresses are then mailed to the various manufacturers for actual fulfillment of the request for a brochure. Some firms choose to send the names on to a local dealer, but most prefer to send out the product information themselves.

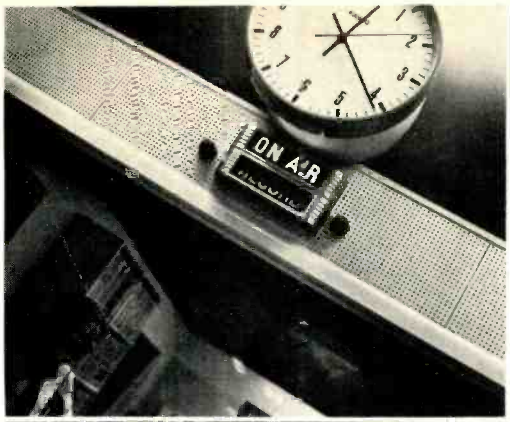
The system is not foolproof—for many reasons. Some folks have handwriting which is difficult to read; they sometimes put down the wrong address; firms can run out of items to mail; products are at times withdrawn from the market. All we can really say in defense of the system is that it does work—usually—and that if you don't receive your product flyer the first time around, give us a second and maybe a third chance.

Armstrong Awards

The 11th annual Armstrong Awards program for excellence in FM radio programming has been announced. Some $4,000 in prizes will be given to eight winners in these categories: news, community service, education, and music in commercial and noncommercial divisions. Feb. 4, 1975 is the deadline for entries, and forms may be obtained from the Executive Director, Armstrong Awards, 510 Mudd Bldg., Columbia University, New York, N.Y. 10027.

Convention Down Under

The Australian Institution of Radio and Electronics Enginers has issued a call for papers for the International Electronics Convention, which will take place from August 25th through the 29th at the University of New South Wales, Sydney. Further information may be obtained from R.S. Garland, General Secretary, Institution of Radio and Electronics Engineers, Science House, 157 Gloucherster St., Sydney 2000, Australia. (Now if I could just convince my boss. . . .) *E.P.*



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QUALITY AM RADIO

George McKay, Jr., W6WXG
as told to Larry Engard

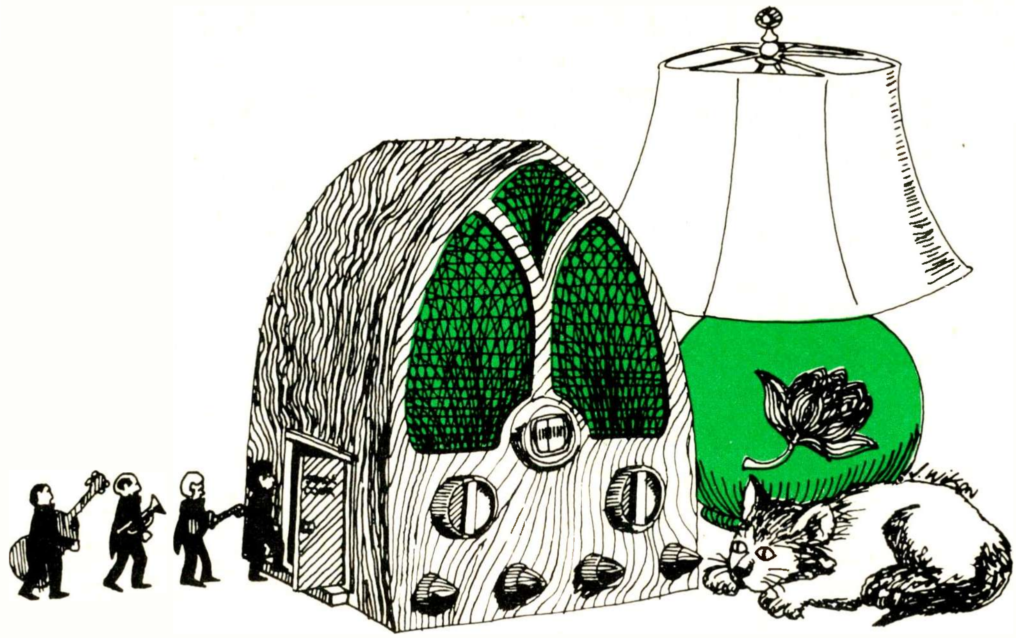
ARE YOU satisfied with what you can get on the radio? A little disenchanted with the FM programming? Think it is useless to try the AM band because of the interference, electrical noise, distortion, and lack of fidelity and signal quality? A lot of people will agree that AM programming has a lot to offer. Many top radio personalities are on AM. All of the sports shows are on AM. There is a greater variety of types of music programming on AM. The top network news programs are on AM.

With all of this going for it, what is the state of AM broadcasting? We hear a lot of people putting AM down, saying it is over the hill, that all that is new and good is on the FM band, and AM is losing popularity. Is this all true? Let's take a good, close look and see!

The AM transmitting equipment in use today can send out a signal that is flat 50 to 15,000 cycles. The transmitted signal is clean, distortion free, and full fidelity, except for the case of some few small local stations.

How about on the receiving end? All-band portables and automobile radios, for the most part, have good to high sensitivity, fair to good fidelity with a compromise on bandwidth, dial calibration is generally poor, and ease of tuning is critical. In low-priced portables, table radios and the AM sections of most AM-FM hi-fi receivers and tuners, sensitivity is low, selectivity is poor, frequency response is usually flat only between 150 to 2500 Hz, and distortion is very high with no shielding of electrical interference from flourescent and neon lights, motors, television sets, electric switches, and all of the other electric consumer products found in the home or office today. Here again, ease of tuning is critical.

Let's pursue the question of programming a little further. Duplication of FM and AM broadcasting occurs in some small markets, but generally, the programming is entirely different. Most networks, except National Public Radio, have their best news programs on their AM affiliates. The news shows are longer, more comprehensive, and more current than the newscasts available on the FM band. AM



stations have the top announcers and personalities, even though we have recently seen several big names move over to FM. AM has the talk shows, the phone-in programs, baseball and football games and all the other sports, the religious stations, the top 40, the MOR and the Country/Western music. They are all on AM radio. There are several excellent classical music stations broadcasting on AM. The popularity of AM radio is attested to by the spending of the advertisers dollars, among other things. The only thing FM radio has that AM does not have is stereo and quadraphonic broadcasting. There has been some experimentation with stereo AM broadcasting in an attempt to keep up with the sounds of FM stereo and quadraphonic.

However, it is not on the broadcasting end that the weak link in AM is found. No matter how good a signal is broadcast, if there isn't a good antenna and receiver to pick it up and translate it into a good audio signal, there will be no way for the listener to know that the transmitted signal was good. You cannot compare the signal of an AM station received on a $25.00 AM receiver with an FM stereo signal interpreted on a $300 tuner with amplifier and dual speakers. Let me reiterate that most signals broadcast on AM have as good a quality and fidelity as most signals broadcast on FM.

Here arises another bit of fiction! We have all heard and read that since distant AM stations are 10 kHz apart on the dial, the FCC restricts frequency response of the AM broadcast signal to 5kHz. Since this is such a narrow bandwidth, it would therefore not be sensible to make high fidelity AM receivers. This whole supposition is fiction, pure and simple! The picture shows me listening to a H.R. Scott receiver in 1936. This receiver had 23 vacuum tubes, and it was a high fidelity receiver. There have been very few high fidelity AM receivers marketed since then; however, it is a fact that back then all locally produced network shows were high fidelity, and all the Western Electric recordings in the 1930s' were produced and broadcast in high fidelity. High fidelity in AM broadcasting has been with us for a long time, is still with us, and I feel will continue to be with us for a long time to come. FM broadcasting, it should be noted, did not begin until January 1, 1941.

Now let's go back to the radio dial. When a station is assigned a frequency, the geographic locations of other stations on the same frequency are considered, along with the power of the station. Stations in the same geographic areas, or with signal patterns in the same area, are separated on the dial by at least 30 kHz, by FCC regulations. This broadens the available frequency response area to 15 kHz. On clear-channel stations and regional stations, the frequency is usually assigned so that the spread is more than 30 kHz. Therefore, in theory at least, clear-channel stations are not limited in station frequency response, though in practice they are limited by complaints. A typical frequency response of an average station can be and most generally is as high as 7,500 Hz, with clear-channel stations going up to 10 kHz.

What does this mean in terms of the human ear? Human auditory capabilities generally range from about 60 Hz to 16 kHz, and many people do not hear the extremes at either end. Therefore, that top harmonic between 7,500 Hz and 15 kHz amounts to very little actual difference. Now, if this 7,500 Hz signal of the average station is reproduced on a low-cost receiver with a bandwidth of 2,500 Hz maximum, the poor audio fidelity of the result should not be blamed on the broadcasting station or AM radio in general.

Filter Bandwidth

Another area we should explore is bandwidth versus fidelity. On AM you can have high fidelity with broad bandwidth or low fidelity with a selective receiver with narrow bandwidth. However, bandwidth does not affect distortion. A high quality filter has a flat top and steep sides, as opposed to the conventional type filter which gives a rounded cycle type of picture. Figure 1 shows the differences in the two types of filters. The frequency response is represented by half of the bandwidth, which is represented by the "top" of the filter picture. On the flat-top filter with the steep sides, the "top" or bandwidth can be quite broad and still serve the purpose of eliminating unwanted interfering side signals. On the normal round-top filter, we have to accept a compromise between bandwidth and cutting off of interfering signals from adjacent channels. Now, if we have a 13-kHz filter, this will give us a frequency response of 6,500 Hz. A good AM receiver will, of course, have two bandwidths available: a narrow or sharp position for distant and weak stations, with a response of about 2,500 Hz, and a broad

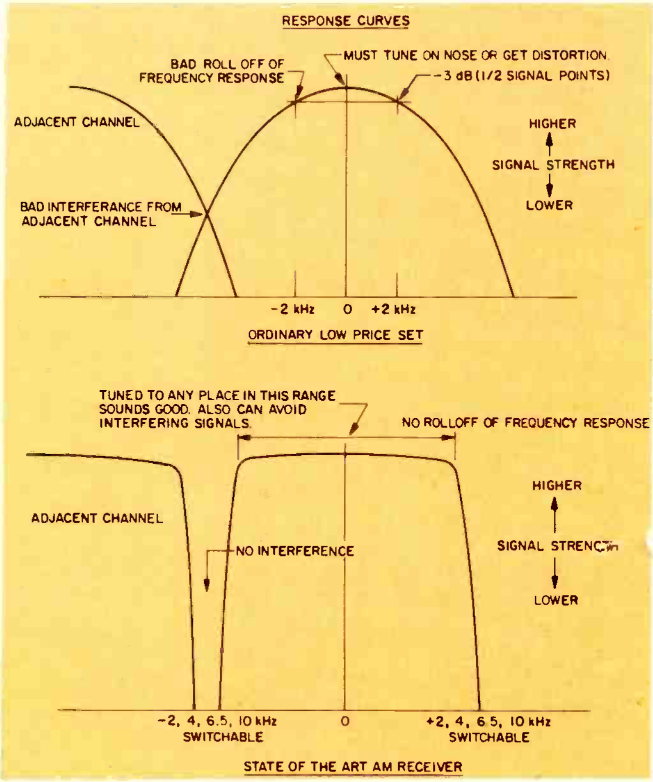


Fig. 1—Flat-top and rounded-top filter characteristics.

position responding to 9,000 Hz. A state-of-the-art receiver should have several crystal filters ranging from 4 to 20 kHz, giving the receiver a high fidelity range of from 2,000 to 10,000 Hz.

Another advantage of the flat-top filter is that tuning is not critical. Setting the dial, or tuning, to any point within the bandwidth range produces a perfectly good sound. The volume does not necessarily peak at just one point on the tuning dial. At times it is advantageous to tune to one side or the other of the center frequency in order to avoid an interfering signal. With a rounded-top filter, slight off-center tuning to avoid interfering signals deteriorates greatly the wanted signal. With a flat-top filter, you can tune out interfering signals without losing quality of the incoming signal over a much greater bandwidth range.

Antennas

One thing we haven't talked much about yet and which has a great effect on our listening pleasure, be it AM or FM, mono or stereo, is the antenna. The FM antenna, if one is needed, should be placed as high as possible and facing the transmitter tower from which the signal is being broadcast. The antenna must be within line of sight of the transmitting tower in order for a signal to be received. FM is limited to a maximum distance from the transmitter of about 150 miles. On the lower power stations, the distance is much less. The signal can also be disturbed or blocked out by such things as mountains and tall buildings between the transmitter and the receiver. On auto radios, either AM or FM, the antenna installation is already done, and the only variable effect we can have is dependent on where we drive the car.

With the average AM receiver or tuner, the placement and installation of the antenna can, and does, have a vast effect on the capture of the r.f. signal and the resultant audio signal. The built-in loop-stick antenna that we find on most AM sections is an adequate, but not really a very satisfactory antenna. It is difficult to tune, subject to heavy TV interference and electrical circuits in the area, and the stations you will be able to receive depend upon the positioning of the receiver in your home.

One alternative to the standard loop antenna is an outside long-wire antenna. First of all, you must have the space to install it. It is usually out of the question in cities, apartment buildings and other areas of high congestion. If you have the area, you must get the wire up high above the ground and string it between two conveniently located trees or erect two towers or poles to hold it up. The lead-in wire from the antenna to the receiver must be installed properly to shield out unwanted interference. Altogether, installation of a long-wire antenna is a rather technical and time-consuming undertaking, but it does work well—until the first storm or heavy wind, then usually has to be re-erected.

One more-satisfactory alternative is the tunable loop antenna. This configuration first appeared in the 1920s as a large loop of wire mounted on the top of large table-model radios. It could be turned by hand to act as a directional antenna to increase the incoming signals. The next step was to arrange the loop inside of large floor-model consoles, with an exterior tuning knob to control the direction of the loop. This arrangement appeared in the 1930s. Changing furniture fashions and miniaturization of receivers made this type of loop very impractical. The next step was a non-tunable loop of wire wound around the back cover or inside the case of the receiver on a permanently placed, small ferrite stick. Neither of these arrangements offered any shielding or adjusting, and it seems the listening public accepted these mediocre arrangements and has become accustomed to the lower fidelity reception that we normally get now on AM.

Remembering the quality AM reception from the days of my youth, we at McKay-Dymek decided that this quality was still possible and designed an indoor, shielded-ferrite loop antenna specifically for AM radio listening. In simple terms, the antenna consists of a special, heavy, 3/4-by-12-in. high-permeability ferrite rod encased in a shielded cover, mounted on a swivel atop a tunable amplifier. The shielding is constructed so as to allow the wanted r.f. signals to reach the rod while shielding out unwanted distortion and the antenna delivers a clean, interference-free, distortion-free r.f. signal to the antenna posts of the receiver.

The next step we have to consider is what the receiver does with this signal. If you have the average receiver we talked about earlier, it cuts off the "skirts" of the signal and limits the bandwidth. If you are trying to receive a distant or weak signal, this would be acceptable. If you want a strong station, whether local or distant and you want to hear the full fidelity of the broadcast signal without the interference and distortion normally associated with AM, you need a receiver which doesn't cut the signal "skirts." Fortunately there are a few units on the market today which don't do this; McKay-Dymek's AM3 is one. The cost of this tuner is quite high compared with what people are used to paying for an AM radio. However, when you compare it with an FM tuner that would give the same frequency response and the same low distortion, the cost is comparable. For those

AM Stations North America

Clear channel AM stations, Most with 50,000 Watts or more.

KHz	NE	SE	NORTH CENTRAL	SOUTH CENTRAL	NW	SW
540			CBK Regina	XEWA San Luis Potosi		
640		CMQ Havana				KFI Los Angeles
650		WSM Nashville				
660	WNBC New York					
670			WMAQ Chicago		KBOI Boise	
680	WRKO Boston	WPTF Raleigh			KNBR San Francisco	
690		CMBC Havana			CBU Vancouver	XETRA Tijuana
700	WLW Cincinnati					
710	WOR New York	WGBS Miami			KIRO Seattle	
720			WGN Chicago			
730			XEX Mexico City			
740	CBL Toronto		CBX Edmonton	KTRH Houston	KCBS San Francisco	
750		WSB Atlanta				
760	WJR Detroit					
770	WABC New York					KOB Albuquerque
780	WBBM Chicago				KCRL Reno	
800	CRLW Windsor	PJB Bonaire		XELO Ciudad Juarez		
810	WGY Schenectady				KGO San Francisco	
820				WBAP Fort Worth		
830			WCCO Minneapolis			
840		WHAS Louisville				
850	WHDH Boston			KOA Dever		
860	CJBC Toronto					XEMO Tijuana
870				WWL New Orleans		
880	WCBS New York		KRVN Lexington NB			
890			WLS Chicago			
900				XEW Mexico City		
940	CBM Montreal			XEQ Mexico City		

kHz	NE	SE	NORTH CENTRAL	SOUTH CENTRAL	NW	SW
1000			WCFL Chicago		KOMO Seattle	
1010	WINS New York				CBR Calgary	
1020	KDKA Pittsburgh					
1030	WBZ Boston				KTWO Casper	
1040			WHO Des Moines			
1050	WHN New York			XEG Monterrey		
1060	KYW Philadelphia				CFCN Calgary	
1070						KNX Los Angeles
1080	WTIC Hartford			KRLD Dallas		
1090	KBAL Baltimore			KAAY Little Rock	KING Seattle	XEPRS Baja, Calif
1100	WWWE Cleveland					
1110		WBT Charlotte	KFAB Omaha			
1120			KMOX St Louis		KPNW Eugene OR	
1130			WDGY Minneapolis	KWKH Shreveport		
1140		WRVA Richmond				
1160					KSL Salt Lake City	
1170		WWVA Wheeling		KVOO Tulsa		
1180	WHAM Rochester					
1190			WOWO Fort Wayne	XEWK Guadalajara	KEX Portland	
1200				WOAI San Antonio		
1210	WCAU Philadelphia					
1220	WGAR Cleveland			XEB Mexico City	CKDA Victoria	
1500	WTOP Washington		KSTP St Paul			
1510				WLAC Nashville	KGA Spokane	
1520	WKBW Buffalo		KOMA Oklahoma City			
1530	WCKY Cincinnati				KFBK Sacramento	
1540	WPTR Albany					
1560	WQXR New York					
1570				XERF Ciudad Acuna		

whose tastes run to the very best available, Dymek will soon announce a state-of-the-art AM tuner with crystal filters, digital frequency readout, very low distortion, and many other features. The price of this tuner will be comparable with the better FM tuners, but still well below several FM tuners on the market.

Stereo AM

On the subject of stereo, we mentioned earlier that there have been some trial runs with AM stereo broadcasting. At this point, it is not at all certain that the FCC will approve AM stereo in this country. An AM station in Baltimore has been doing some AM stereo broadcasting, but there has been very little publicity about it. The only way to receive AM stereo broadcasts in this country is to have two receivers, one tuned to the left of the center of the signal, the other tuned to the right. There is an AM stereo receiver available in this country, but it is for export only in sample quantities from Kahn Electronics, Inc., 74 North Main St., Freeport, NY 11520. Mr. Kahn also has a stereo AM transmitter driver-modulator which goes for about $16,000. This is available for foreign broadcasters only. Mr. Kahn says that his new transmitting equipment is superior to his previous model that has been in use by XETRA in Tijuana, Mexico. Since AM does not require line-of-sight reception as FM does, it is easy to conclude that if AM stereo does become available and practical in the U.S., it will be preferable for automobile listening and a valuable addition to a home sound system for its varied programming.

There are a few other points I wish to make about AM broadcasting in general. Amplitude modulation transmission is actually a carrier frequency with side bands that is used to transmit radio frequency signals in the electromagnetic spectrum in a range of from 150 to 26,100 kHz in many separate frequency bands. When we talk about the broadcast band in this country, we are covering only the range from 540 to 1600 kHz which is usually referred to as the medium wave band. In audio circles in Europe and North Africa, the bands usually referred to are the long wave band, from 150 to 300 kHz, and the medium wave band, 540 to 1600 kHz. The long wave band is used very little for broadcasting except in Europe, North Africa, and the Soviet Union. The main characteristic of the long wave band is that it has very long range, during both daytime and nighttime hours. We here in the United States may be losing a lot by not using the long wave band to relieve some of the congestion in the AM broadcast band. The range of this band is put to good use by BBC Radio 2 on 200 kHz. They cover all of Western Europe and the United Kingdom in the day time.

The medium wave frequencies of 540 to about 1000 kHz have long range characteristics during daylight hours. From 1000 to 1600 kHz, the range that the broadcast signal will cover shortens quite considerably during the daylight hours. At nighttime, the clear-channel stations in the 540 to 1600 kHz band have very long range characteristics. There are about 70 of these clear channel stations scattered around the country, and their signals cover great distances. The remainder of the 4,413 AM stations share their frequencies, and dependent on their strength, location, signal patterns and location, transmit their signals over a range as short as 5 miles and up to 100 miles from their transmitter.

There are a lot of AM stations out there in the 107 AM channels on the broadcast band. With the proper receiving equipment you can enjoy a lot of good radio listening.

The Dual 1229Q. Why many music lovers will settle for nothing less.

Many serious music lovers are not satisfied unless every component in their system is the very finest in its class, with cost secondary. The 1229Q, Dual's highest-priced multi-play turntable, is one of these "no compromise" components.

The 1229Q is a full-sized turntable with a twelve-inch dynamically balanced platter that weighs a full seven pounds. Its massive platter is driven by Dual's powerful Continuous-Pole/synchronous motor.

The 8-3/4" tonearm is mounted in a true gyroscopic gimbal that centers and balances it within both axes of movement. All four tonearm pivots turn on identical low-friction bearings permitting flawless tracking at as low as 0.25 gram. And since a turntable of the 1229Q's calibre is used most frequently in the single-play mode, the tonearm is designed to track at precisely the correct angle in that mode. With the exclusive Mode Selector, tracking angle can be instantly adjusted for correct tracking at mid stack in the multi-play mode.

Low capacitance tonearm leads and an anti-skating system with separate calibrations for conical, elliptical and CD-4 styli, make the 1229Q compatible with any stereo and four-channel cartridge available or likely to be available in the foreseeable future. Other features include a calibrated illuminated strobe with adjustable viewing angle, and cueing damped up as well as down to prevent bounce.

The 1229Q is too new for test reports to have appeared, but reports on its immediate predecessor, the Dual 1229, indicate why it was the largest selling quality turntable ever made. Stereo Review called its rumble measurements "among the best we have yet made on a turntable." High Fidelity said, "It takes one step further the progressive improvements that have made top Dual models among the most popular turntables in component systems for the better part of a decade, to judge by readers' letters."

Stereo & HiFi Times' noted, "I unhesitatingly recommend it to anyone looking for the best possible record playing equipment." And Popular Electronics rated it "the equal of any combination of record playing components known to us."

Of course, not everyone can afford the 1229Q's price: $259.95. But every Dual turntable, starting with the 1225 at $129.95, provides the same high quality materials, carefully finished parts and meticulous quality control that have long earned Dual its reputation for reliability.

Thus which Dual you select is not terribly important. Your choice can be made in terms of the level of refinement you require. And if, like many music lovers, you require every refinement it is possible to have in a multi-play turntable, chances are you too will choose the Dual 1229Q.

Dual **United Audio Products**
120 So. Columbus Ave., Mt. Vernon, N.Y. 10553
Exclusive U.S. Distribution Agency for Dual

Check No. 39 on Reader Service Card

dBs Made Simple

Herman Burstein

IN THE popular literature for audiphiles, writers have generally skirted the task of explaining the decibel (dB). They have contended that a full explanation involves logarithms and therefore is too technical for pages such as these.

To this I am compelled to reply *NOT SO!* First, the decibel is well within the intellectual grasp of those who read these pages; it can be explained and understood without recourse to logarithms or other mathematical concepts more profound than multiplication. Second, an understanding of the ubiquitous decibel is too important to the audiophile to deny him a full explanation. Where, in any discussion of audio equipment's specifications and performance, does the decibel fail to appear?

The essential meaning of the decibel can be summed up in two brief statements, on which we will enlarge:

1. The decibel denotes a *ratio* between two amounts of power—electrical or acoustic power.

2. The decibel rests on the concept of *multiplication* as the way to get from a small magniture (of power) to a large magnitude (of power). Successive additions of decibels denote successive multiplications.

If Harry has twice as much money in the bank as Tom, the ratio between their respective bank accounts is 2. If Jack makes three times as much money this year as last year, 3 is the ratio between his spending power this year and last year.

Now let's talk about audio power. If Amplifier A can produce 10 times as many watts as Amplifier B, the power ratio is 10. If Amplifier C can produce 50 watts at 1,000 Hz but only 20 watts at 30 Hz, the power ratio is 2.5. The notion of a ratio between two amounts of power is straightforward and simple.

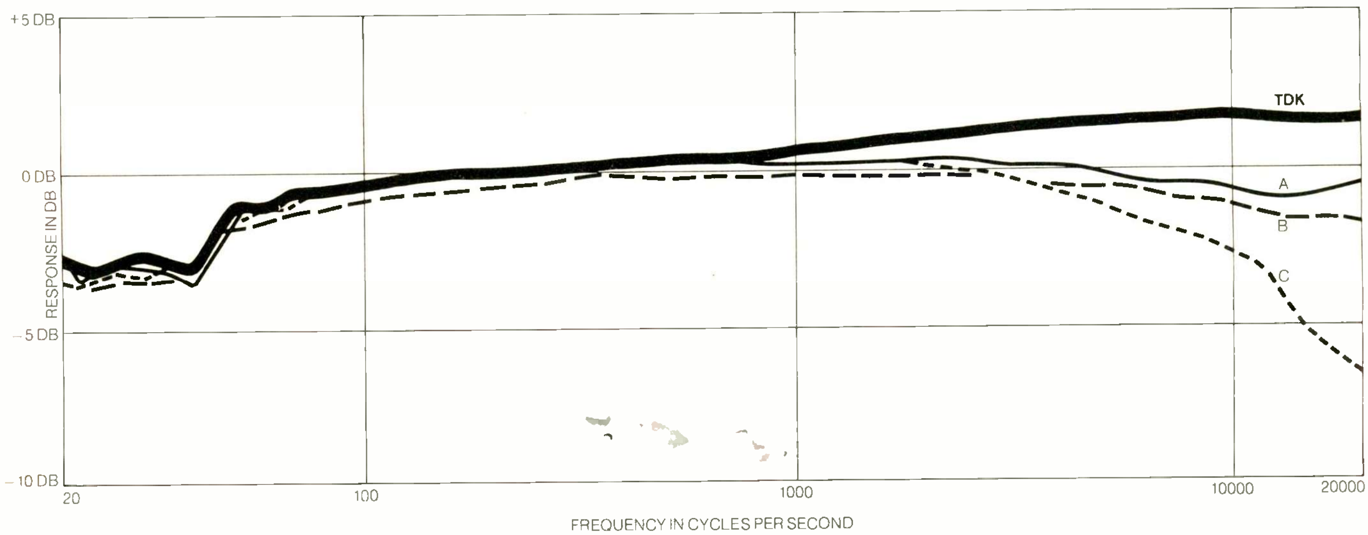
In going from a low number to a high number, we can do so slowly by adding. Thus we can go from 2 to 16 by adding: 2+2+2+2+2+2+2+2=16. Or we can proceed more swiftly by multiplying: 2x2x2x2=16. In the first case we are repeatedly adding a constant factor, 2. In the second case we are repeatedly multiplying by a constant factor, also 2. When we use the decibel, we are multiplying by a constant factor.

Specifically, 10 dB signifies multiplication by a factor of 10. Every 10 dB signifies another multiplication by 10. For example, what does 20 dB signify? 20 dB = 10 dB + 10 dB, which in turn signifies 10 x 10, which equals 100. If Amplifier A can produce 10 dB more power than Amplifier B, this says that A can produce 10 times as much power as B; in brief, the power ratio is 10. If Sound C is 20 dB louder than Sound D, this means that C is producing 100 times as much acoustic power as D; the power ratio is 100.

This simple yet very basic knowledge can be put in the form of Table 1A. In fact, we can put it into the form of a brief rule, which applies when converting 10 dB steps into power ratios: For each 10 dB, add a zero to the number 1. Thus 10 dB represents a power ratio of 10; 20 dB represents a ratio of 100; 30 dB represents a ratio of 1000; etc.

(Another, but seldom used, term for 10 dB is 1 bel. This was named in 1928 in honor of Alexander Graham Bell.)

TDK ED: BEST FREQUENCY RESPONSE. FOR AN EXTRA BUCK.



TDK ED tape was shown to have the best frequency response of four leading cassette tapes tested recently by an independent laboratory. The other three were large-selling popular competitors, retailing for about a dollar less than TDK ED. As you can see, their output tended to fall off noticeably in the high frequencies.

Even a slight loss of high-frequency reproduction can make a difference in clarity and detail to a discriminating ear. That quality of life that music should have just won't be there—the sheen on the violin note, the glitter on the cymbal finale.

Conclusion? If you're serious about the sound of music, try a TDK ED tape next time. It offers you that quality of lifelike brilliance you might otherwise have to buy a ticket to hear. And we think that's worth an extra buck.

TDK®

Wait till you hear what you've been missing.™

What power ratio does 1 dB represent? The answer is 1.26 (more exactly, 1.25893). An explanation follows.

Keep in mind that the decibel represents a process of successive multiplications. 100 dB is produced by 10 steps of 10 dB each; correspondingly, a ratio of 10,000,000 is produced by 10 successive multiplications by 10. In parallel fashion, 10 dB is produced by 10 steps of 1 dB each; correspondingly, a ratio of 10 is produced by 10 successive multiplications by 1.26 (If you have doubts, borrow a calculator for a few moments to check the result of 10 successive multiplications by 1.25893.)

Our knowledge about the meaning of 1 dB can be put in the form of Table 1B. Together, Tables 1A and 1B each 10 dB we add a zero to the number 1. Therefore: 134 dB = 130 dB + 4 dB = 10,000,000,000,000 x 2.51 = 25,100,000,000,000 (power ratio).

Note how useful the decibel is in succinctly expressing very high power ratios. In the preceding example, 134 dB is a much more compact statement than a ratio of 25,100,000,000,000.

Examples of the Decibels Use

* It has been stated that the dynamic range of a symphony orchestra is about 110 dB. This denotes the ratio between the loudest and softest passages played. The corresponding power ratio is 100,000,000,000!

* A tape deck claims a signal-to-noise ratio (S/N) of 63 dB. Specific-

Table 1A—Translation of decibels into power ratios in steps of 10 dB.

Decibels	Power Ratio	Decibels	Power Ratio
10	10	70	10,000,000
20	100	80	100,000,000
30	1,000	90	1,000,000,000
40	10,000	100	10,000,000,000
50	100,000	110	100,000,000,000
60	1,000,000	120	1,000,000,000,000

Note: To translate dB into power ratios, for each 10 dB add a zero to the number a zero to the number 1.

Table 1B—Translation of decibels into power ratios in steps of 1 dB.

Decibels	Power Ratio	Decibels	Power Ratio
1	1.26	6	3.98
2	1.58	7	5.01
3	2.00	8	6.31
4	2.51	9	7.94
5	3.16	10	10.00

Note: Each ratio, except the first, is obtained by multiplying the preceding ratio the preceding ratio by 1.26 (more exactly, by 1.25893).

fully equip us to translate decibels into power ratios:

* Assume a figure of 52 dB. Table 1A shows that 50 dB represents a power ratio of 100,000, while Table 1B shows that 2 dB represents a power ratio of 1.58. Adding dB signifies that we are multiplying the corresponding ratios. Therefore we have: 52 dB = 50 db + 2 dB = 100,000 x 1.58 = 158,000. In sum, 52 dB represents a power ratio of 158,000.

* Assume a figure of 47 dB: 47 dB = 40 dB + 7 dB = 10,000 x 5.01 = 50,100 (power ratio).

* Assume a figure of 134 dB. This exceeds the scope of Table 1A. However, the table note states that for

ally, if a 400 Hz tone is recorded at a level resulting in 3 percent harmonic distortion on the tape, then in playback the desired audio signal is 63 dB above the undesired noise produced by the tape system. 63 dB denotes a power ratio of 2,000,000. (In low-price tape decks, S/N ratios of 50 dB are not uncommon. Noise tends to be quite apparent in such decks, even though the audio signal contains 100,000 times as much power as does the noise.)

* Frequency response of a speaker is stated to be 7 dB down at 30 Hz relative to 1,000 Hz. If equal amounts of electrical power are fed to the speaker at 30 and 1,000 Hz, the acoustic power produced by the speaker is 7 dB less at 30 Hz. (Stated conversely, it produces 1/5th as much power at 30 Hz as at 1,000 Hz.)

* Phono discs contain a large amount of treble boost. The RIAA phono equalization standard requires the playback amplifier to supply a prescribed amount of compensating treble cut, starting at about 2,100 Hz and increasing steadily thereafter. A table or graph shows RIAA treble cut reaching nearly 14 dB at 10,000 Hz. In terms of electrical or acoustic power, this denotes approximately 25 times as much power at 1,000 Hz as at 10,000 Hz; or, conversely, 1/25th as much power at 10,000 Hz as at 1,000 Hz.

How Loud Is a Decibel?

For most program material, such as rock, pop, or classical music, a power increase of 1 dB—to 1.26 times its starting level—tends to be inaudible. It has been observed that volume must be increased about 3 dB in order for the human ear to have a definite impression of an increase in loudness. Even so, a 3-dB volume increase produces only a *slight* rise in apparent loudness.

Yet 3 dB represents a doubling of power. The lesson is that great increases in power are required to produce substantial increases in apparent loudness. If one considers a 30-watt amplifier to have insufficient power and replaces it with a 60-watt amplifier of otherwise equal quality, one can achieve but a slight rise in maximum undistorted sound level. For a hefty lift in sound level, one might have to go to an amplifier of 300 watts or more. This would amount to a 10-dB increase over the 30-watter, yet still would not permit a "great" change in apparent loudness. A rise of 10 dB sounds to the human ear more like a doubling of the sound level than like a multiplication by 10.

The decibel appropriately describes how the human ear responds to changes in acoustic level. The ear interprets equal increases in decibels as approximately equal increases in apparent loudness. Going from 1 watt to 2, from 2 to 4, and from 4 to 8—in each case an increase of 3 dB, or doubling of power—tends to sound like a series of equal increases in loudness. But going from 1 watt to 2, from 2 to 3, and from 3 to 4—in each case an increase of 1 watt—would sound like successively smaller increases in loudness. The increase from 3 watts to 4 might well be inaudible. Not long after, an increase of 2 watts would be inaudible; then one of 5 watts; etc.

Introducing the KLH Research X Model Sixty Turntable:

A solid triumph in human engineering.

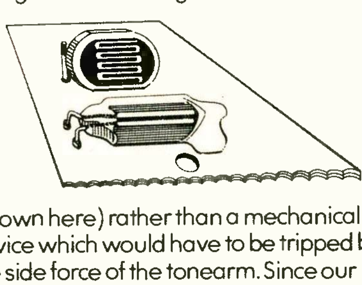
There are more manual turntables to choose from these days than ever before. And most of the better models share many of the same fine features and specifications.

So why make a turntable? (And we are making it—not just slapping our name on someone else's product. Every part is *hand* assembled in our plant in Cambridge, Mass.)

The answer is in the product itself. The Model Sixty is a two speed, belt-driven, transcription quality turntable that combines *all* of the most wanted features with exceptional performance and a maximum of something we call "human engineering."

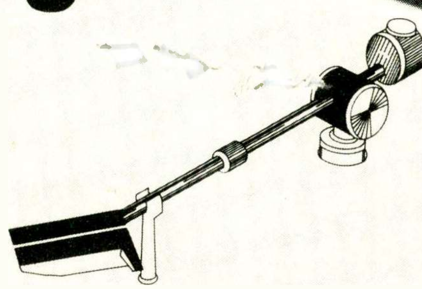
What is human engineering?

It's designing an electro-optical system that automatically shuts off the turntable at the end of the record and gently lifts off the tonearm. This is achieved through the use of a light detector resistor



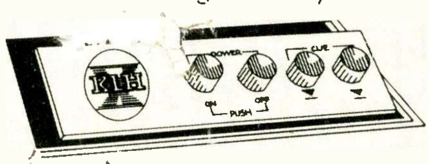
(shown here) rather than a mechanical device which would have to be tripped by the side force of the tonearm. Since our system requires no side force, it virtually eliminates all potential distortion and side thrust problems.

Human engineering is designing a special low mass aluminum tonearm and unique low friction pivot block and post assembly to such exacting standards that



usage deterioration and performance deviation is all but eliminated.

Human engineering is designing all of the electronic controls into an upright module for incredibly simple and convenient operation. It's also making the controls *feel* as good as they look.



(Just one touch and you know there's something substantial here.)

In short, human engineering is finding out what people want and need in a product and putting it there. That's why the Model Sixty also features push-button electronic cueing, anti-skating control, a discrete suspension system that minimizes rumble, acoustic feedback and vibrations, one piece dynamically balanced platter, 24-pole synchronous motor and every other important feature you could want in a precision turntable.

All for $150.

Now *that's* human engineering.

The Model Sixty. Another superb new product from KLH Research X—a new era in audio.

For more information, visit your KLH dealer or write to KLH Research & Development Corp., 30 Cross St., Cambridge, Mass. 02139.

Specifications

Rumble: -58 dB (CBS-RRLL), exceeds DIN requirements.
Wow & Flutter: .09%, lower than one half of DIN requirements.
Tracking Force: Continuously adjustable from 0.5 to 4.0 grams, with precision calibrated scale.
Average Absolute Tracking Error: 0.5° less than 0.01 radian.
Arm Structure: Low inertia, precision ground, high strength aircraft aluminum alloy.
Suspension: Tripoint seismic suspension of arm and turntable on single precision casting, damped to minimize influence of external vibrations causing high order resonances.
300 RPM Motor: Precision polyphase synchronous low speed motor for minimal vibrations and optimum instantaneous speed accuracy and freedom from counter-rotation.
Timing Accuracy. Better than 5 seconds per average LP side; twice as good as DIN requirements.
Speeds: 33⅓ & 45 RPM
Record Sizes: 7", 10", 12"
Operates on: 105-125 volts, 60Hz only, pilot light indicates power "ON"
Dimensions: 17" (W) 13⅜" (D) 6¼" (H) with dust cover.

KLH®

KLH Research X Division
KLH Research & Development Corp.
30 Cross St., Cambridge, Mass. 02139

Check No. 17 on Reader Service Card

Negative Decibels

Sometimes decibels are presented as negative numbers. For example, a preamplifier's specifications might state that noise is −70 dB for high-level inputs (such as tuner). The negative figure merely indicates that one is comparing the smaller with the larger power, rather than the other way around. In our example, we are informed that noise produced by the preamp is 70 dB less than that of the desired audio signal. 70 dB means a power ratio of 10,000,000 between the audio signal and the noise. −70 dB means that the noise power is 1/10,000,000th as great as the signal power.

Another way of viewing the negative decibel is to consider it as representing division instead of multiplication. If 10 dB means multiplying by 10, then −10 dB means dividing by 10, so that power is reduced to 1/10th its original level. In the preceding example, −70 dB signifies that in order to arrive at the power of the noise, the power of the audio signal is divided by 10,000,000.

Voltage Ratios

Ultimately we are concerned with the acoustic power produced by the speaker; and before that, the electrical power produced by the amplifier. Therefore the relationship of primary interest to the audiophile is the one between decibels and power ratios. However, in earlier stages of the sound chain (tuner, tape deck, preamp, etc.) electrical considerations and measurements tend to be primarily in terms of voltage rather than power. Hence the need arises to interpret decibels as voltage ratios, particularly on the part of the engineer and technician, but also by the audiophile who assembles kits or otherwise tinkers with equipment.

Electrical power involves both voltage and current: power = voltage x current. When voltage increases, current tends to increase proportionately. If voltage doubles, current also doubles. But power goes up four-fold, since 2 x 2 = 4. This illustrates a basic phenomenon: power varies with the square of the voltage change. Thus, if voltage increases by a factor of 10, power increases by a factor of 100—the square of 10. Conversely, the increase in voltage is the square root of the increase in power. If power increases 16-fold, voltage increases 4-fold. (All the foregoing assumes no other changes in the electrical circuit.)

Assume a 20 dB increase in power, representing a power ratio of 100. But the corresponding voltage ratio, namely the square root of 100, is only 10. Thus a voltage ratio of 10 corresponds to 20 dB. Every 20 dB denotes multiplication of *voltage* by 10. Similarly, if 1 dB represents a power ratio of 1.26, 1 dB represents a voltage ratio of 1.12 (more accurately, 1.12202); 1.12 is the square root of 1.26. We can put all this together in Tables 2A and 2B, which fully equip us to translate decibels into voltage ratios:

* Assume a figure of 52 **dB**. 52 **dB** = 40 dB + 12 dB = 100 x 3.98 = 398 (voltage ratio).

* Assume a figure of 135 dB. 135 dB = 120 dB + 15 dB = 1,000,000 x 5.62 = 5,620,000 (voltage ratio).

Table 2A—Translation of decibels into voltage ratios in steps of 20 dB.

Decibels	Voltage Ratio	Decibels	Voltage Ratio
20	10	120	1,000,000
40	100	140	10,000,000
60	1,000	160	100,000,000
80	10,000	180	1,000,000,000
100	100,000	200	10,000,000,000

Note: To translate dB into voltage ratios, for each 20 dB add a ze[illegible] the number a zero to the number 1.

Table 2B—Translation of decibels into voltage ratios in steps of 1 dB.

Decibels	Voltage Ratio	Decibels	Voltage Ratio
1	1.12	11	3.55
2	1.26	12	3.98
3	1.41	13	4.47
4	1.58	14	5.01
5	1.78	15	5.62
6	2.00	16	6.31
7	2.24	17	7.08
8	2.51	18	7.94
9	2.82	19	8.91
10	3.16	20	10.00

Note: Each ratio, except the first, is obtained by multiplying the preceding ratio the preceding ratio by 1.12 (more accurately, by 1.12202).

Converting Ratios Into Decibels

Ordinarily the audiophile is more concerned with translating decibels into equivalent power ratios than the other way around. However, conversion of power ratios into decibels can be easily done, using Tables 1A and 1B:

* Assume a power ratio of 200. What is the corresponding number of dB? First, 200 = 100 x 2. Since a power ratio of 100 corresponds to 20 dB (Table 1A), and a ratio of 2 corresponds to 3 dB (Table 1B), we have: 200 = 100 x 2 = 20 dB + 3 dB = 23 dB.

* Assume a power ratio of 12,000. 12,000 = 10,000 x 1.2 = 40 dB + 1 dB = 41 dB. (This is an approximate answer rather than an exact one, because 1 dB represents a power ratio of 1.26 rather than 1.2. But the error is not serious; the exact answer would be 40.79 dB.)

Similarly, one can convert voltage ratios into dB, using Tables 2A and 2B:

* Assume a voltage ratio of 700. 700 = 100 x 7 = 40 dB + 17 dB = 57 dB. (The exact answer is 56.90 dB.)

Accuracy of the Tables

Tables 1 and 2 permit one to translate between decibels and ratios with sufficient accuracy for most practical purposes. Their compactness and ease of use compensate for the slight inaccuracy that may arise.

However, should the audiophile insist, he can achieve greater accuracy by either of two methods: He can obtain and learn to use a table of logarithms. Or he can construct tables similar to 1B and 2B, following the same principles as used to construct those tables, except that the new tables are in steps of .1 dB.

To do the latter, he need only equip himself with a calculator that can do multiplication, and note two essential items of information:

1. .1 dB corresponds to a power ratio of 1.023293, so that 10 successive multiplications by this number result in 1.25893 (power ratio represented by 1 dB).

2. .1 dB corresponds to a voltage ratio of 1.01158, so that 10 successive multiplications by this number result in 1.12202 (voltage ratio represented by 1 dB).

The "Absolute" Decibel

Sometimes we encounter statements that suggest the decibel is an absolute measurement in the way that watts, volts, amperes, etc. are absolute measurements. Thus, we are told that the sound level is about 90 dB in a noisy factory, about 110 dB on an orchestral peak, about 120 dB on a rock concert peak (or throughout much of the concert), about 45 dB in a typical residence, etc.

In fact, though, the decibel has no absolute meaning. It does not refer to a specific sound level. As stated at the outset, it denotes a ratio between two amounts of power.

The statements about sound levels in such places as the home, factory, etc. are based on an *implied* ratio, namely between the cited sound level and a standard reference level. The reference is the sound level at the lower threshhold of human hearing. The reference is a sound wave with an intensity of .000,000,000,000,000,1 watt per square-centimeter. That is, one-tenth of one-quadrillionth of a watt barely escapes detection by the human ear.

A sound level of 90 dB, as in a factory, refers to acoustic power that is 1,000,000,000 times as great as the reference level of power; in other words, .0000001 watt per square-centimeter. A sound level of 130 dB, which represents the upper threshhold of human hearing (higher levels are felt rather than heard), denotes .001 watt. This seems very little, yet relatively brief exposure to a level of 130 dB, as can happen near a jet aircraft or in an up-front seat at a rock concert, can temporarily or permanently impair one's hearing.

What Does 0 dB Mean?

0 dB does not signify the absence of power. It means that power is unchanged, or that two amounts of power (other than zero) are equal.

To indicate the absence of power, we simply state that power is zero. Decibels do not get into the act in this case.

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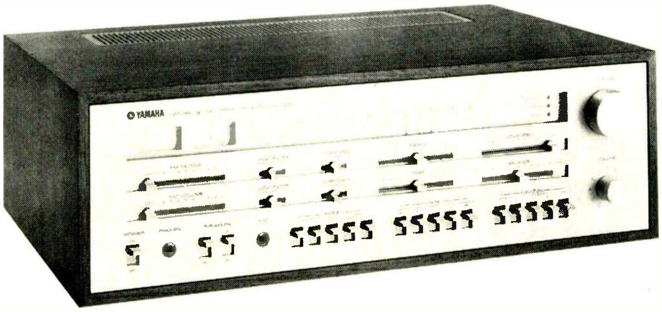
Equipment Profiles

Yamaha Model CR-1000 Stereo FM Receiver



MANUFACTURER'S SPECIFICATIONS

Tuner Section

IHF Sensitivity: 1.7 μV. **Quieting Slope:** 55 dB at 5 μV; 60 dB @ 10 μV. **S/N:** 75 dB. **Capture Ratio:** 1.0 dB. **THD:** Mono, 0.15% @ 400 Hz, 0.3% from 50 Hz to 10 kHz; Stereo, 0.3% @ 400 Hz; 1.0% from 50 Hz to 10 kHz. **Selectivity:** 80 dB. **Image Rejection:** 110 dB. **I.F. Rejection:** 110 dB. **Spurious Response Rejection:** 110 dB. **AM Suppression:** 55 dB. **Stereo FM Separation:** 45 dB @ 400 Hz; 35 dB from 50 Hz to 10 kHz. **Frequency Response:** 20 Hz to 15 kHz ±1.5 dB. **Sub-carrier Suppression:** 60 dB. **Muting Override Level:** 10 μV to 30 μV, variable.

Amplifier Section

Power Output: 70 watts per channel, 8 ohm loads, both channels driven, at any frequency from 20 Hz to 20 kHz; 85 watts per channel, both channels driven, 4 ohm loads, at any frequency from 20 Hz to 20 kHz. **Rated Harmonic Distortion:** 0.1% at rated power. **IM Distortion:** 0.1% at rated power output. **Damping Factor:** 70 @ 1 kHz. **Frequency Response:** Phono, RIAA ±0.2 dB; AUX & Tape, 10 to 50,000 Hz, +0.5 dB, −1.0 dB. **Input Sensitivity:** Phono, 3 mV; AUX, 150 mV; Mic, 3 mV. **Hum and Noise (IHF "A" weighting network):** Phono, 80 dB; Mic, 70 dB; AUX and Tape, 90 dB; Residual (volume at minimum), 100 dB. **Tone Control Range:** Bass, ±15 dB @ 50 Hz; Treble, ±10 dB @ 10 kHz. **Low Filter:** −3 dB at 20 Hz or 70 Hz. **High Filter:** −3 dB at 6 kHz or 12 kHz.

General Specifications

Maximum Power Consumption: 430 watts. **Dimensions:** 20 in. W x 13¼ in. D x 6¾ in. H. **Weight:** 42 lbs. **Retail Price:** $850.00.

Yamaha's top stereo receiver is one of the most expensive on the market and is one of a handful of receivers which lack AM circuitry. Both of these facts immediately suggest that the performance of this receiver is to be compared with the performance obtained with separate components. The unit differs in appearance from most stereo receivers in that there are only two rotary knobs on the entire front panel—one for tuning, the other serving as a master volume control. All other control functions and switching operations are performed by means of slide controls, slide switches, and piano-key toggle switches, which occupy the lower two-thirds of the panel height. The dial-scale area is rather narrow, though well illuminated and calibrated with a 0-100 logging scale in addition to the usual MHz markings. At the left are signal-strength and center-of-channel meters, while the right-hand end of the dial area has three indicator lights: one for power, one to signal stereo reception, and one which Yamaha calls an "AFC/Station Indicator." This last light works in conjunction with a capacitance effect when touching the tuning knob. So long as your fingers touch that knob, the built-in AFC circuitry is defeated while you tune accurately to the FM station of your choice. When the knob is released, and assuming a station has been tuned, the panel light turns on, indicating the AFC circuit is correcting possible mistuning. This refinement requires a preamplifier, three transistors, a couple of signal diodes, and the indicating LED light, not to mention the passive capacitors and resistors required in the associated circuitry.

Horizontally oriented slide controls vary muting threshold, microphone input volume, bass, treble, left-right balance, and loudness. The loudness compensation arrangement is one of the few found on modern receivers that actually permits the user to employ loudness compensation meaningfully. With the loudness slide lever set to the right, indicating "flat," the user adjusts the volume control to the loudest desired level. Then, increased settings of the loud-

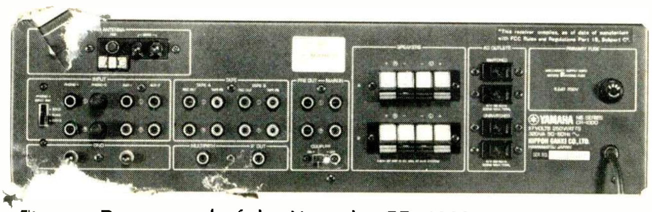


Fig. 1—Rear panel of the Yamaha CR-1000.

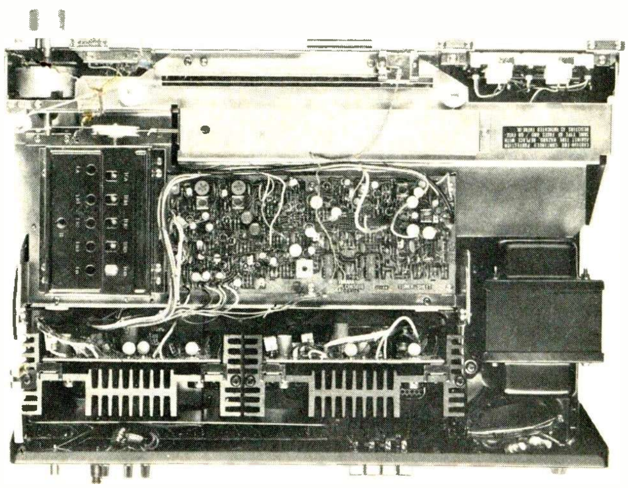


Fig. 2—Internal view of the chassis.

ness slide lever introduce just the right amount of loudness compensation. This dual control system is more effective and accurate than the arbitrarily designed combination volume/loudness control found on most competitive receivers.

Three position high- and low-filter slide switches provide two cut-off points plus an "off" position for each filter. Similar slide switches are used to set the turnover points for the bass and treble controls, with a flat position available for tone-control defeat. Eighteen toggle switches located along the bottom of the panel take care of power on/off switching, speaker system selection (one or two possible pairs or both), mono and stereo modes (including left-only, right-only, and left-plus-right mono, stereo, and stereo reverse). Five of these switches are program source selectors (there is provision for two phono input pairs, two AUX pairs and, of course, FM selection). The remaining lever switches have to do with the tape monitoring functions and permit connection of two tape decks, with dubbing from either one to the other, recording on one or both, and full monitoring on one or both externally connected tape machines.

The rear panel, pictured in Fig. 1, contains the usual assortment of input and output jacks, with the "Phono 1" pair augmented by an impedance switch with settings for 30 K, 50 K, and 100 Kohms. Coaxial connection of 75-ohm transmission line or terminal connection for 75- or 300-ohm lines is provided for on the rear panel, as are ground terminals and a pair of jacks to feed the horizontal and vertical inputs of any oscilloscope for visual display of multipath interference. Speaker terminals are the spring-loaded, push-to-insert-wire type, and there are four a.c. convenience outlets (two switched, two unswitched). Circuit interruption jacks between preamp section and power-amp section are internally connected (or disconnected) by means of an adjacent slide switch which frees up these jacks so that preamplifier output signals are available to feed additional power amplifiers even when the receiver is used in its entirety. A power line fuse completes the rear panel layout. It should be noted that switchable impedance, the coaxial connector, and 'scope outputs are features usually found only on separate components.

An internal view of the CR-1000 chassis layout is shown in Fig. 2. There are some 16 individual circuit-board modules in the receiver, the largest of which contains the FM i.f. and stereo multiplex circuitry. A partial schematic of this rather novel stereo decoder circuit is shown in Fig. 3. The composite stereo signal, entering at I_1 is demodulated through the 38 kHz switching action of Tr 119 and Tr 123, which are in turn used to switch Tr 120 and Tr 124. Residual crosstalk between channels is cancelled out by VR 1 and VR 2, and negative feedback is applied back to the input from the junction point of these two internally adjusted potentiometers. The negative feedback aspect of this circuit is unique to Yamaha and is a circuit refinement we have not encountered before. The result is lowered distortion.

The front-end section employs dual-gate MOSFET's along with a five-section variable capacitor. Seven stages of i.f. amplification are employed including a high-gain IC differential amplifier with constant current bias circuitry and a six-element phase-linear ceramic filter. The power amplifier circuits are direct-coupled complementary designs and are provided with a double form of protective circuitry. One circuit detects power dissipation of the output transistors and regulates the input signal when power exceeds the area of safe operation. The second circuit is a relay-equipped speaker-protection circuit that prevents direct current from ever reaching the speaker voice coils. This circuit also prevents any popping noises when the power switch is turned on or off. A block diagram of the complete receiver is shown in Fig. 4.

FM Measurements

Figure 5 is a plot of the more important FM performance characteristics. IHF sensitivity was measured at 1.9 microvolts. With only 3 μV applied, quieting reached 50 dB, and ultimate S/N in mono reached 70 dB for all input signal levels above about 60 μV. Mono THD for strong signal levels was 0.18% at mid frequencies. Transition to stereo occurs automatically at a signal strength of 14 microvolts, a bit too high in our view, but at that signal level, S/N in stereo already exceeds 40 dB and improves to a maximum of 67 dB at stronger signal levels. There was absolutely no evidence of sub-carrier product output in stereo, thanks to the active 19 kHz and 38 kHz filters used in the multiplex section of the receiver. Best THD readings for mid-frequencies in stereo operation were around 0.24%.

Stereo FM separation measurements proved disappointing on our sample. As received, mid-frequency separation

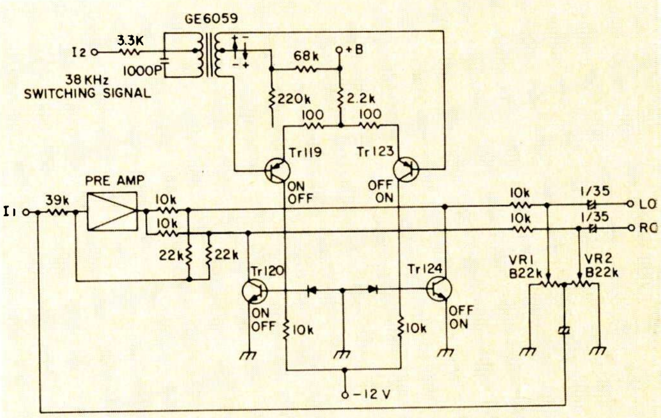


Fig. 3—Multiplex demodulator, using transistor switching circuit with negative feedback.

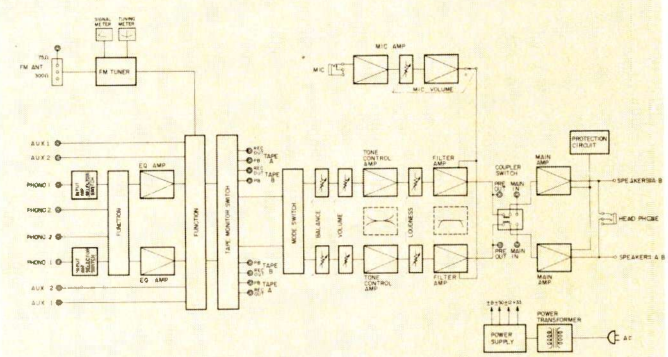


Fig. 4—Block diagram.

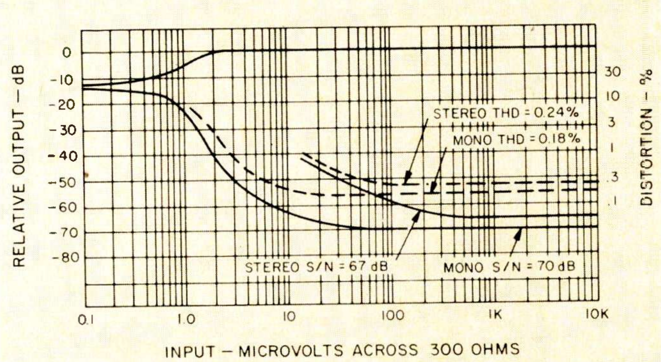


Fig. 5—FM quieting and distortion characteristics.

was only 34 dB as against the 45 dB figure claimed by the manufacturer. We have no doubt but that minor touch-up alignment of the separation controls would have resulted in the unit's living up to published specifications in this regard but we make it a practice to review products as received, since a consumer would not be likely to have the necessary equipment to perform such adjustments. Often, maintaining good stereo separation in FM is difficult because of vibration encountered during long-distance Shipping. This situation does not usually apply to units shipped to an audio dealer, as these units are bulk shipped, strapped to skids, rather than individually. Separation capability over the entire audio range is plotted in Fig. 6, along with THD figures for both mono and stereo operation. The very low reading obtained at 10 kHz in stereo (0.6%) is not of itself terribly significant, since the first harmonic of 10 kHz is 20 kHz, which would be inaudible in any case. What this low reading does convey is the virtual absence of any "beat" effects between the 19 kHz pilot signal and high frequency audio components of the program. Extreme linearity and care in design of the multiplex section is necessary to eliminate such bothersome beats, and Yamaha seems to have done this job in an outstanding manner.

Other measurements taken, but not shown graphically, include alternate channel selectivity of 80 dB as claimed, AM rejection of 60 dB (better than claimed), and capture ratio ranging from 0.85 to 1.1, depending upon signal strengths. The outstanding 110 dB figures assigned by Yamaha for image, i.f., and spurious rejection could not be confirmed by our test equipment which is limited to 100 dB capability in these specifications, but we can confirm at least 100 dB in each of those cases.

The variable muting adjustment is always a welcome feature on a quality FM product, but in this case we wished that Yamaha had seen fit to lower the threshold to something below the present 10 microvolts. At that signal level, quieting is already in excess of 60 dB and signals are quite listenable—so that it seems a shame to have to defeat the mute feature when desiring to listen to weak signals of lower than 10 μV strength. While we admit that the front-panel mute adjustment balances the aesthetics of the panel, this seldom used adjustment might better have been relegated to the rear panel. Meter action, dial calibration, and even the AFC automatic feature all worked perfectly, with a slight mis-calibration (about 200 kHz) observable near the 108 MHz end of the dial. The multipath output jacks were checked by connecting to an inexpensive audio 'scope which seemed to have enough vertical sensitivity to work well with this feature.

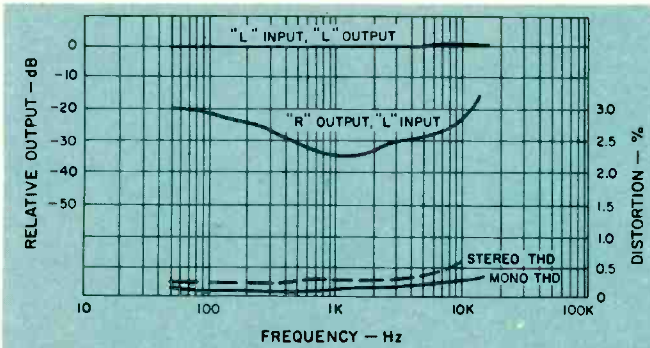


Fig. 6—Separation and distortion versus frequency.

Amplifier Measurements

Although the Yamaha CR-1000 manual and literature were prepared in advance of the date of enforcement of the new FTC power rule, it is to the manufacturer's credit that all the required power information was available, and our power output checks were conducted in accordance with the new required power statements. Thus, as can be seen from Figs. 7 and 8, power output per channel with both channels driven into 8-ohm loads exceeded the 70 watts claimed, reaching 84 watts at mid-frequencies and over 75 watts at the frequency extremes—all at less than 0.1% rated distortion. At anything less than full power output, THD and IM were about 0.03% and 0.02% respectively—figures comparable to separate components and just about as low as our audio test signal itself!

Readers should note that we have discontinued the use of "power bandwidth" measurements, as defined by the Institute of High Fidelity. Formerly, IHF power bandwidth meant the frequency extremes at which a product could produce *half* its rated power at rated distortion. The FTC has, for its part, chosen to use the term "power bandwidth" to define the frequency extremes at which the product can produce its full stated power at or below rated distortion. Since our graphic plot of Fig. 8 conveys this new information directly, and since this FTC definition of power bandwidth is more demanding than the older one, there seems to be no point

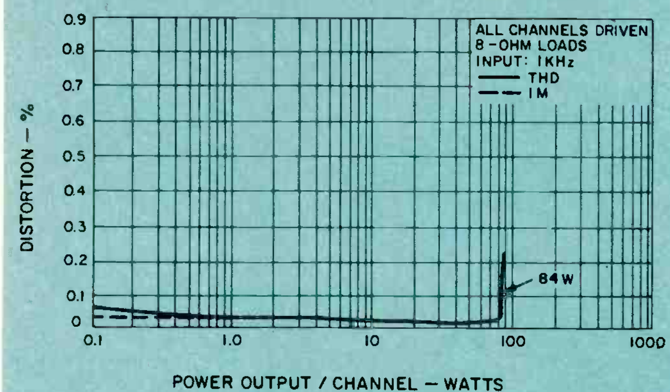


Fig. 7—Harmonic and intermodulation distortion characteristics.

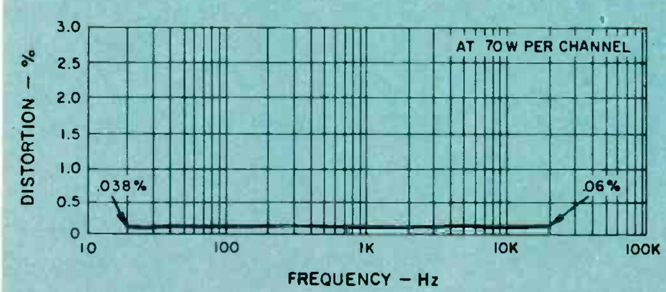


Fig. 8—Distortion versus frequency.

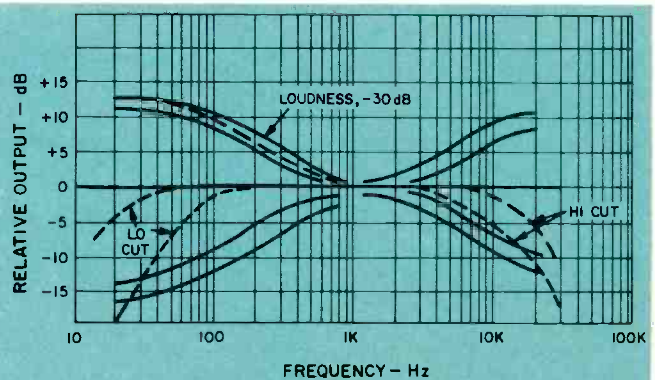
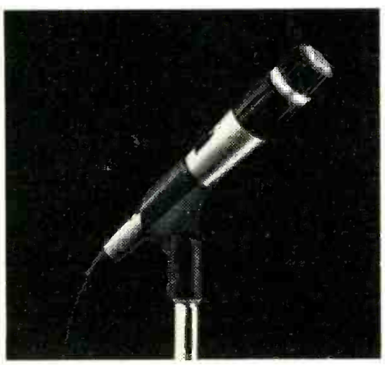


Fig. 9—Tone-control range, and filter and loudness characteristics.

Good time capsule.



Saving fleeting moments requires a quality tape recorder. But, just as a camera can be no better than its lens, tapes can be no better than the microphone. Whether it costs $200, $500—even $1,000—a tape recorder can be significantly improved by the addition of a Shure *unidirectional* microphone —a mike that can be 'aimed" so that only the target sounds will be recorded. Microphone misers who ignore this will never hear the *true* sound of recorded music lessons, parties, classes, speech therapy, sound movies and rehearsals. With Shure microphones, creating tomorrow's treasures is today's pleasure.

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in continuing to define the older limits and we shall abandon that practice effective with this review.

Variable turnover points in tone controls are desirable and usually are found only in separate components, though this innovation in the CR-1000 leaves a bit to be desired. The turnover points are somewhat too close to each other (and to the mid-frequency region) to offer very much choice. Even when the lower bass turnover and higher treble turnover are chosen, an attempt to compensate for deficiencies in response at the extremes still results in significant alteration of tonal response towards the mid-range. This is apparent in the plots of Fig. 9. The low-frequency filters, with their steep slope of 12 dB per octave, are much more effective than the 6 dB/octave hi-filters which do little more than can be accomplished with the aforementioned tone controls.

Preamplifier performance was outstanding. The high overload capability of the phono input circuits is noteworthy. A 280 millivolt capability is claimed for the 3 mV sensitivity inputs, and we actually measured a bit better than that before observing first-stage distortion. Equalization was found to be precise within the 0.2 dB claimed.

Listening and Use Tests

Above all, the Yamaha CR-1000 is a powerful receiver. Hooked up to a pair of low-efficiency speakers capable of excellent bass response when properly driven, the receiver delivered enough clean power to permit us to boldly advance the volume control without fear of reaching "limits." Several hours of high powered use produced no serious overheating of cabinetry or heat sinks—further proof that high powered listening doesn't always mean high average power output when the program material is music. Phono hum was inaudible even at these loud levels and, in fact, our measurements were a fine -70 dB referenced to 3 mV input, with no weighting curve. That would be more like the 80 dB claimed if an "A" weighting curve had been used, and that is about as low as any phono hum we have ever measured or heard using a magnetic-cartridge preamplifier circuit.

The somewhat unusual control layout of the CR-1000 takes a bit of getting used to, but that's probably because we have been so conditioned to the usual row of rotary controls and switches. Slide controls (when they are as smooth acting and easily resettable as these are) actually do afford more precise control and give the user a greater sense of precision adjustment capability. As stated at the outset, the price of the Yamaha CR-1000 is a bit high for what it does, Yamaha CR-1000 is an expensive unit, but this honestly rated, high powered, multi-featured stereo receiver will give a good many separate components a run for their money in terms of performance and control features. *Leonard Feldman*

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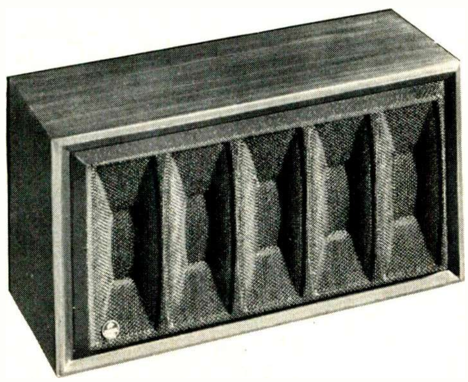
Fisher ST-425 Speaker System



MANUFACTURER'S SPECIFICATIONS

Frequency Response: 55-20,000 Hz. **Nominal Impedance:** 6-8 ohms. **Minimum Amplifier Requirements:** 15-20 watts at 8 ohms. **Woofer:** 10 in. **Tweeter:** 1-in. mylar dome. **Weight:** 25 lbs. **Dimensions:** 12¼ in. W x 10 in. D x 22½ in. H. **Price:** $89.95.

The Fisher ST-425 is a two-way loudspeaker system utilizing a 10-in. extended-range woofer, mounted in a sealed enclosure, and a 1-in. mylar-dome tweeter. The cabinet is finished on all sides in walnut vinyl and may be mounted in either a horizontal or a vertical position.

Connection to the speaker is made to well-marked terminals in a recessed cavity on the rear of the cabinet. Depressing a lever adjacent to each terminal exposes the metal opening for speaker lead insertion; releasing the lever clamps the wire firmly. The recessed panel allows for flush wall mounting without danger of shorting wires or damaging the connector. A three-position treble-control switch is also placed in the recessed panel for increasing or decreasing the tweeter response from its nominal setting. The switch positions are marked with a plus sign, zero, and a minus sign to indicate treble boost, normal, and treble cut respectively.

At 25 lbs, this enclosure may easily be placed on most any shelf without strain. But with a smooth finish on all sides, this reviewer recommends that for safety's sake either a mechanical barrier or friction mounting base be provided if the unit is mounted on a smooth shelf and cord-pulling toddlers are in the house.

A good set of instructions accompany the speakers and they give excellent guidance on setup and adjustment. An amazing thing, in today's world where many manufacturers are too busy for customer relations, is a Fisher offer extended in the instructions. If you have trouble in placing the speakers for optimum sound, an invitation is extended to write Fisher's Customer Relations Department, enclosing a sketch of the room containing the installation, an indication of the furniture (including draperies) in the room, and the place where you normally sit. Fisher states that you will receive a prompt and authoritative reply concerning suggested operation.

An original owner, 5-year warranty covering parts and labor is suplied with the Fisher ST-425.

Technical Measurements

The measured impedance of the Fisher ST-425 is shown in Fig. 1. The overall characteristic of this curve conforms to

(Continued on page 56)

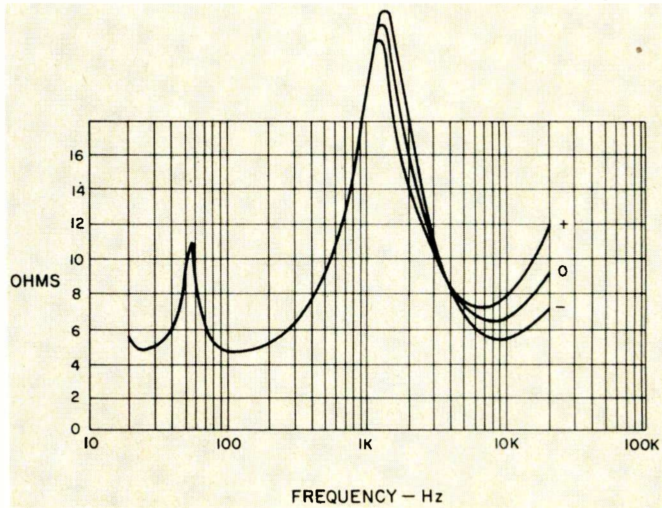
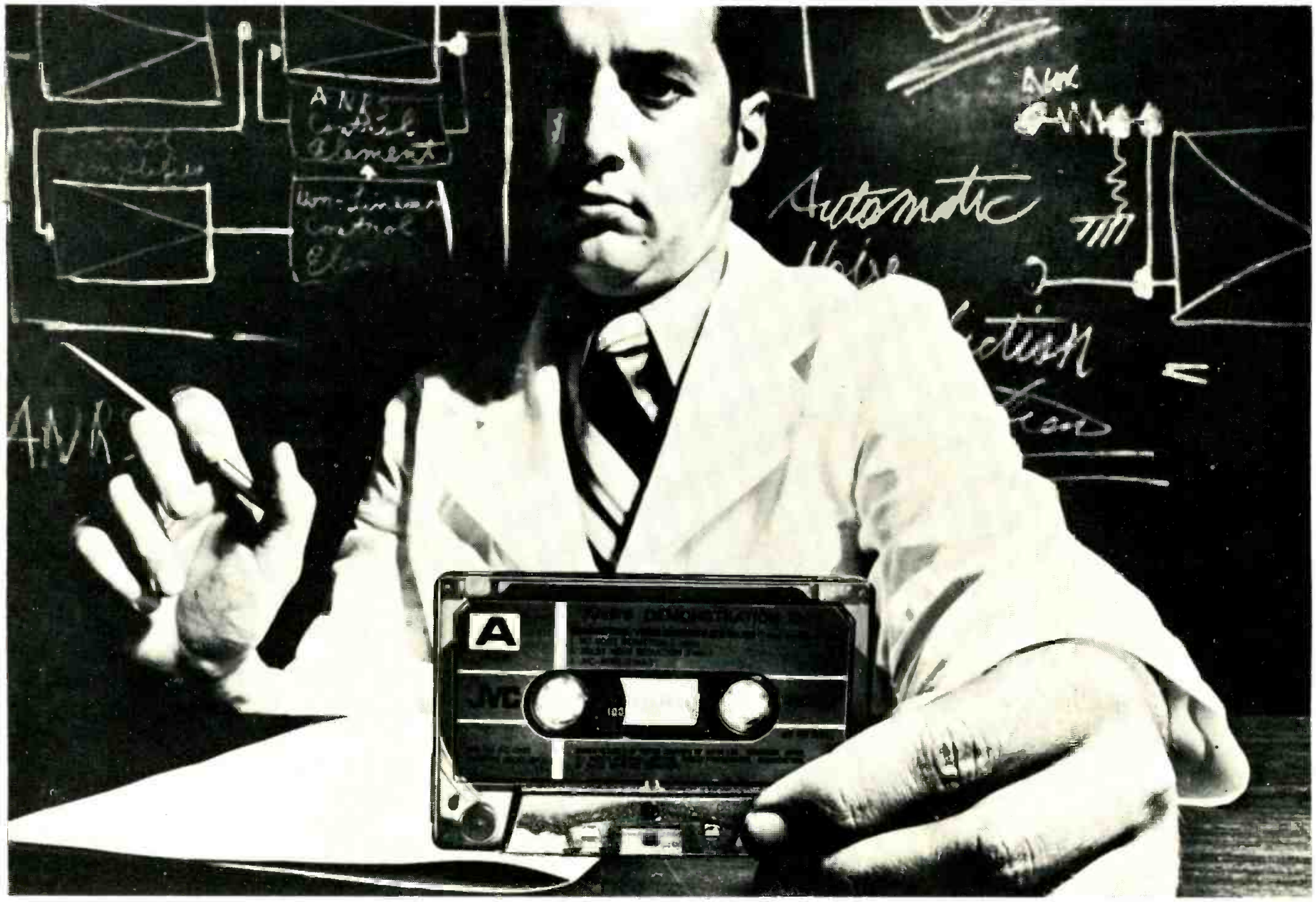


Fig. 1—Impedance.

the truth about noise reduction



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Before you invest . . . find The Truth About Noise Reduction Systems . . . write for an informative brochure on ANRS to: JVC America, Inc., 50-35 56th Road, Maspeth, N.Y. 11378. Better yet, ask to hear a JVC Cassette Deck with ANRS. For the name of your nearest JVC Dealer, call this new Toll Free Number: 800-221-7502 (In New York call (212) 392-7100.

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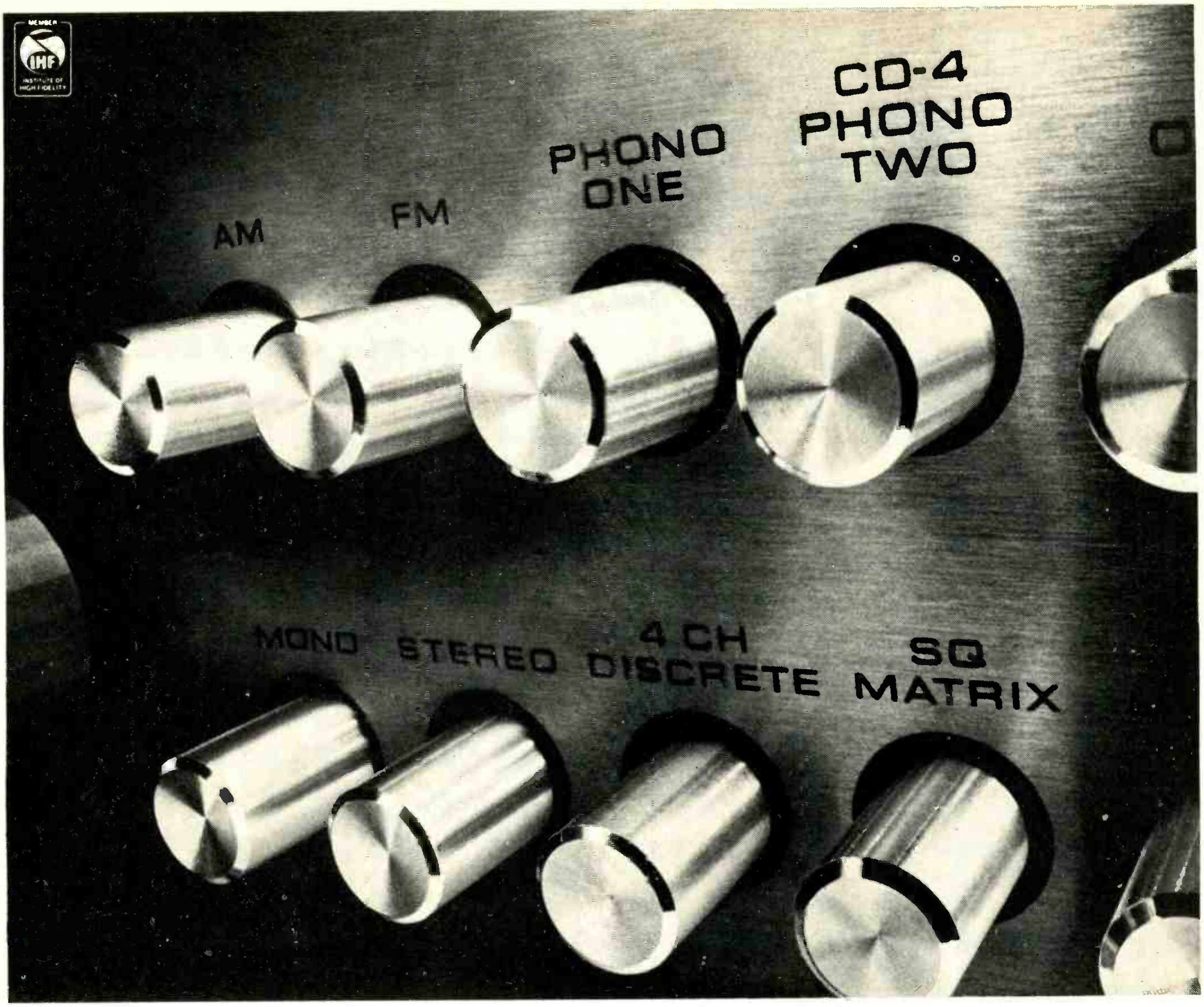

Now Sylvania has everything.

Our RQ3748 four-channel receiver had just about everything. Which is why *Stereo Review** called it "powerful," "superb," "impressive," "well designed." But good as it was, the RQ3748 didn't have built-in CD-4.

True, it had mono, stereo, and SQ matrix modes. True, it delivered 50 watts per channel, min. RMS at 8 ohms from 20Hz to 20KHz with no more than 0.5% total harmonic distortion (all channels fully driven to rated power). Or 125 watts per channel min. RMS in stereo bridge. True, it had exceptional FM sensitivity . . . 1.9 μV (IHF). And an outstanding 67 db signal to noise ratio. True, it had all kinds of other features, including a highly versatile jack panel. But it didn't have built-in CD-4.

Well, now it does.

We took the RQ3748 and built in a CD-4 demodulator. In addition, we included a separate phono input and pre-amp for magnetic stereo cartridges. That way you enjoy true discrete four-channel without sacrificing maximum performance in stereo or SQ matrix.

The result is a receiver that has everything. The new Sylvania RQ4748.

Check it out with your Sylvania dealer. After all, now that we have everything, it's time you seriously considered having us.

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GTE SYLVANIA

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(Continued from page 48)
what should be expected from a two-way sealed-enclosure system. Bass impedance resonance occurs slightly below 60 Hz. The minimum impedance is just under 5 ohms. Consequently this system should be treated as though it were a 4-ohm speaker when connection is made to the power amplifier, i.e. other speakers should not be paralleled with the Fisher and reasonably heavy-gauge speaker wire should be used for hookup.

Curves are plotted for each of the three tweeter-level positions. A small amount of interaction of impedance peak with control setting is seen at around 1,300 Hz, but this is small and should not cause response difficulties.

Figure 2 shows the measured one-meter sound pressure amplitude response. Two plots are shown. The complete response, marked on-axis, is a measurement made directly in front of the enclosure. The second plot, labelled 30 degrees left, is a measurement made for an off-axis position corresponding to the Fisher used as a left channel stereo speaker. An interesting point is that the Fisher has a smoother frequency response off-axis. In making these measurements the enclosure was mounted with its longer axis vertical, in which case the instructions on the back of the enclosure are in a normal erect position. The frequency response for an off-axis position with the enclosure long axis mounted horizontally is not as smooth as with a vertical mounting, due to the wider horizontal spacing between woofer and tweeter which occurs in horizontal placement. Woofer response is smooth and free of irregularities down to 60 Hz where it rolls off smoothly, approaching an ultimate slope of 12 dB per octave.

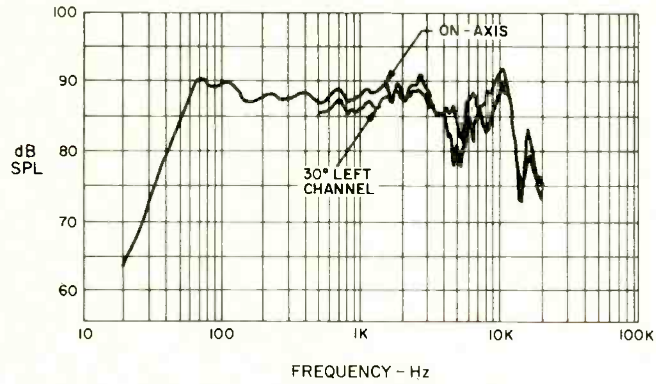

Fig. 2—One-meter anechoic SPL with one-watt drive for on-axis and 30-degree left channel positions.

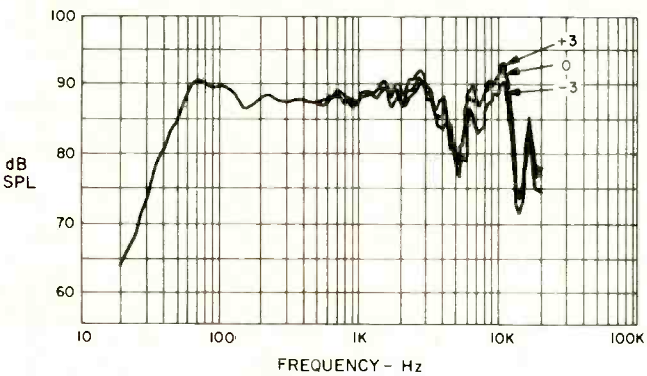

Fig. 3—One-meter anechoic SPL with one-watt drive measured on-axis with grille on and for all three tweeter level positions.

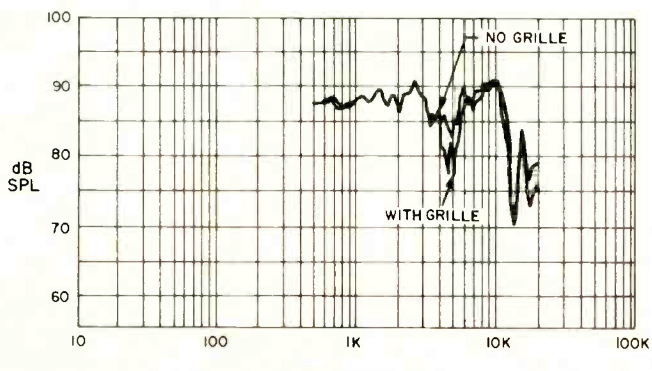

Fig. 4—One-meter on-axis response with and without grille.

(Editor's Note: Bass performance is essentially a series of design compromises between box size, efficiency, and the desired cutoff frequency, with several other factors playing relatively minor parts. Thus, a 60-Hz rolloff point is not unusual for a correctly aligned, closed-box system in this price class.

The response in Fig. 2 is plotted for the normal tweeter level position. Figure 3 shows the on-axis measured response for each of the three tweeter-control positions. The difference in tweeter-level settings is slight and would be noticeable only on very "bright" program material. The dip in response at around 5 kHz is due primarily to the perforated grille and is noticeable in listening tests. This is shown in Fig. 4 where measurement is made both with and without the sculptured appearance grille. It is this reviewer's opinion that, if it is cosmetically acceptable, the grille should be removed or replaced since it causes a deterioration in sound. As a point of clarification, this grille is not a foam plastic material, but a thin molded membrane with a large number of perforated openings for free sound passage.

In the measured response, the dip at 12 kHz is due to the protective perforated metal dome which is placed over the tweeter. This dome cannot, and should not, be removed. But the re-emergence of acoustic response above 15 kHz to beyond audibility may give a "peaky" sound in some wide range material.

Figure 5 is the measured phase response. The acoustic transition between woofer and tweeter appears to occur between 4 and 5 kHz, and this is also why the grille has its most noticeable affect in that range. For a direct on-axis measurement the acoustic position above 5 kHz is approximately one inch in front of the acoustic position above 5 kHz is below 4 kHz. The phase measurement is therefore shown in two segments, one corrected for the average acoustic position above 5 kHz and tied to the right-hand angle scale, and the other corrected for the average position below 4 kHz and associated with the left-hand calibration.

The phase transition is very smooth in crossover. Both woofer and tweeter are properly phased. The only substan-

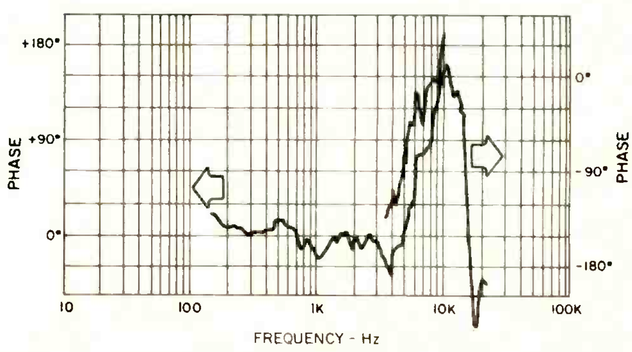

Fig. 5—One-meter phase response.

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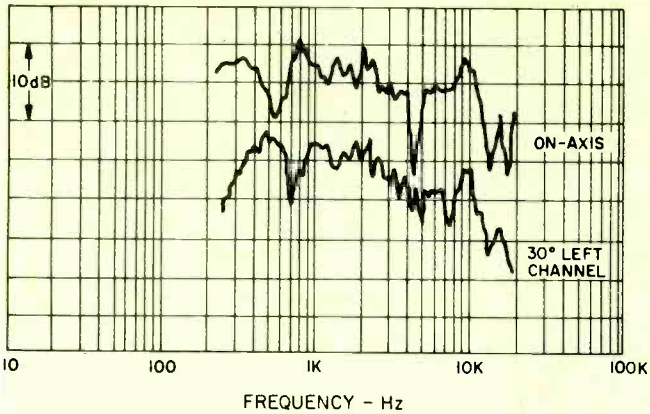

Fig. 6—Three-meter room response.

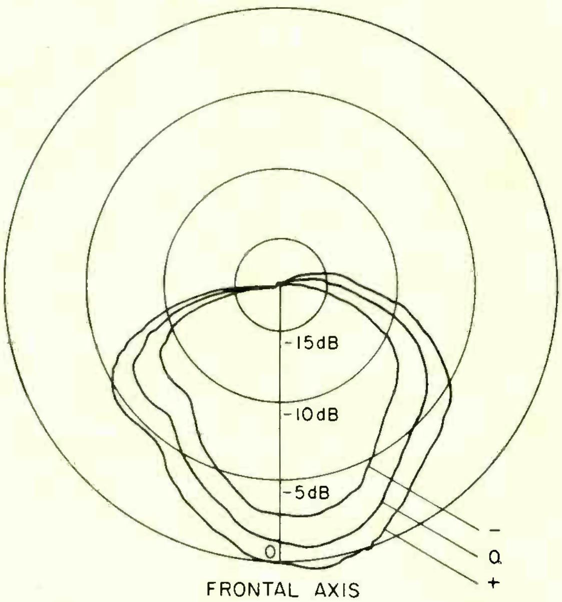

Fig. 7—Horizontal polar-energy response for three tweeter level positions.

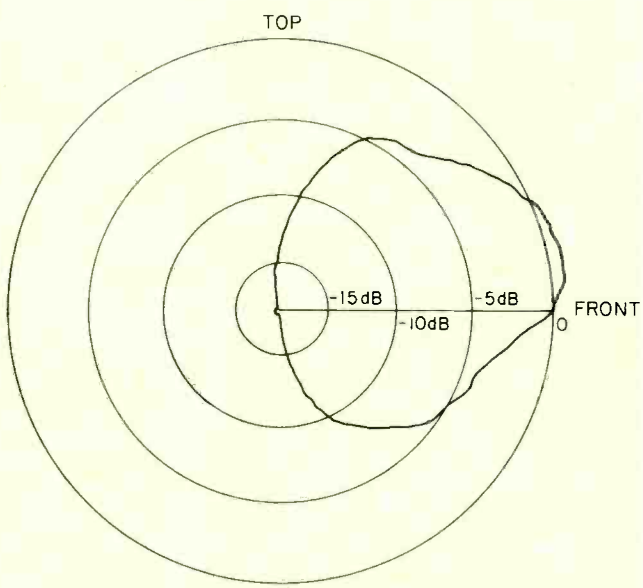

Fig. 8—Vertical polar-energy response for maximum tweeter level position.

tial non-minimum phase portions of the response are around 2 - 4 kHz and above 11 kHz.

The three-meter room response, which corresponds more nearly with how a speaker sounds in the listening room than does the anechoic response, is shown in Fig. 6 for the on-axis and a 30-degree left channel stereo position. The curves are displaced 10 dB for clarity. The speakers were mounted with the long axis vertical and were placed against a wall one meter above a carpeted floor. Measurement was then made of the frequency response for the first 10 milliseconds of early sound. Substantial ceiling reflections were observed for this typical room configuration. The on-axis 5 kHz dip observed anechoically was present in the room response but was substantially filled up with floor and ceiling scatter. The response for stereo listening rolls off at an average slope of around 3 dB per octave above 2 kHz. This can be brought back up with a moderate treble boost with conventional tone controls. The room response coincides with the anechoic measurement in that the overall response is smoother off-axis than directly in front of the speaker. For a more accurate stereo image, the speaker should be left flat against the wall and not rotated toward the listening area. The energy peak at around 10 kHz may tend to cause a "spitty" response if too much treble equalization is used.

Figure 7 is the horizontal polar energy response of the Fisher measured for each of the three tweeter positions. The change in average energy between positions is less than 2 dB, which means a subtle change in tonal balance. For narrow-base stereo installation the sound should be well balanced, but extremely wide angular separation should be avoided since the left channel speaker will be "hotter" than the right channel. If a very wide stereo stage is unavoidable, the speakers should be angled slightly toward the listening area.

Figure 8 is the vertical polar energy response for one of the tweeter positions. The other tweeter positions are very similar. A strong ceiling reflection can be expected for the Fisher mounted in the normal configuration with the tweeter above the woofer. If this causes an unpleasantly bright response in a room, or if the speaker must be mounted close to the ceiling, then this response indicates that the speaker should be inverted so as to launch its high frequency energy downward. While the Fisher is finished so as to be mounted either horizontally or vertically, this plot suggests that a vertical mounting is definitely preferred for better stereo imagery. In a very live room the speaker should be mounted at or slightly below a usual listening position of one meter.

Harmonic distortion for the tones E_1 (41 Hz), A_2 (110 Hz), and A_4 (440 Hz) is shown in Fig. 9. Surprisingly, the lowest average distortion occurred for A_2, rather than A_4, and in fact, the A_2 distortion was extremely low throughout the test range. The intermodulation of A_4 (440 Hz) by E_1 (41 Hz) is shown in Fig. 10. Frequencies higher than about 60 Hz are handled with very much lower distortion than the harmonic and intermodulation distortion measurements indicate, though distortion will occur for very low bass signals. The nature of the IM was that of a combined amplitude and phase modulation characteristic of A_4 up to about 10 watts, then the behavior assumed an amplitude modulation characteristic above that level.

The crescendo-handling properties of the Fisher ST-425 are very good. The addition of a wide-band crescendo signal at an average level 20 dB greater than a 440 Hz inner musical voice, reduces that voice by less than one tenth decibel for any total power level up to clipping on most super power amplifiers. The Fisher has a slight increase of acoustic gain with drive signal.

Figure 11 is the energy-time response measured at one meter. This is the total energy density of the sound due to a

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perfect impulse of electrical energy applied to the speaker terminals. The first sound from the tweeter arrives at 2.9 milliseconds on this scale and is joined within 0.08 milliseconds by the woofer signal which "fills in" the remaining 0.1 millisecond. The reverberant scatter with about a 0.2 millisecond period, due to adjacent structure including grille, rapidly drops at around 7 dB per reflection to be insignificant after one millisecond. An enclosure diffraction signal one millisecond after first sound arrival is the only other significant aberration to impulse response. Transient response should be moderately good with the Fisher "as is." Removing the grille will help this response somewhat.

Listening Test

The speaker mounting position used for this evaluation was flat against a wall and centered one meter above the floor. Separation between speakers was then adjusted to give about a 60-degree total stereo angle.

The overall impression of tonal balance without equalization was that the high frequencies were good but slightly down, there was a relatively smooth but shallow-dipped upper midrange, the units had a small mid-bass bump, and the extreme low bass was missing.

The best high frequency sound, to this reviewer, was obtained with the tweeter level in its zero position and the top end lifted by pre-amp tone control. The effect of the tweeter control was slight so as to be inaudible on anything but the widest range material. The best lower frequency balance was obtained by putting in a small bass drop in the pre-amp (Marantz Model 33). While these touch-ups made low organ pedal notes a bit anemic and caused usually excellent low bass (Percussion Music, Nonesuch H-71291) to droop, the overall balance seemed more accurate. After this touch-up of response, we got down to serious listening.

The Fisher ST-425 can handle wide-range signals at very high levels. This cleanliness of response, coupled with a relatively low efficiency, means that you are more likely to run out of amplifier than you are of running out of speaker, a situation which can cause accidental damage to the speakers. There is a greater danger of burning out such low-efficiency speakers with a low-power amplifier than with a high-power amplifier because the low-power unit driven well into clipping will present a much higher average power to the speaker, at a given subjective loudness, than a super power amplifier capable of readily passing the peaks. Thus, if you really like your music *loud*, I recommend that you fuse the speaker leads with fast-acting fuses rated no larger than 2 amps. This will not only protect the woofer from overload, but will partially protect the tweeter from the heating effect of distortion fragments pushed up into its frequency range. In any case, the Fisher will need a power amplifier capable of 50 watts or more peak capability in order to get a brisk level in a moderately draped room. (Editor's Note: None of this explanation of the Fisher's ability to handle powerful, broad-band signals is meant to demean the ST-425, but rather to protect it from accidental damage in a not uncommon usage situation.)

Human voice was moderately accurate, but mixed choral groups appeared to be moved back in the stereo image. Sibilants were well articulated. The transient response of percussion instruments is excellent, though the extreme high frequencies seemed down even with treble equalization. I have never been completely pleased with the accuracy of any loudspeaker's piano reproduction—that's why I use it for test. The subjective impression of piano on the ST-425 was a lack of body and depth, and full piano

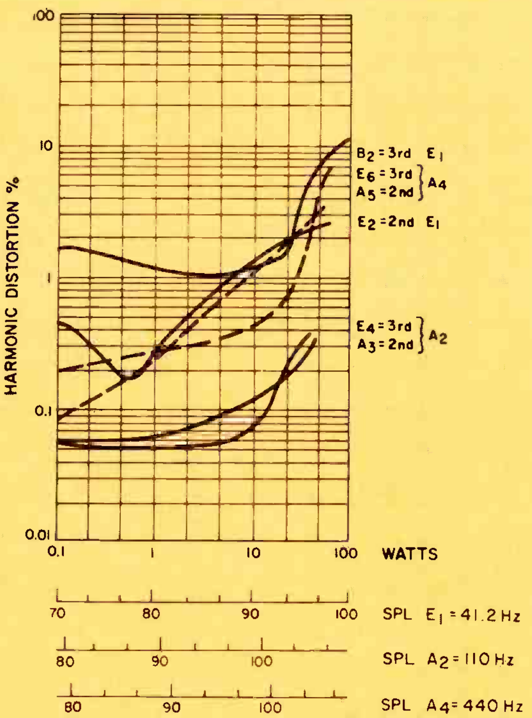

Fig. 9—Harmonic distortion for the tones E_1 (41 Hz), A_2 (110 Hz), and A_4 (440 Hz).

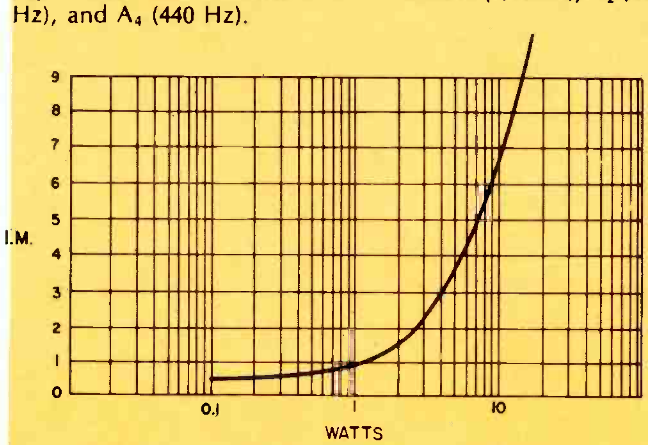

Fig. 10—Measured intermodulation of A_4 (440 Hz) by E_1 (41 Hz) mixed 1:1.

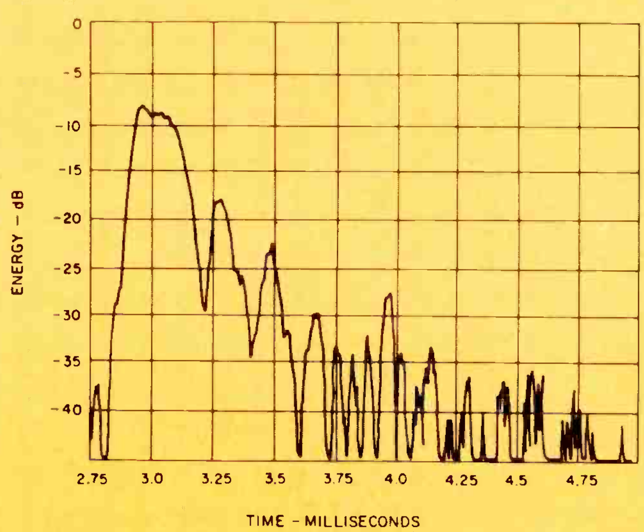

Fig. 11—Energy-time response at one meter.

chords had an analytically accurate overtone structure, though fundamental tones appeared a bit suppressed in relative level when the speakers were equalized.

Overall stereo imagery was rather good with no requirement for the listener to sit on a calibrated chalk mark to hear good stereo, as is often the case with speakers in this low-price range.

The ability of the Fisher to be driven at high levels without "crunch" allows for a more natural reproduction of rock, and the smooth midrange response allows for extended listening without listener fatigue. In addition, the slight natural emphasis of mid-bass material which the unequalized Fisher gives when mounted against a wall may well prove very pleasing to those who prefer this sound in rock.

Richard C. Heyser

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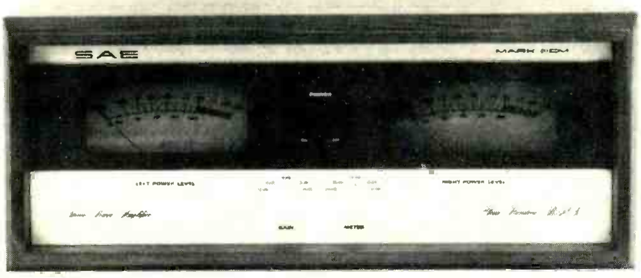
SAE Mk IIICM Basic Amplifier



MANUFACTURER'S SPECIFICATIONS

Power Output: 200 watts per channel, both channels driven into 8-ohm loads at any frequency from 20 Hz to 20 kHz with less than 0.1 percent total harmonic distortion; 300 watts per channel, both channels driven into 4-ohm loads at any frequency from 20 Hz to 20 kHz with less than 0.1 percent total harmonic distortion. **Intermodulation Distortion:** 0.05 percent at rated power output. **Frequency Response:** 1 Hz to 100 kHz ± 1 dB, 1 watt output. **Hum and Noise:** 100 dB below rated output. **Damping Factor:** 150. **Input Sensitivity:** 1.2 V rms for rated output. **Dimensions:** 17 in. W x 13½ in. D x 5¾ in. H. **Weight:** 60 lbs. **Price:** $1,000.00, with fan.

The SAE MK-IIICM is an attractive, well-made unit of unusual design. A MK-IIIC version is available with identical performance but without the front-panel meters. PC construction is used throughout, keeping the number of actual wires to a minimum. The bulk of the circuitry is on two boards which are an integral part of the heat sink which SAE calls their "UNISINK" concept. The heat sink works by heat wires to a minimum. The bulk of the circuitry is on two boards which are an integral part of the heat sink which SAE calls their "UNISINK" concept. The heat sink works by heat expansion rather than convection. Hot air, generated at the base of the fins, expands and thus forces itself upwards creating its own chimney effect. Outside cool air is sucked in from the ends of the sink. The front panel has a five position gain-control switch, a five position meter-sensitivity switch, a dual-pushbutton power switch, and two meters with VU and power scales calibrated for 8-ohm loads. As meters go, these are most attractive, and having a power scale calibrated in watts is more meaningful than a VU scale alone.

Circuit Description

The circuit of the MK-IIICM is different from most high-power amplifiers in two respects. It is complementary push-pull from input to output, and the output stage uses series connected epi-base devices to attain the necessary safe-operating area. The result of this design philosophy allows the amplifier to drive resistive and reactive loads with equal ability in both the plus and minus directions. The safe area of the output stage is sufficient to drive a pure reactive 8-ohm load to 250 VA (volt-amps) without any limiting—a feat that few other solid-state power amps can achieve. A block diagram of the circuit is shown in Fig. 3, along with a circuit schematic, Fig. 4. Q3&4 form a NPN differential input amplifier whose output is coupled to the emitter of Q1, a common base stage that is acting as a level translator and relieves Q3&4 from having to stand off the 75-volt supply. The output of Q1 drives the Darlington-connected, common-emitter, inverting predriver stage pair, Q7&8. In a similar manner, transistors Q2, 5, 6, 8, & 10 are also driven from the input, and form a mirror-image circuit, ending up with a signal at Q10's collector that is the same phase and amplitude as the signal at the collector of Q9, but with even-order harmonic distortion products in opposite phase. These collectors are tied together through the bias regulator, which provides the necessary turn-on bias and temperature tracking for the output stage. Connection of the predriver collectors together is equivilent to standard push-pull operation in that signal currents are additive and even-order distortion cancels out (assuming circuit balance). The end result is a circuit that can drive the output stage in a symetrical manner with equal ease in the plus *and* minus directions.

The output stage itself amounts to a Darlington-connected complementary emitter-follower, with the composite output devices being a series connection of three Darlington power transistors. Q13&13 are the driver tran-

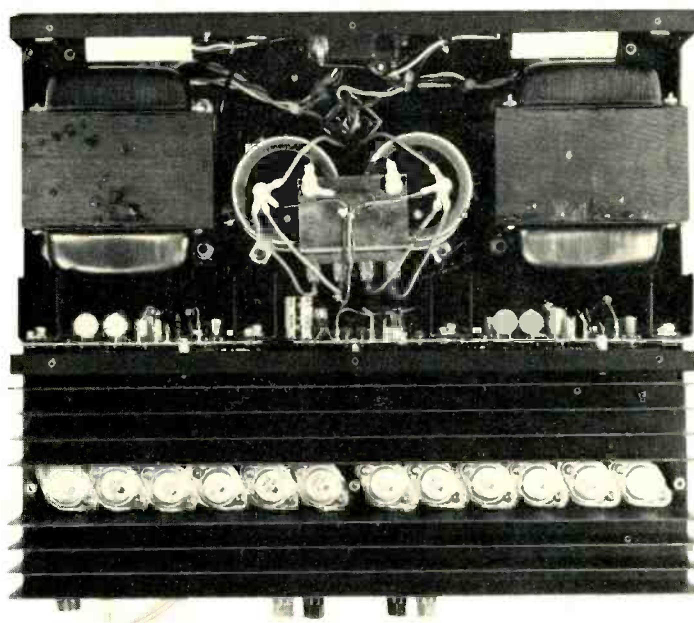


Fig. 1—Internal view.

Fig. 2—Back panel view.

sistors which are operated class A, and have their emitters tied together with a 62-ohm resistor. The composite output transistors, Q15, 16, 17 for the plus half cycle and Q18, 19, & 20 for the minus half cycle, are operated in class AB with a substantial idling current. Q17 is the plus half-cycle, control output transistor and is driven directly from driver Q13. The bases of Q16&17 are biased with voltage dividers from the plus supply to the emitter of Q17. These dividers cause the supply voltage to be divided equally across the three series-connected devices both under quiescent and signal conditions. Similar circuit action occurs for the negative half-cycle, composite output transistor, Q18,19,&20. The 62-ohm resistor connecting the bases of the control output transistors Q17&18 insures their rapid turnoff at high frequencies, as the *on* base is actively pulled in the *off* direction through the resistor as the opposite base is being turned *on*. This is in contrast to the usual quasi-complementary circuit where the stored base charge of the *on* device is passively discharged through the resistors connected from base to emitter of the output devices. This feature results in lower distortion and better efficiency at high frequencies due to the lack of common mode conduction where both devices are *on* for a fraction of the signal cycle. Another point of interest in the output stage is the use of rather large (0.39 ohm) emitter degeneration resistors, R39&40, for a power amp of this output power. In general, the larger these resistors, the more thermally stable the output-stage quiescent current becomes. However, the larger the resistors, the greater the power loss in them at high output powers. The MK-IIICM solves the power loss problem by shunting the resistors with Shottky rectifiers which are expremely fast and have a foward voltage drop of less than 0.6 volt at 20 amp but are essentially out of the circuit at quiescent conditions.

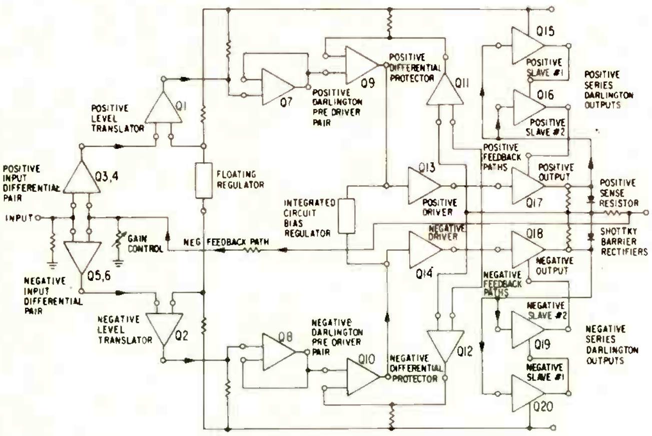


Fig. 3—Block diagram of output stage.

Protection circuitry for the output stage is of the volt-amp (VI) type, where both load voltage and current are sensed. Whenever the voltage and current levels are considered excessive, protection control transistors Q11 or Q12 will be turned on increasing the voltage drop across the emitter resistors of the predriver Q9 or Q10. This action will, in effect, reduce the conduction of the predriver affected and thus reduce the conduction of the corresponding output transistor. Further protection for the load is in the form of a circuit that controls a relay with contacts in series with the two hot output lines. This circuit provides a turn-on/off time delay upon application and removal of power to prevent thumps from getting to the speakers. Additionally, the circuit monitors the amplifier outputs for d.c., low-frequency subsonic energy and high-frequency supersonic content, and opens the relay when these factors are considered unsafe for the load. The circuit does not latch or stay on for an excessive time when triggered, recovering almost instantly except when the unsafe condition persists wherein the circuit "toggles" on and off until the unsafe condition is removed. A thermal output is mounted on the heat sink and is wired in series with the coil of the speaker relay. If heat-sink temperature rises above the cutout set point, the speaker relay is opened but power remains on in the amplifier. Protection of the amplifier and power supply in case of internal failure is provided by four 6-amp fuses in series with the power feeds to each channel.

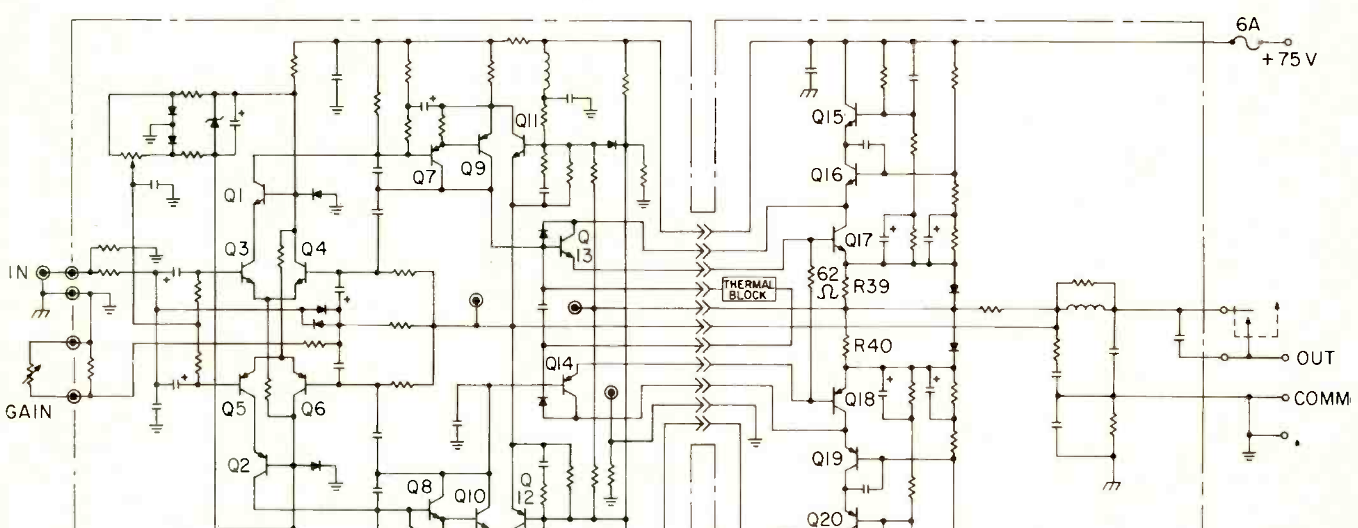


Fig. 4—Circuit schematic.

The input level control for this amplifier is in the form of a five-position 3-dB/step attenuator which does not control input attenuation per se but adjusts the shunt feedback resistor in the overall feedback loop of the amplifier. This results in controlling the closed loop gain instead. This permits essentially constant input resistance as a function of gain setting and eliminates the need for an input gain control buffer amplifier.

Meter circuit sensitivity is adjustable in 6 dB steps from 0 to −24 dB. Corresponding sine-wave power values into 8 ohms at 0 dB on the meters are: 200, 50, 12.5, 3.12, and 0.78 watts respectively. The meters are underdamped compared to standard VU meter ballistics and therefore respond more rapidly to power level changes.

Power-supply circuitry consists of two power transformers with secondaries wired in series to form a center-tapped source for the full wave rectifiers that generate plus and minus 75 V d.c. Filter capacitors are 10,000 μF at 80 volts.

Listening Tests

The MK - IIICM was compared to a number of other power amplifiers over a several month period. The impressions were that it was quite clean and defined and generally sounded as good or better than the commercial amplifiers on hand during these listening tests. On a more absolute basis, when compared to the best amplifiers that this reviewer has ever heard which include several modified commercial products and a recently introduced commercial amplifier, the MK-IIICM was found to have relatively more irritation and edginess but was comparable in terms of definition and low-end solidity.

Measurements

The gain of the MK-IIICM is adjustable in 3 dB steps from 0 dB to −12 dB. Input sensitivity is speced at 1.5 V input for 200 watt output into 8 ohms. This would be a gain of 26.7/1 or 28.5 dB. Gain in both channels was measured at 1 kHz into a 8-ohm load as a function of the gain-control switch position with results shown in Table 1.

Table 1—Gain in both channels of the Mk-IIICM.

Gain Setting	Gain, A	dB Difference
0	26.7x28.53 dB	
−3	18.8x25.48 dB	3.05
−6	13.0x22.28 dB	3.21
−9	9.41x19.47 dB	2.8
−12	6.63x16.43 dB	3.04
	Gain B	
0	26.8x28.56 dB	
−3	19.0x25.58 dB	2.98
−6	13.0x22.28 dB	3.3
−9	9.45x19.51 dB	2.77
−12	6.68x16.50 dB	3.01

Since this gain control method varies the amount of negative feedback in the amplifier, most measured parameters like frequency response, rise time, and distortion would tend to be better at the −12 dB position because of 12 dB more feedback. Accordingly, to represent worst case, all measurements were made at the 0 dB (max) gain position unless otherwise noted.

IM distortion is shown in Fig. 5 for a 8-ohm load, both channels driven. The dashed curve is the sum of the 5th and 7th harmonics in the IM residue and is representative of the more irritating components of the IM characteristic. There is no rise in IM at low levels in this amp and the sum of 5th and

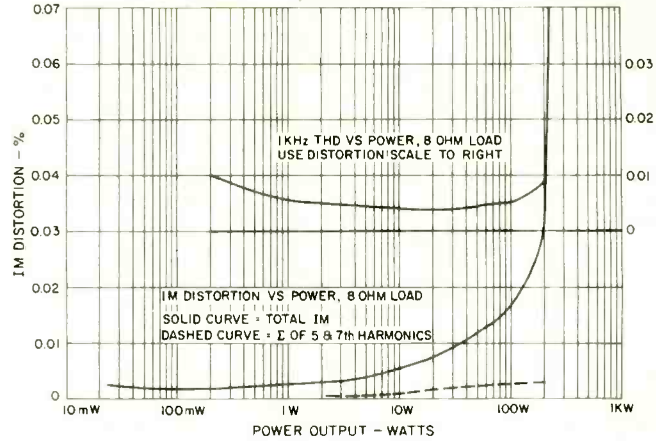


Fig. 5—Distortion versus power output.

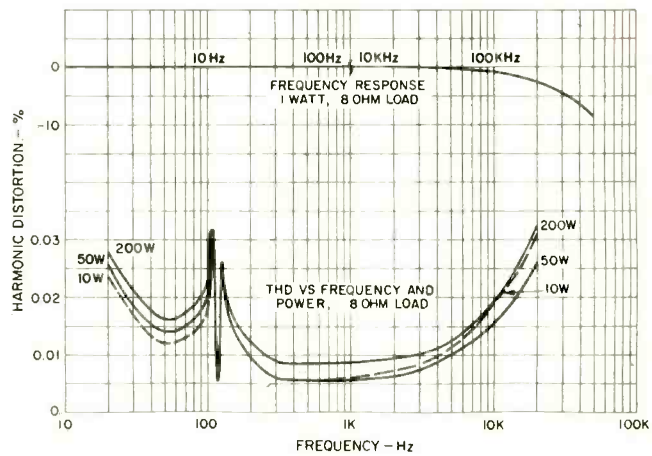


Fig. 6—Frequency response, and THD versus frequency for three power levels. Note break in upper frequency response scale.

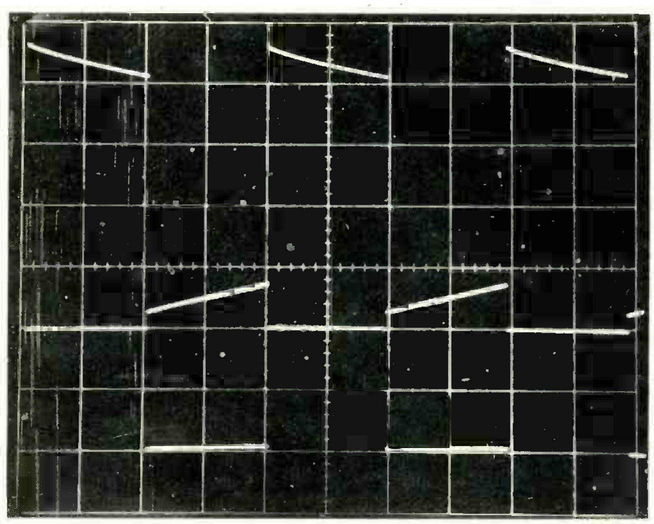


Fig. 7—50 Hz square-wave response at two power levels: top, approx. 200 watts, 8 ohms, 20 V/cm, 5 mS/cm; bottom, 3.12 watts, 8 ohms, 5 V/cm, 5 mS/cm.

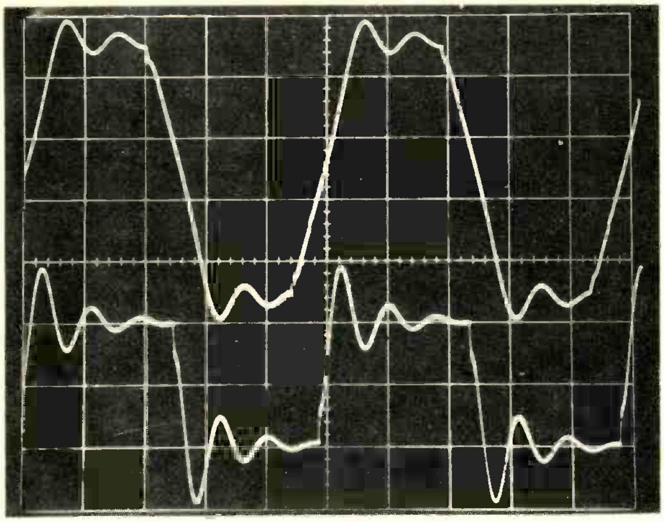


Fig. 8—10-kHz square-wave response at two power levels: top, approx. 140 VA, 2 μF, 20 V/cm, 20 μS/cm; bottom, approx. 2.5 VA, 2 μF; 5 V/cm, 20 μS/cm.

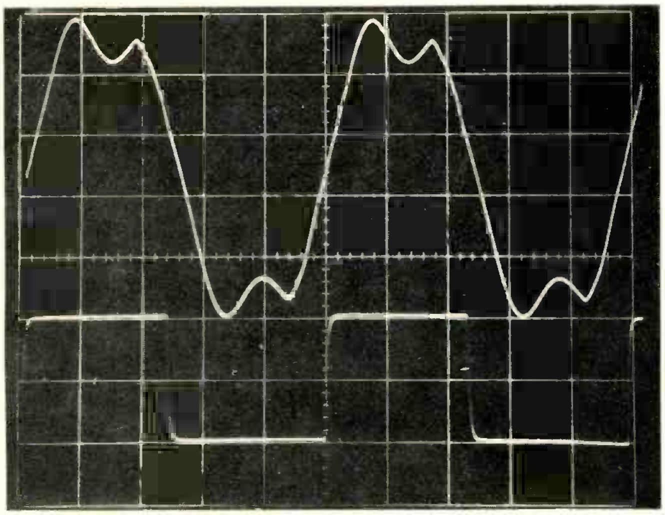


Figure 9—10- and 20-kHz square-wave response: top, approx. 140 VA output, 20 kHz, 1 μF, 20 V/cm, 10 μS/cm; bottom, 3.12 watts, 10 kHz, 8 ohms; 5 V/cm, 20 μS/cm.

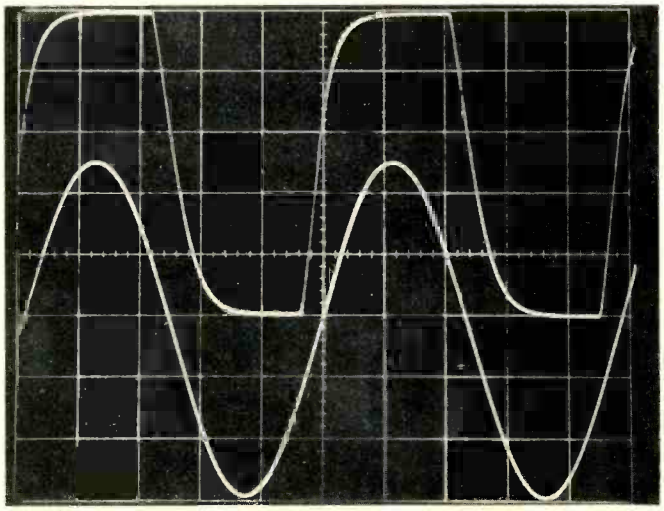


Fig. 10—20-kHz square-wave and sine-wave response: top, 230 watt output, 8 ohms, 20 V/cm, 10 μS/cm; bottom, 200 VA output, 0.5 percent THD, 1 μF; 20 V/cm, 10 μS/cm.

7th harmonics becomes unmeasureable below approximately two watts. From a measurement standpoint, these measurements are superlative. Harmonic distortion vs power at 1 kHz with 8-ohm loads is shown in Fig. 5 also. Harmonic distortion was measured with a Sound Technology 1700A, a new THD measuring set that is very good and fast to use. THD vs frequency and power is shown in Fig. 6. A word of explanation is order about the variation in THD near 120 Hz. In this amplifier and others to varying degrees, a beat frequency is generated—a first-order difference tone—between the test frequency and the 120 Hz power-supply ripple on the amp's power-supply lines. The difference tone seems to be the strongest when the test tone is nearest to 120 Hz. The value of the peak on either side of 120 Hz might be higher but would be limited in reading by the low-end subsonic response of the THD analyzer. The THD meter is reading the harmonics of the test signal plus the difference tone with the magnitude of the difference tone being dominant near 120 Hz. The audible effects of this phenomena might be spurious low-frequency thumps and tones when the musical spectra was strong near 120 Hz if the magnitude was large enough. It is doubtful that the magnitude exhibited here would be audible.

Frequency response at one watt into 8 ohms is shown in Fig. 6. Of interest is the superior low-frequency response, which is better than most a.c. coupled power amps. The MK-IIICM is a.c. coupled at the input and has several other LF rolloffs, the dominant one being in the overall feedback loop. The time constants are large enough to allow an extended LF response at the several watt power level. The 50-Hz square-wave response is shown in Fig. 7 for two power levels. The 10 V P-P level shows very little droop, which would be expected from the response shown in Fig. 6. The high-level response near full power exhibits more droop and is actually happening as a blown up 10 V P-P waveform at the same scope trace size as the one shown at high level has much less droop. This suggests that the LF amplitude and phase response is a function of signal level. This phenomena will be checked more closely on other amps and shown in future reviews where the effect is found to be significant.

The high-frequency square-wave response for a 10 kHz 10 V P-P level is shown in Figs. 8 & 9 for a 2 μF and 8-ohm load. An idea of the high-frequency capability of this amplifier can be seen in Figs. 8, 9 and 10. The upper trace of Fig. 10 shows the waveshape of a 20 kHz square wave at 100 V P-P into 8 ohm at a power level of about 230 watts. The lower trace shows a 200 VA sine wave into a 8-ohm reactive load at 20 kHz. The upper traces of Figs. 8 & 9 show the response to a 10 and 20 kHz square wave into 2 and 1 μF, respectively, which are both 8-ohm reactive loads at the fundamental frequencies indicated. The power levels shown are at about 140-150 VA.

The ringing on square waves with capacitive loads is usually caused by the low-pass filter formed by the parallel RL network that most solid-state amps have in series with the output leads and the capacitive load itself. Most manufacturers use such a network to prevent too low a load impedance at high frequencies with capacitive loads on the amplifier itself. Generally, the response inside the amplifier ahead of the RL network is relatively free of ringing and the ringing at the output is a result of protecting the amplifier with the RL network. With the above in mind, the square-wave behaviour of this amp into reactive loads is excellent and plus-and-minus half-cycle symmetry is evident in the waveforms. The specs for this amplifier state that it is not slew-rate limited in the audio range and that the full power rise time of a 20 kHz square wave is 2.5 μS. The amp is not slew-rate limited for a sine wave at full power up to 20kHz but some evidence of slew-rate limiting is present with square waves into resistive and reactive loads. A linear network will have a constant absolute value of rise time independent of level where a slew-rate-limited active circuit will have a rise time that increases with increasing level. Most transistor power amps will have a small signal rise time that is fast—in the order of a microsecond or so and at high levels will be much slower with a linear or straight-sided edge transition, indicating that some internal current source can only charge a necessary stability compensation capacitor so fast. The MK-IIICM is different in that the high-level resistively-loaded square wave has an exponential edge transition with a rise time of 6-7 μS where the low-level rise time is less than 1 μS. Since the rise time does increase with level, some equivalent of slew-rate limiting must be taking place. The full-power rise time at a −12 dB gain setting with a resistive load was very close to 2.5 μS. The above really represents some technical nit-picking and to be honest, this reviewer hasn't seen or measured any power amp that is as good as this one in delivering high-power, high-frequency square waves.

Power output at onset of clipping into 4-,8-,&16-ohm loads was 340, 230, and 125 watts respectively with both channels operating. Output noise with shorted inputs as a function of gain control setting and bandwidth is shown in Table 2. The rather large increase in noise voltages when measuring in a 20-20 kHz bandwidth was due to the noise being dominated by line harmonics. Note, however, that the S/N is better than 100 dB re 200 watts in a 20-20 kHz band at the highest gain setting.

Amplifier protection was seemingly foolproof as the worst that happened for such things as dropping pickups on records at full volume and tone bursting supersonic signals with large d.c. components, etc., was the speaker relay opening momentarily and then restoring operation after a short delay.

Damping factor was found to be greater than 200 from 20-1 kHz and decreased smoothly to about 25 at 20 kHz.

The Federal Trade Commission has stepped into the high fidelity area with a new ruling designed to eliminate false or misleading advertising of power output and power output versus frequency in audio power amplifiers. Legitimate high fidelity manufacturers generally rate their products honestly but nevertheless fall under the jurisdiction of the new FTC ruling. One particular requirement of this ruling makes it tough on most power amps. This is the requirement that an amplifier under test be preconditioned by simultaneously operating all channels at one third of rated power for one hour with a 1 kHz sine-wave test signal. This 33 percent of maximum power is close to the worst-case condition of about 40 percent of maximum power in class B and low AB power amplifiers. Most hi-fi power amps don't have adequate heat sinking to allow continuous operation with a sine wave near the worst-case conditions and consequently have thermal cutouts that shut the amp down when it gets too hot. This situation is realistic for most hi-fi use, as the average power output is about 1 to 15 percent of maximum power due to the high peak-to-average ratio of typical program material. A case in point; the MK-IIICM under review has a comparitively large heat sink and a thermal cutout that probably won't be activated with most usage in hi-fi systems. When operated continuously at one-third maximum power with a sine wave, it operates for 15 to 20 minutes before the thermal cutout shuts it down. It thus appears that many otherwise satisfactory power amps will have to be redesigned with consequent added bulk and weight and resultant increased cost to the consumer.

Table 2—Output noise versus gain setting and bandwidth.

Gain Setting, A	400-20 kHz μV	20-20 kHz μV	S/N, dB, re 200 W
0	80	240	−104
−3	50	160	−108
−6	34	110	−111.2
−9	24.5	79	−115
−12	18.5	57	−116.9
Setting, B			
0	83	230	−105
−3	57	180	−107
−6	44	140	−109.1
−9	32	105	−111.6
−12	23	77	−114.3

(Editor's Note: As is evident from Bascom's remarks in the "listening test" portion of this review, this particular amplifier was delivered to us in advance of the FTC's announcement of their new ruling. SAE tells us that all Mk-IIICM amps sold after November 1, 1974 include a small whisper fan, thus preventing premature action of the thermal cutout and meeting the FTC's preconditioning requirement. This fan is also available as a kit, costing $44.00, to update older Mk-IIICM amps.)

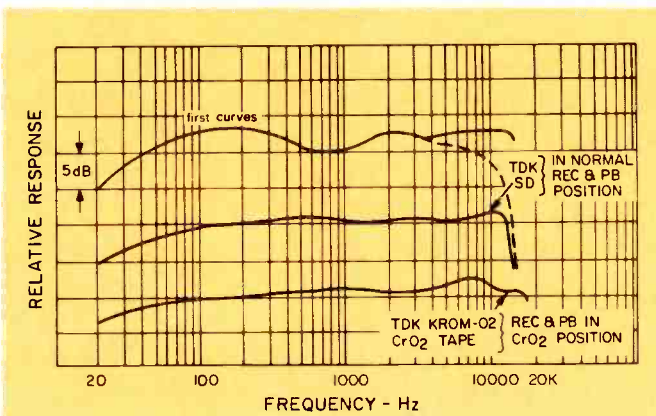
To sum up, the SAE Mk-IIICM is a well-made, esthetically attractive and reliable product that generally meets or exceeds its published specs. It is particularly well suited for driving inefficient and difficult loads and warrants serious consideration for anyone interested in a basic amplifier in this power class. *Bascom H. King*

Check No. 72 on Reader Service Card

ADDENDUM
Sharp RT-480U Cassette Recorder

The November, 1974 review of the Sharp RT-480U cassette recorder contained frequency response curves not representative of the unit's best performance. Response with TDK SD tape extends to about 13 kHz with the equalizer switch in the *normal* position for record and playback. A second CrO_2 curve, run with TDK KROM-0_2, has a bit better high frequency response. Both are a bit flatter. The S/N ratios for Dolby and non-Dolby operation were transposed, i.e. Dolby S/N is 55 dB; non-Dolby S/N is 53 dB.

We apologize to Sharp Electronics for these errors and hope that the firm and our readers have not been caused too great an inconvenience by them.



Speaker Tests: Room Test

Richard C. Heyser

THE ANECHOIC frequency response of a speaker tells a great deal about what that speaker is capable of doing. However, none of us listens to a speaker under anechoic conditions. Walls, floors, ceiling, and household furnishings all form part of our acoustic environment. Many speaker systems are also designed to use portions of a room to augment reproduction.

AUDIO provides a measurement specifically designed to indicate how the speaker will sound to you when you listen to it in a room. This is where the difficulty begins because two questions immediately present themselves: 1. what room shall we use, and 2. how should the measurement be made?

Both of these considerations may be dealt with by considering some of the psychoacoustics of listening in a room. It has long been recognized that the first sound arrivals you hear substantially determine the quality of what we identify as the source of that sound. This is the "early sound" of architectural acoustics and amounts to the first few tens of milliseconds of sound arrival for a very large room. Our ability to locate a source of sound based on the precedence effect is similarly associated with the first five to 50 milliseconds of arrival. Similarly, on the average, the pitch of a suddenly applied tone may be determined within 13 milliseconds independent of the value of that pitch. What we are referring to here are, of course, considerations based on dynamic program material associated with real or apparent sources of sound for that material.

The later sound arrivals, which in a conventional room are due to sound scattering off various objects, tend to establish the ambience we normally think of as the "sound" of that room. The earliest of these later arrivals yields the impression of reverberance, while later and later arrivals no longer fuse into a continuous sound pattern but dissociate into what we perceive as echos. In many cases the net amount of sound can be greater for the reverberant sound than for the direct sound from a discrete source. In that case, we are in what is known as the reverberant field. This still does not prevent our assignment of localization and quality for the apparent direct source of sound. You can quickly verify this by observing that you have no difficulty talking to a friend in a highly reverberant hallway—that is, until you block one ear and disable some of the psychoacoustic mechanisms.

Our microphone is a single receptor analogous to that unblocked ear. To measure the properties of room sound which may be best associated with quality, localization, and timbre, we therefore measure the spectrum of the early sound.

Our job is not complete, however, because we have to worry about the room and how it may differ from the room you might use for listening. The next time you are in an audio showroom or a friend's home listening to reproduced music, notice where you tend to position yourself relative to the speakers if you have any freedom of choice. AUDIO's measuring location is based on such observations.

We place our microphone three meters (about 9 ft., 10 in.) from the front of the speaker. We assume you will want to sit down while listening, so the microphone is placed about at average ear height above the floor of one meter (about 3 ft., 3 in.). The speaker under test is placed exactly as recommended by the manufacturer, if such a recommendation is in the instructions you receive with the speaker. If the maker gives no recommendation or is unclear about speaker placement, we place the speaker according to our judgment.

Now we must concern ourselves with the room. AUDIO not only tries to use a reasonably conventional room geometry but has designed a measurement that can be duplicated by any well-equipped acoustic facility anywhere in the world, as it is important to produce repeatable, credible objective measurements. All we require of a room is that it have a floor, walls, and ceiling. The walls and ceiling are assumed to be hard reflecting surfaces, such as plaster or wood panel. The floor is assumed to be carpeted. The ceiling is assumed to be slightly over 8 ft. (251 cm) above the floor. The direct sound from the speaker to microphone takes about nine milliseconds for our three-meter measurement. No substantial article of furniture is allowed in the area where the first speaker reflection would have a path about twice the direct path. We do this *not* because we don't feel you should have lamps, chairs and the like that close to the line of sight from yourself to speaker, but because we want a reproductible measurement that doesn't depend upon detail layout of furnishings adjacent to the speaker.

For this test we energize the speaker with a special coherent signal which has equal energy density within 1/10 decibel for all frequency components from 20 Hz to 20 kHz. Since the sound will take about nine milliseconds to travel to the microphone we set up an acceptance window for the microphone signal which is centered at this nine milliseconds. We allow the first 10 milliseconds of this early sound to pass to our processor through what is known as a Cauchy window for the amplitude of the components. This is, of course, an electrical gating of the microphone signal.

The transform of this time-gated signal is the frequency response of the first 10 milliseconds of sound you hear from that speaker, this is what is plotted as the three-meter frequency response. Depending upon physical placement of the speakers, this measurement contains the contributions of floor, wall, and ceiling reflections.

Because we take only a 10 millisecond "chunk" of sound for this measurement, the frequency response is accurate down to about 200 Hz. For that reason the plot only extends from 200 Hz to 20 kHz. The phase response is not plotted because it would be extremely difficult to interpret without additional measurements. Two amplitude measurements are made. One is made directly on-axis and the other 30-degrees off-axis to simulate stereo listening.

Is all this effort worth it? AUDIO believes it is because this measurement apparently correlates more nearly with the subjective sound impressions related to timbre than does the anechoic response. We compute the data for every 15th-octave interval throughout the useful audio range to cover every possible musical tone. This gives a response that is far less smooth than good advertising copy might dictate, but it is the way you hear it.

The three-meter room response may be used in the same manner as the amplitude of the anechoic response. Quite often near crossover points you will see a great many interference nulls and peaks. This is due to differences in angular dispersion between crossed-over drivers causing a substantial interference due to floor or ceiling reflection. Compare the anechoic and three-meter test to verify this condition. If the anechoic response is uniform but the room response is jagged, then the implications are that first-order reflections are coloring the sound. This is an indicator also that stereo or quadraphonic sound images will be dispersed when they have substantial energy in that part of the spectrum. The reason for this is that a left and right channel will never be exactly balanced for such absorption dips and the relative energy of sound in that range will rapidly shift from left to right with small changes in timbre or seating position.

Some speakers will measure better in the three-meter test than under anechoic conditions. Invariably these are the speakers which have been designed more by how they sound than how they measure, and this is a very desirable property to look for.

Occasionally some drivers will have such a multiplicity of interference nulls that they are artificially smoothed by even a 15th-octave sampling. We will identify such conditions as they occur. It doesn't necessarily mean that it is a bad sounding speaker, but it does mean the measurement is not as smooth as it appears.

Periodic patterns on a linear frequency basis are indicators of sound coloration due to physical structure. Many times a wall-mounted enclosure will create such patterns because of the acoustic discontinuity of its physical extension from the wall. If this is the case, it will be more apparent in the 30-degree off-axis measurement than in the on-axis measurement.

A uniform roll-off of higher frequency energy as a trend in the measurement is no sign of acoustic problems, particularly off-axis. If bothersome it can be touched up with conventional tone controls. Beware of severe or gross peaks and dips as a trend, however, if you demand accurate sound. As a general rule, because this is a multipath acoustic interference situation, dips in response will be less objectionable than peaks more than 5 dB above the average through a given range.

Classical Reviews

Edward Tatnall Canby

Boston Pops—Fiedler in Rags. Polydor PD 6033, stereo, $6.98.

Like the Philadelphia and Boston Symphony Orchestra, the Boston Pops leads a double and alternative life these days, on two labels—and who is to know which came first. "New" releases come right along, and never a date of recording so much as suggested. You may just happen to know, of course, that Polydor began in Boston after RCA ended, just as RCA began in Philadelphia after the CBS regime ended. On discs, it seems to make less and less difference. Zany sonic world.

Anyhow, this obviously recent Polydor recording is the very first Polydor to reach us from Boston, and decidedly it is the best. Just delightful. I laffed and laffed. You can't beat the old Pops! Better and better (that is, in real time) over the decades and the half centuries. Fiedler in rags, indeed! Rags, I dimly remember, once was a pop term for black dress clothes—so here's old Fiedler on the cover, dressed to the nines, with a batch of preposterous female models more or less in his lap . . . do they use a dummy for him? Sometimes I think so. Anyhow—

It all starts quite solemnly, in the fashionable Scott Joplin style of oh-so-effete *culchah*. (So I read the intent, anyhow.) Big-orchestra Joplin renditions, made from the original modest piano works including the inevitable *Maple Leaf,* very nicely done considering the elephantime performing group. But oh, what a bore, for two whole sides, I was just beginning to think, when suddenly it dawned on me that things were getting curiously lively for Joplin. By the time we were on to *Charleston Rag* (Eubie Blake), the lid was coming off and I flipped.

On the flip side all heaven breaks loose, to the tunes of *Alexander, 12th Street* and *Darktown.* And by the time we are into *Tiger Rag,* the program notes have to list a set of apologies—to George Gershwin and, especially, Spike Jones! We have jumped clear out of our field and, indeed, from thence onwards there's everything *and* anything, from police whistles and wah-wah trombones to modern jazz. Absolutely crazy! But done with such innate style and intelligence that nobody but a snob could be offended.

Now you take Spike Jones, a whole disc of Spike Jones, and the snorts and sneezes and crashes just become monotonous after a few cuts. But the Fiedler outfit knows how much is too much, which is what I mean by style. The sly mix-up of every rag/jazz style that Joplin did *not* have (since he wasn't around) is the sort of humor

the Boston Pops have always been good at, and no doubt because the boss, Arthur Fiedler, wants it that way. No other Pops orchestra, the original excepted (London's Prom concerts), has ever managed it so well.

Is it Symphony Hall in Boston? Or has Polydor somehow managed to preserve that big, golden ambience, very classical, that has always washed over Boston Pops sound since the earliest RCA days? Somehow, it makes the whole thing funnier and even more effective. After all, this was the beginning of pop culture in classical surroundings! As a college youth I sang in a chorus once with the Pops in Symphony Hall. The chaste balconies, as I remember, were all painted an improbable tropical green, the rows of floor seats removed in favor of miles and miles of tableware, and beer—could it have been *beer?*—flowing from every pitcher. If

I am right, we sang Brahms or something. Anything goes at the Pops, even in rags.

Bach: The Unaccompanied Sonatas and Partitas (complete). Christiane Edinger, violin. **Orion ORS 74151/2** (2 discs), stereo, $13.96.

The unaccompanied solo works by Bach—for cello and for flute too—are a Baroque specialty, a species of "skeleton" stunt music, big works of complex harmony and involved, many-voiced counterpoint, music easily of orchestral scope—transcribed and *implied,* so to speak, on an improbable solo instrument. You fill in the details in your mind, and it's easy, once you get onto the style. It's like somebody playing a symphony on the piano, hitting a note here and there, sort of roughing the thing out, and yet (if he is good) getting the idea over. I remember the composer Roger Sessions once whanging out the entire Cesar Franck *D Minor Symphony* in this fashion on the piano, and no matter that half the notes were missed and most of the rest of them messed; it was a splendid performance!

Not much need be said here, then. Christiane Edinger is a fine fiddler who understands and hears the music, plays it accurately and on pitch. (Many a big violinist doesn't.) Her violin is well recorded in a proper space, and you will have minimum trouble getting the Bach musical sense. She never rushes and strains at the double and triple stops, she takes things easily and forthrightly, so that all is made clear. You have an optimum chance here to absorb what Bach had to say in these potently musical works. She's good looking too; see cover.

The Tracker Organ at Iowa. Delbert Disselhorst, Gerhard Krapf. **Univ. of Iowa Press** *(Iowa City, Iowa 52242).*

Interesting. (1) University School of Music builds fancy new recital hall. Recital Hall needs organ. (2) University get money, orders fancy new organ, a Casavant, all Tracker action and wow!—how modern. (3) Organ is inaugurated by recital, organ profs from School of Music. (4) Organ concert is recorded, via Recording Studio, School of Music, and wow!—how modern. (See list of equipment on the record liner.) (5) Record issued by University Press, sent out to All Critics. That's the way university music gets around these days. Very efficient.

Not surprisingly, the two players on

the same organ are quite different, though what a lovely and sonic pair of names. The older, Gerhard Krapf, is a solid Establishment organist with plenty of technique and a brassy approach. The good old Bach *Toccata and Fugue* roars out powerfully, the sweetish Reger is nice, his own *Fantasy on Frescobaldi* is absolutely hideous (my ear says), especially when followed by two modest little 17th century pieces to end the side, models of good composition.

Vladimir Horowitz - New Recordings of Chopin. Columbia M 32932, stereo, $6.98.

New recordings? What is a new recording these days? All of these, it says were made in 1973 except two from recitals in 1968, and one more, the "Revolutionary" Etude, which is "a completely new recording, made in 1972, and appearing for the first time in this album." Then we may take it for granted that all the other items, 11 of them, are *not* new and have appeared before? New, I suppose, in the sense of recent. After all, Horowitz has been around for awhile.

Let's face it, this piano genius was never made for recordings. He never has enjoyed them, it seems, and mostly won't play unless before a real audience. Hence many of his recordings are "live"—and all of them somehow seem to take on a concert stage sound, distant, rather thin, lacking in bass and wholly lacking in intimacy (which Chopin often needs), quite often loud and metallic in the whirlwind parts. Oddly, the old RCA Victor recordings are very much like the newer Columbias, including this one—so it must be the artist. It surely is.

I think the way to enjoy Horowitz, if and when you have the rare chance, is live on stage—*live* live! Like Switzerland Swiss cheese. On the spot, yourself in person, acoustic, via the ambient air, minus mikes—how am I going to say it! So many people today assume that "live" means taped before an audience. Not taped! *In actual concert*. That is the way to listen to Horowitz, and if he gives no more of those astonishing concerts, then that is that. You can study the recordings on a technical basis, just to see how he does it.

Tallis at Waltham Abbey. Cantores in Ecclesia, Michael Howard. **L'Oiseau-Lyre SOL 337,** stereo, $6.98.

Tallis? For those in the choral know, he is one of those austere, expressive composers who came a generation before the great, familiar "Elizabethan" period of later 16th century music, out of an earlier generation—Tye, Taverner. He reminds me of his rough Spanish contemporary and technical enemy, overseas, Morales in Spain. Just as William Byrd, at the end of the century, has some similarity to Victoria in Spain at the same time.

A fascinating story here. The vast Waltham Abbey, its truncated half shown on the cover, was partly destroyed in that infamous Dissolution of 1540 when Henry VIII, on behalf of his new religeon tore down and dissolved hundreds of monkish institutions and their ancient and beautiful buildings, leaving only those which were bought off in one way or another such as Tewkesbury Abbey, which I saw last summer. Thomas Tallis was musician and composer in this Abbey of Waltham, aged 35, and all the music on this record was composed and presumably performed in this very spot (with its much larger inner extent) before the Dissolution. Tallis went on to become an Elizabethan composer in the new religeon, as did William Byrd, and for awhile Queen Elizabeth gave them an exclusive licence for composition.

Michael Howard's earlier recording of Byrd and Tallis, music in the days when they worked together for the Queen, seemed to me somewhat stiff and metrical, not very satisfactory. This one, of earlier music, is remarkably better. The English choir is lovely, immensely musical on its own, and that metrical rigidity of the earlier disc is somehow softened and made more expressive, here in Tallis' own acoustic enclosure. Must be the inspiration of the spot—the oldest Norman building in England in its remaining portion.

Hovhannes: Tumburu, Op. 264, No. 1; Varuna, Op. 264, No. 2. Macalester Trio. **Vally Weigl: Nature Moods; New England Suite.** Geo. Shirley, ten., soloists. **CRI SD 326,** stereo, $6.98.

Alan Hovhannes, that half-Armenian out of Boston, has written so much

I wonder that he can remember most of it. These two piano-violin-cello trios are new enough, 1973. Their characteristic high colored semi-near-East Western sound is somewhat spoiled by a very dry recording; a larger, more mellow space would have better suited the somewhat exotic atmosphere. Very listenable, even so, as Hovhannes always is. A great deal of Eastern Indian material—see his extensive program notes—but the stuff is not at all a literal Indian imitation. Sheer Hovhannes.

The energetic and indefatigible Vally Weigl, promoter of her husband's Vienna-style music, is quite a power in her own right. I liked the easy Nature Moods, for tenor, clarinet and violin, a nice combo. The New England Suite is a bit too ducky for me, a New Englander—rather forced for a lady who is the essence of good Central Europe! There's even a Berkshire Pastorale—that's where I live. And a Connecticut Country Fair. Out of Vienna.

Chase. Epic EQ 30472, SQ quadraphonic, $7.98.

I wouldn't count matrix quadraphonic out just yet as a viable four-channel medium. Not when discs like this, in the vulnerable pop area, can turn around on your table and come out with such a quadruple impact. This one just happened to come my way (probably on purpose); I dig it. (*All right*, then, I fancy it.)

If you have the essential and absolutely required full-logic decoding, then I think you should study this disc with all the intelligence and feeling that you can muster, always assuming the music is of a sort you can take. Because here, in so many sounds—not words—SQ encoding sums up what it can do at this stage of our complex game plan.

For instance—that screaming trumpet solo that opens the lead out. This is Bill Chase, for whom the album is named, and his sound is quardrapanned right around the room, reverb and all, into one speaker after the other. SQ (with full-logic decoding) can do that, and spread the reverb out as smooth as butter, too. To be sure, if there were *four* simultaneous trumpets, one in each speaker, all screaming together, the SQ logic would be in a wee tizzy of confusion, not having the brains to cope. This we know! But do we *have* to have four trumpets? Not necessarily.

The thing we must all understand is that the aesthetics are best when the medium—any medium—is used for what it *can* do, not what it can't. Brahms on the harpsichord? Wagner on the piano? If I am right, the matrix mixers are finding a lot they *can* do, in spite of very clear matrix incapabilities. If we are to be fair, we should listen to the results in their own terms. The rest balances up in terms of side effects—distortion, wear, ease of handling, costs, even repertory (where CD-4 was weak and now is less so).

The music? High-powered, expensive sounding jazz-rock, the new bringing together of the rock tradition with that of the big-band music of a quarter century ago (and still alive in the playing). This band is definitely big and brassy, nine basic players which is like 40 in acoustic music. The pitch is definitely commercial, to my way of thinking, but the innate strength of the hybrid idea is very much evident. The music speaks. I also hear a lot of that curious high-voltage stuttering style that is the latest among the very young bands who are into this sort of synthesis—such as I heard locally last summer via an outfit called "Too Much Too Soon," referring to their collective talent and age—the drummer was 16.

My only minor objection was to a rather self-conscious change of style between cuts, sort of reminding us of the fusion by un-fusing the different elements, back to rock and jazz.

All this in the name of technological progress, and apologies to my pop colleagues.

Beethoven: Fidelio. Margarete Baumer, Heinz Sauerbaum, Manfred Hubner; Chorus & Orch. Leipzig Radio, Pfluger. **Everest 9103/3** (3 discs), QS *quadramonic*, $14.94.

Quadramonic? *Now look* what Everest is doing! I'm not totally sure of this one, though I remember every note of it from 'way 'way back and I am sure it was mono. In any case, Everest has reissued a large batch of old classicals, both mono and stereo, which also carry very prominently the QS logo—and an explanation that the recording contains four separate channels of sound. *From mono??* Well, possible! But I am sorry that the very first QS discs I receive, aside from several new ones from Vox, should be these! I would think that the QS people might be a bit uncomfortable.

To be sure, I made up the above term, quadramonic. What else? You start, apparently, with a mono tape (or pre-tape disc). You sure can't just play it baldly through a QS encoder! So I'd guess you first "enhance" it into simulated stereo—which is a legitimate technique, so long as it is so indicated on the record. It does help to spread a mono record out and away from that central point in the middle. Then—again my guess—you take your two-channel simulated stereo and feed it blithely into QS, which being only a mere circuit, doesn't object a bit. And so we have quadramonic enhancement. As a matter of fact, it works, moderately, if you mean that it does in fact more or less distribute the sound around the room. Same old scratchy mono sound from 'way back. A distinct hum, too. Could it be from too much enhancing?

After all that—I must say that this was a nice performance of its sort, and rare today, a genuine German-provinces-type job, all German, wholly in the German opera tradition, rather low-keyed but beautifully, instinctively, styled, as only the Germans can do. No international hoopla here and I am all for it. Margarete Baum has a foot-wide wobble and I think she was rather more elderly than youthful at that point, but she sings well, within her limits; the other principals are also alive and aware and the opera really moves along, orchestra included. The spoken dialogue is particularly excellent—I think done with a separate speaking cast—and the echo-ridden segments in the dungeon are positively spooky. Quite an early triumph of recording, probably done with "live" echo. It was too early for reverb. All in all, then, this is a first rate evocation of "Fidelio" in the German style, quadramonic or no. I hafta recommend it.

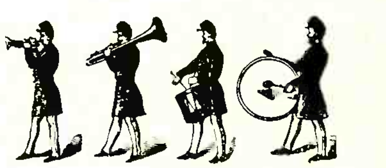
Ravel: Scheherazade. Berlioz: Cleopatre. Jennie Tourel; N.Y. Philharmonic, Bernstein. **CSP CMS 6438,** mono/stereo.

I am not clear as to what this CSP (Columbia Special Services) label is all about. Nice music, however. The early Ravel song cycle with orchestra is Impressionism at its loveliest and Jennie Tourel, long-time associate of Bernstein and a superbly musical interpreter of French and Russian music, is the ideal singer for it—the recording, if I am right, is pre-stereo, though an excellent taping. On the obverse is a rare work, excellent companion piece—Cleopatra instead of Scheherazade. It is early Berlioz, from the time of the familiar "Fantastic Symphony" and, though the piece is modelled on Beethoven's concert aria *Ah, perfido!* of not so long before Berlioz, the "Fantastic" turns of musical speech are everywhere, most interestingly. All sorts of weird dramatic moments, along with the semi-Beethoven, and when the asps bite Cleopatra and she dies the effect is no less than chilling. Some piece! Gorgeously performed, and this one seems newer and in stereo, too.

John Philip Sousa conducts Band Music of the World. Everest 3360, sim. stereo, $4.98.

They used to be a dime a dozen, the Sousa acoustic 78s, and I dimly remember a few from my childhood. These items are transcribed "from the personal collection of Music Man Murrary" who must own a pile of oldies. Just a matter of copying them off.

I have long thought that Sousa, in his own field, was easily the equal of, say, Johann Strauss the Great (and indeed he owes much to Strauss in the

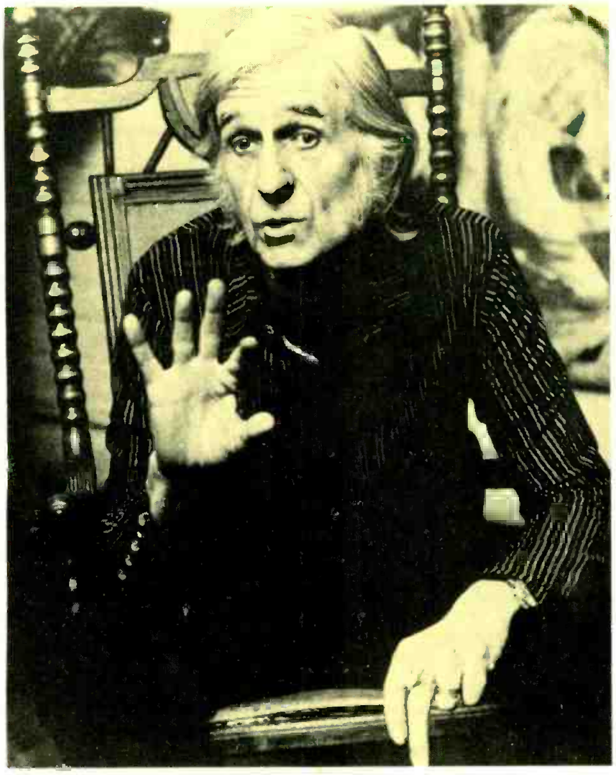


shaping of his marches), or Offenbach, or G & S. The first side here is mostly Sousa himself, five items and not a one had I ever heard before; side 2 goes on to other and lesser items, but ending in a grand slam—the *Blue Danube*, truncated to the necessary 3:18. It's acoustic sound at its most typical—even in pseudo stereo—and the only really noticeable musical facet is that the tempi are remarkably fast, in the Sousa and in most of the other items. Let's hope Everest didn't pitch them all high. Not too difficult, in those days of variable-speed recording tables! Maybe some of you band experts can name the right keys, and figure out whether or no.

Sousa intensely disliked recorded sound and called the thing that made it an *infernal machine*. You can't please everybody. Maybe he just played fast to get it over with (and beat the end of the record).

The Column

Fred DeVan



Gil Evans: **Svengali**
Atlantic QD-1643

This is a musically and aurally fantastic album, one of the finest CD-4 records yet offered. It's so good musically that it would even be great on a kid's wind-up unit, though you'd miss the finer points of the state of the CD-4 art that way. Evans made sonic musical extravaganzas in mono, then in stereo (just to name a couple of memory refreshers: **Sketches of Spain,** Columbia CS-8271, and **Porgy and Bess,** Columbia CS-8085, both with that human extravaganza, Miles Davis). Now, in four channel, Evans is just too much. He is trying to blow your doors down.

I hadn't heard much from Evans for quite some time. I thought that his obscurity was a result of his taking a job in the White House or Pentagon, but no, he was out collecting microphones for this recording. There must have been 2,000 or so used for each channel of this disc. But the guys at Atlantic Studios really outdid themselves cutting the master for this; it's the cream of the crop.

Svengali is a masterful, eloquent tour de force in every way. Every good studio musician in New York seems to be on this record, which was cut on location in New York City's Trinity Church and Avery Fisher Hall. It is loud, big band music and the disc should be played that way. It sent my meters and 'scopes flying and made me wonder how many musical ideas could get condensed into 40 odd minutes, yet be fresh and crystal clear. The name says it, folks. Gil Evans is a Svengali. Evans, along with younger guys such as Bill Watrous, are bringing the big band into the 70s, and big recording companies, such as Atlantic and Columbia, are giving them the budget to make the music happen right.

Gershwin's *Summertime*, which was to me the high point of the Miles Davis/Gil Evans **Porgy and Bess** album, gets yet another wonderful rendition—softer than the **Porgy** version, but with a touch of morning in the country rather than the pounding summer sun and tough temper of the original story which Evans captured last time. Other than the Gershwin tune, the compositions are totally of today and yet a part of all time. *Thoroughbred,* written by woodwind man Billy Harper, is just a glory of sound, highlighted with a tuba solo by Howard Johnson and sheer wizardry on bass by Herb Bushler. But believe me, everybody gets into the act. The engineering is letter perfect, the mix is perfect, everything is perfect. Even Richard Williams, totally unabashed by the fact that Miles is a hard act to follow, veritibly shines on a Davis tune, *Eleven.*

What a personal, musical, and technical triumph this record is for all concerned! Best of all, it is a record which will appeal to most everybody, even if they use an ear horn or have to dig mascara out of their ears in order to see. Get this record in CD-4, even if you're not set up for it yet; you may change your mind, and this disc is one which proves that CD-4 not only works, but works damn well! As for Gil Evans, if you are broke, find a quadraphonic showroom, ask for this specific record and pretend you're going to buy six systems.

PEACEABLE KINGDOM. Rob Carlson and Jon Gailmor.
Polydor 6023, stereo, $4.98.

Remember that wonderful, gentle music that Kenny Rankin used to do for Mercury, like his *Mind Dusters* set? If I can offer a point of reference for the work of Rob Carlson and Jon Gailmor: If they did not use words, parts of this could be ECM material. Maybe Polydor is learning from its sibling. The heck with why this record exists. It's so nice, and gentle, and good—what else is there? A couple of cuts did not bowl me over, but few albums are made specifically for my tastes (maybe one day).

First of all, this record seems to playback on RM/QS. The effect is a broad, somewhat-bigger-than-your-room, 270° sound field. The recording is in keeping with the material. Just lovely. Smooth, rich, warm words and the rich, warm voices of Carlson and Gailmor. *Ridin' To Nantucket* (and honestly most of the rest) is a very together song. The words could be trashy nonsequiturs, with this kind of production, but they're not. The instruments and arrangements are nearly impeccable. But the words are real and meaningful. They tell stories and co-exist rhapsodically with the music around and within them. The arrangements use nearly all acoustic instruments from mandolin to tuba. Rob Carlson is a writing find (Jon Gailmor co-authored one and authored one cut out of the ten on the album). Carlson, as well as Tim Moore, are two writer-performers to keep an eye on. His voicing with Jon Gailmore's inevitable vocal agility and smoothness creates a sound that is vaguely reminiscent of Seals & Crofts, Brewer & Shipley, Art Garfunkel, and Loggins & Messina. But, only because we heard them first. Their sound is truly their own, as are their songs.

Nice going, guys. I really like your record. I have a suggestion to anyone who would like a change from bombardment and assault, or to anyone who might have any interest in sensitive, warm, worthwhile, honest music that sounds and feels just great. Go get a copy. There may be some lonesome Thursday night when for 40 minutes or so this record could be a nice thing to have. Give Jon and Rob a bit of applause, this record has earned it.

P.S. Love that tuba dart in *Gardner Illinois.*

MO'ROOTS :TAJ MAHAL
COLUMBIA KC 33051

A few days ago I received a rather valid letter from a reader who stated that he could not tell what kind of music I am writing about. I know this to be a fact. Much of the music that finds its way into these pages cannot be type-cast by anyone, from the musicians who play it to the companies that promote and sell it. A cute or tricky little title would help to turn some folks on, but also would serve to provide unwanted guidelines to fit into for music that is free to go and be whatever it wants to be. Even the term "pop music" is *obsurd*. It tells you nothing anymore. Think about it in terms of how vastly different the world is today from what it was in 1968. Think of what differences there are in the meaning of certain words we use all the time, words like: dollar, oil crisis, fast food, The President, food prices, China, Watergate, economy car, exorcist, Linda Lovelace, truth and honor—why, even E. T. C. has changed. (Only the latter is a positive statement, all the rest are either negative or a bad joke.

Well, anyway, Taj Mahal made a new record. Incidently Taj Mahal is a fine black musician from Jamacia who named himself after one of the seven wonders of the world. His music is yet another wonder that you cannot simply describe as being from one school of style of music. You just sit back and enjoy and forget that you don't like the music of some other Jamacian-born musicians, as is the case with yours truly. I honestly did not know where he is from until recently, but have long been a fan of his. His **Giant Step** (11-69 Columbia GP-18) two-record set is one of the highlights of my collection. It also instilled a lot of curiosity in me about him. I still know very little about him, but as his music flows out I keep learning more. Not in words, but in the vast scope of styles he works in. Up until now Taj has been adapting music and himself to fit what he wanted to do. With **Mo' Roots** he goes home carrying with him all the accrued musical knowledge since he left (his first album was in 1968). He produced **Mo'Roots** himself and his attention to tiny detail is amazing. Everything fits and is right. The hollow drum sound is probably attributable to the use of plastic drums and very clever microphone placements, but it works as if it were the only drum sound possible. The sonics of the record are open and full of air and space, but the instruments and voices are tight, full and very precise. Incidently, Taj plays guitar, banjo, french harp, whistle, organ, Fender Rhodes piano, piano, and finger cymbals. He also sings the lead vocals. The music in a word is stunning. It is so simple and pretty, that you do not have to like its style or its words to appreciate its beauty. Taj Mahal's fine musical acumen transcends personal tastes and gently fills your ears with melodies, harmonies and rhythms that are tasteful and rewarding irregardless of what you are used to hearing. This is one heck of a good record.

There is not one top-40 (or is it top 30 in our present stagflated world?) hit on it, but music that still will be valid 40 years from now. Probably the only familar song is *Johnny Too Bad* which I first heard on the soundtrack album of **The Harder They Come** (Mango SMAS 7400). Taj gives this song a whole new life with his performance of it, but for me the best is to be found on the entire second side. This record has no weak spots except that it's too short. It is no shorter than many others, but you want more after you have heard it through. My solution to this dilemma was to place my turntable on "repeat" and I sat back and enjoyed a never-ending side two of **Mo' Roots.**

J. Geils Band: **Nightmares & Other Tales From the Vinyl Jungle**
Atlantic SD-18107

A lot of working rock and roll bands will be compelled to go back to school because of this album. J. Geils plays flawless rock and roll! Heavy, solid, musical rock and roll. This band of Boston bad boys *shure* do know what they want and how to play it. They have few peers in knowing how to use their instruments and their heads to make eloquent rock and roll.

This is the best rock and roll band in the world today! I will probably only say that five or six times again this year. They are so good, it makes you think twice about rock musicians not knowing anything but brute force and animalistics. They are an undulation—a moving mass of 2, 4, and 8 bar figures that are as tight "as can be." The solid togetherness of the bottom of the band just makes you quake to its thunder. Disco music? For sure, but much more than your run-of-the-mill disco crash bashers. The run of the mill disco music is junk specifically designed to keep you apart not only from your ears, but from your senses and those of other people. J. Geils has none of this faults. There are good musical lines and words forcefully sung about tenacious feelings. They certainly know how to use time and phrasing to lift them far above most of the raw power bands. The music is so aggressive it is contradictive to the fact that it has musical ideas that if expressed in another form could make an adagio movement of a string quartet virtually lope and sing. Yet they are big, bad, and verbose. It's gutsy and great! Lusty, strong, well thought-out, perfectly performed rock and roll. Like a flat-out, well-tuned zophtic sports car. Viceral, gut, gettin' down rich music. Every single cut is a monster out to get you and it will. The bad boys from Boston are something else.

The production and sound is that of Bill Szymczyk (of Edgar Winter, et.al. fame); it is as expected—utterly fantastic. Detailed, big, complete, textured and flawless. This is another record to be appreciated loudly yet, it is pleasant to report that J. Geils has put music that holds together with spirit at any volume. *Nightmares* (and other tales from the vinyl jungle) is about the strangest name anyone could apply to this exciting, pleasurable, and very civilized product from one of the creatively civilized clearings in the vinyl jungle.

STEVIE WONDER:
FULFILLINGNESS' FIRST FINALE
TAMLA T6-332

Stevie did it again. No words necessary. Buy, beg or borrow a copy. This the fourth, and as the name more than implies, the final part of this phase of Stevie Wonder's growth toward total musical fulfillment. The previous three albums, in case you missed one or have been lost at sea for three years are: **Music Of My Mind** TAMLA S-314, **Talking Book** TAMLA S-319, and **Innversisions** TAMLA S-326. They make a quadripartite of unpresidented quality and perfection from the rock or R&B world (or any other area of contemporary music). These albums are a must in any record collection. They are together and apart, true works of art. Their mass appeal is boundless, but even that cannot dim the glow their music provides to most all who hear them. Stevie is Stevie. There is no better; there is no other.

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Canby's Capsules

Edward Tatnall Canby

Is The Disc Dying?

Haydn: London Symphonies, Vol. I (93, 94, 102, 103). Little Orch. of London, Jones. **Advent CR/70 Process Cassette E1001**, stereo, (103 mins.).
Tchaikovsky: Symphony No. 4. London Symphony, Kosier. **Advent Cassette E1020**, stereo (47 mins., side 2 blank).

The disc is *not* dead, but here's its state-of-the-art competition. Long-play cassettes, chrome, double Dolby (A, then B), a new rigorous duplication process, plus top master material. Quieter than *any* commercial LP; only the dbx-encoded disc can complete. No hiss, no rumble, wow & flutter nil, very wide dynamic range—all this greatly enhances musical impact. These two, from Nonesuch masters, are best of first batch; see others, also Connoisseur Society. Some faint tape echo, packaging is clumsy, free annotations by mail request only.

Bach: Cantatas 7, 44, 101. The Cantata Singers, Harbison. **Advent Cassette D1016**, stereo (72 mins.).
Songs of a Traveling Apprentice. The Cambridge Consort, Cohen. **Advent Cassette C1023**, (47 mins.)

These originals from Advent, some first recordings, are a mild disappointment, if with reservations; not musically up to available (disc) competition. The Bach is rigidly conducted, solos sincere but tentative, chorus tone coarse, recording distant. The "Traveler" is nicely organized old-music program, good instruments, beautiful recordings, but the two solo voices grate, especially the harsh tenor.

Kalliwoda: Symphony No. 1 Tomasek: Piano Concerto No. 1. Petr Toperczar, pf., Prague Symphony, Rohan. **Candide CE 31073,** stereo, $3.98.

Two early 19th c. unknowns—both write a pleasing Mozart-Haydn idiom enlarged a la Mendelssohn or Rossini, not exactly earthshaking but beautifully polished, highly professional—fine entertainment if you aren't out for Instant Greatness. Adequate stereo recording.

Eugenia and Pinchas Zukerman: Music for Flute and Violin/Viola. Columbia M 32842, stereo, $5.98.

Flute-string duets—an unlikely medium but the sound is all entertainment here, thanks to superb husband/wife team, big resonant recording, plus Beethoven (age 21), Telemann, and a surprising duet, concerto-size, by one Kraus Lovely.

Callas is Medea (Cherubini). Teatro alla Scala, Tullio Serafin. **Everest 3351**, stereo, $4.98. *(Also the complete opera, Ev. 437/3, 3 discs).*

Callas back in her heyday and important for Callas fans, this reissue was once on Mercury, c. 1958, out of Cetra, in very early stereo. The ambience is fine, but sound is both wide range and edgy, notably (of course) in the powerful Callas voice. Use heavy filtering—and enjoy! This was her great role.

The Sistine Choir-The Story of Christ. **Everest 3349,** sim. stereo, $4.98.

The famed Sistine Choir, recording in the Sistine Chapel! Big, rumbly basses, unctuous choirboy sopranos, a Caruso-type blend and the singers slide from each note to the next; every piece goes dismally flat. Dreadful comedown from its days of glory in the 16th century. Recorded for a pair of color films, back before stereo.

Dvorak: Serenade Op. 22. Arensky: Variations on a Theme by Tchaikovsky. Engl. Chamber Orch., Somary. **Vanguard VSQ 30011**, SQ quadr., $6.98.

Somary is most at ease doing the high Baroque—Handel especially. This not-so-easy Dvorak string piece is here a bit nervous and fast, not quite the warm ripe-peach music it should be, but persuasive even so. Arensky seldom fails—it plays easily and sounds good here.

Dvorak: Quartet No. 6 (American); Quintet No. 3 in E Flat (with Walter Trampler, vla.). Budapest Quartet. **Columbia MQ 32792,** SQ quadr., $6.98.

The Budapest Quartet—in quadraphonic?? An unreleased recording, from 1967! It's remixed from multi-track original, to clear advantage. The ever-so-familiar Budapest sound, driving, often on edge of harshness, but also the uniquely penetrating understanding—phew, what a superb playing group it was! This was their very last, held back for fancied imperfections, never redone—they are inaudible to you and me, those minor faults.

Schubert: Sonata in A minor, D.784; Moments musicaux. Alfred Brendel, piano. **Philips 6500 418**, stereo, $7.98.

Brendel is good for this dark, inward Sonata; his sure control of rhythm and phrase, his underplay, are as potent as Walter Klien's more surging drama. Schubert's depths go down and down—few pianists can really touch them. This one does. Nice "moments" on side 2.

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Francisco Espina*
Newport, Rhode Island

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