Heyser On Impedance Tests

Audio

THE AUTHORITATIVE MAGAZINE ABOUT HIGH FIDELITY • SEPTEMBER 1974 75¢ ®
47425

Cassette Transport Problems

A Primer on Choosing Tape

lifiers,

phase distortion, plus substantially better stability with four double tuned phase linear ceramic filters and four monolithic IC's in the IF section.

6-stage limiters

The IF section includes 6-stage limiter circuits. Used in conjunction with differential amplifiers in monolithic IC's, noise interference is completely elimin-ated with a signal to noise ratio of 75dB.

Exclusive Phase Lock Loop (PLL) IC circuitry in the TX-9100 multiplex section

Developed and used for the first time by Pioneer, the Phase Lock Loop (PLL) circuit is actually an electronic servomechanism. It maintains continuous and precise phasing between the pilot signal and the subcarrier, supplying optimum channel separation. Completely drift free, no alignment is ever required.

The PLL cannot be affected by humidity or temperature since there are no coils or capacitors to be detuned. This provides complete stability and reliability.

New pulse noise suppressor in the TX-9100 operates with computer control

This circuit operates automatically when it is switched on. It effectively blocks radiated noise from airplane and auto ignition systems, neon and traffic lights, etc. It does not interfere with frequency response and stereo separation. Whether the signal is weak or strong, this automatic 'brain' decides when the PNS gate circuit is to operate.

Unique muting control

A 2-position variable muting control uses electronic switching as well as reed relay switching. This eliminates interstation noise and the popping noise of tuning and detuning.

Complete command with a wide variety of controls

Whether it's for AM, FM or headset output levels, Pioneer provides greater operating precision with three independently operated output level controls. A headset may be used without a following power amplifier. Precision tuning is achieved with the aid of signal strength and tuning meters.

AM section highlights IC's

The entire AM section, following the front end, is a unitized IC. A monolithic IC replaces 84 individual components plus a ceramic filter. By using a differential amp circuit and a balanced mixing circuit, there are better spurious characteristics and special AGC amplification.

Great specs for great performance

	TX-9100	TX-8100	TX-7100
FM Sensitivity (IHF)	1.5uV	1.8uV	1.9uv
Selectivity	90dB	80dB	60dB
Capture Ratio	1dB	1dB	1dB
S/N Ratio	75dB	70dB	70dB
Image Rejection	110dB	100dB	85dB
Stereo Separation	40dB	40dB	40dB
Distortion (THD)			
Mono	0.2%	0.2%	0.2%
Stereo	0.3%	0.4%	0.4%
Spurious Response	110dB	100dB	100dB

The Amplifiers: SA-9100, SA-8100, SA-7100

Two separate power supplies utilize 30,000 uF total capacitance

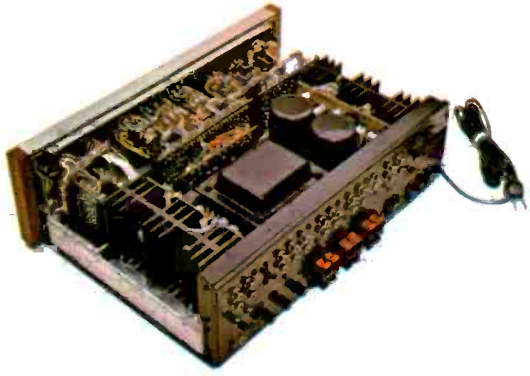
You read it right. The power supply in the SA-9100 uses a total capacitance of 30,000 uF. 15,000 uF each for the balanced positive and negative power supplies. This completely eclipses anything now available in integrated amplifiers. This super high capacitance results in an absolutely pure DC voltage supply. There's constant DC voltage regulation regardless

Two 15,000uF power supplies eclipse anything now available in integrated amplifiers.

of line voltage changes and signal input. Even at extremely low frequencies there's stable power output, excellent transient response and minimum distortion — only 0.1% at any frequency between 20-20,000Hz for 60 watts output per channel.

These positive and negative power supplies provide absolute stability in all stages, even in the equalizer amp and proceeding to the control and power amps. Therefore, the signal lines become zero potential to completely eliminate the usual (and annoying) click noise of operating controls and switches.

Stability is increased even further by the differential amplifier used in the first stages of the equalizer and control amplifiers (also the power amp.) 100% DC negative feedback supplies excellent stability and transient response; it also eliminates distortion. To further increase



Interior view. SA-9100

In tuners and amp
Pioneer is the very best.

The time has come to completely re-evaluate the standard you now use to judge high fidelity performance.

With this new line of tuners and amplifiers, Pioneer presents many ingenious innovations in circuitry that are being used for the first time. However, this exclusiveness is only secondary. While each new circuit can be considered revolutionary by itself, what is even more important is that their combined capabilities achieve precision and performance heretofore unattainable.

The Tuners: TX-9100, TX-8100, TX-7100

FM front end — an engineering triumph

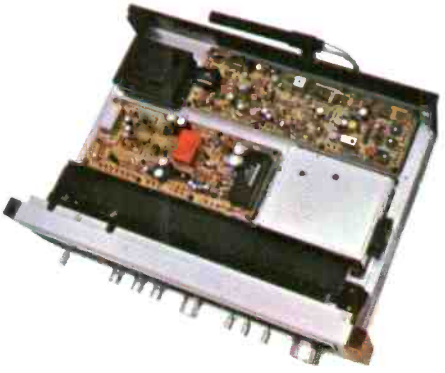
The height of sophistication, the TX-9100's stabilized, drift-free front end replaces printed circuit boards with completely metallized construction. The same used in high precision communications equipment.

Employing three dual gate MOS FET's and a buffer circuit in the local oscillator, there's exceptionally high gain with extremely low noise. Two tuned RF stages with a 5-gang variable tuning capacitor contribute to the highest selectivity (90dB) and astonishing FM sensitivity (1.5uV). The exclusive use of a heavy gauge die cast aluminum housing assures uncanny stability.

IF section — the epitome of advanced research

In the pursuit of excellence, significant new IF section technology was developed. The result is optimum selectivity with minimum

Exclusive heavy gauge die cast aluminum housing assures uncanny stability.



TX-9100 interior view. Chrome plated shielded front end housing and multiplex section.

Critics acclaim...

HIGH FIDELITY: "... The performance of the SA-9100 is so exceptional and the many extras in the way of switching options, and so on, so eminently useful, that we find it the most exciting piece of audio hardware we've yet tested from this company."

STEREO REVIEW: "... The TX-9100 unequivocally outperforms anything we have tested up to this time."

HI-FI STEREO BUYERS' GUIDE: "(The SA-9100) is a powerhouse of sound level, performance and features. Works like something the chief engineer had built for his own use."

"The Pioneer TX-9100 AM/FM stereo tuner offers notably excellent performance and sound quality."

AUDIO: "You can't buy better audible performance than is achievable with Pioneer's new TX-9100 (AM-FM stereo tuner) at any price."

STEREO REVIEW: "This (SA-9100) is an essentially distortionless, bug-free, and powerful amplifier with exceptional flexibility ... A highly complex array of electronic circuitry has been packaged into a consumer product of relatively modest price without a trace of 'haywire' or slipshod assembly. It almost seems a pity to hide internal workmanship."

Complete reprints available upon request.

stabilization, special electronic regulator circuits are used. Transient response is also improved with a superb damping factor of 70.

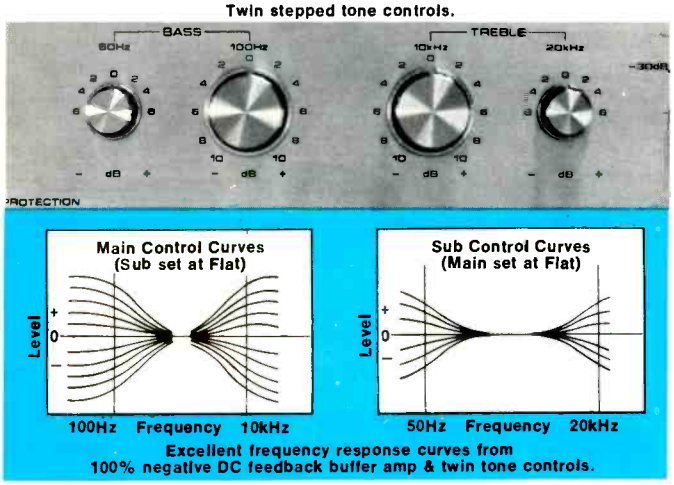
The unique equalizer amplifier

To make certain that extraneous signals do not interfere with the input signal, the equalizer amp is totally enclosed and sealed to shield it against leakage.

There's also extra assurance of precision with special low noise metal film resistors and styrol capacitors. Both are manufactured under continuous computer control to highest laboratory test equipment tolerances: ±1% for resistors; ±2% for capacitors. Until now such precision has been unheard of in hi-fi equipment. Deviation from the ideal RIAA curve is only ±0.2dB.

Since a direct-coupled SEPP complementary circuit is used in the equalizer amplifier, virtually any dynamic phono cartridge can be accommodated without overloading or distortion. For example, with 2.5 mV sensitivity, the overload at 1KHz is an unbelievable 250mV, and 1200mV at 10KHz!

Twin stepped tone controls.



Excellent frequency response curves from 100% negative DC feedback buffer amp & twin tone controls.

The control amplifier: Twin stepped tone controls custom tailor your listening.

Now you can make the most critical bass and treble adjustments with supreme ease. In fact, there are 5,929 tonal combinations to suit your listening room acoustics and to compare or compensate for component frequency response.

On the SA-9100 and SA-8100 four tone controls (two for bass, two for treble) make 2dB (2.5dB with SA-8100) step adjustments for the entire audio spectrum. Working together with the tone controls is a buffer amplifier with 100% negative DC feedback. The main bass control governs ± 10 dB at 100 Hz; the sub-bass, ± 6dB at 50 Hz. The main treble control governs ±10 dB at 10KHz and the sub-treble, ± 6dB at 20 KHz. This, plus the tone defeat control (described in the next paragraph) makes the SA-9100 the most exciting-to-use amplifier that has ever powered any hi-fi system.

New tone defeat switch

Because of the extremely wide variety (5,929) of frequency adjustments made possible by the twin tone controls, the tone defeat switch adds extra flexibility. Adjusting the tone controls to your satisfaction, you can flip the tone defeat switch. Bass and treble responses instantly become flat. When it is switched off you return to the original tone control settings.

The power amplifier

To sustain the ultra sophistication of the equalizer and control amp sections, the power amp has a direct-coupled pure complementary SEPP circuit, double differential amplifiers and two constant current loads. The combined effect is the achievement of wide power frequency range and excellent transient response. 100% negative DC feedback is supplemented by 66dB dynamic negative feedback for minimum distortion and absolute stability. The pre and power amps can be used independently with a separation switch.

Exclusive direct-coupling in all stages

Until now direct-coupling has been used only with the power amplifier. Pioneer takes it a dramatic step further in the SA-9100 and SA-8100. Direct-coupling in all stages from the equalizer amp to the control amp to the power amp. More effective? Absolutely. It achieves the finest transient response, wider dynamic range, THD and IM distortion of only 0.04% (1 watt). It's an incredible achievement.

Level set, volume and loudness contour controls adjust to listening preference

Three controls working together adjust to any degree of loudness. The level set control is the primary volume control. Its maximum loudness setting is 0dB.

Successive settings of —15dB and —30dB result in lower gain. Once the desired volume is obtained, the volume control is used for fine adjustments within the given range. While the loudness contour boosts bass and treble, it may also be used with the level set control. The more advanced the positlon of the level set control, the lower the effective range of the loudness contour.

The original and positive speaker protector circuit

Since the signal is fed directly to the speakers because of direct-coupling, an automatic electronic trigger relay system is incorporated into the power amplifier. This protects the speakers against damage from DC leakage which can also cause distortion. It also prevents short circuits in the power transistors.

Maximum convenience for program source selection

While there is a multiple function rotary switch for microphone, phono 2 and two auxiliaries, Pioneer has included an additional convenience. A separate flip type lever control for instant switching between the more widely used tuner and phono 1 and any other single program source. Incidentally, both switches are shielded to protect the input against undesirable extraneous signal pickups.

Convenient program source selection switch & control lever.

Two-way tape duplicating and monitoring

There are two separate flip type switches on the front panel of the SA-9100 for tape-to-tape duplicating and monitoring. Two tape decks can be connected for recording, playback and duplicating in either direction, with simultaneous monitoring.

Level controls for phono 2, aux 2

In order to match the level of various inputs, individual level controls are provided for phono 2 and aux 2.

Speaker B control

This special control helps in the use of two pairs of speaker systems of different efficiencies. There is no sacrifice of damping or distortion when switching from one pair to the other.

Impedance selector for phono 2

An easy-to-use switch allows you to employ any phono cartridge input (25K, 50K, 100K ohms).

Two-position high & low filters

The low filter switch on the SA-9100 and SA-8100 has subsonic (below 8Hz) and 30Hz positions. The high filter switch has 12KHz and 8KHz positions.

Maximum versatility in program sources

	SA-9100	SA-8100	SA-7100
Inputs			
Tape monitor—S/N	2-90dB	2-90dB	2-90dB
Phono—S/N	2-80dB	2-80dB	2-80dB
Auxiliary—S/N	2-90dB	2-90dB	2-90dB
Microphone—S/N	2-70dB	2-70dB	1-70dB
Tuner—S/N	1-90dB	1-90dB	1-90dB
Outputs			
Speakers	3	2	2
Headsets	1	1	1
Tape Rec.	2	2	2

Consistent power for every requirement

	RMS power both channels driven 20-20KHz	RMS @ 8 ohms both channels driven @ 1KHz	RMS @ 4 ohms single channel driven @ 1KHz
SA-9100	60+60 watts	65+65 watts	100+100 watts
SA-8100	40+40 watts	44+44 watts	60+60 watts
SA-7100	20+20 watts	22+22 watts	36+36 watts

This new lineup of Pioneer tuners and amplifiers is unquestionably the most advanced available today. Yet despite this overwhelming sophistication, they're sensibly priced.

See your Pioneer dealer. He'll show you how this series of fine instruments can outperform any units in their price range. All prices include walnut cabinets.
SA-9100—$449.95; SA-8100—$349.95;
SA-7100—$249.95
TX-9100—$349.95; TX-8100—$249.95;
TX-7100—$199.95
While not discussed here, Pioneer is also introducing the SA-5200 stereo amplifier and the TX-6200 stereo tuner for high quality hi-fi on a low budget. Only $139.95 each, with walnut cabinet.

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.

PIONEER®
when you want something better

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Audio

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Feature Articles

Equipment Profiles

Record Reviews

Audio In General

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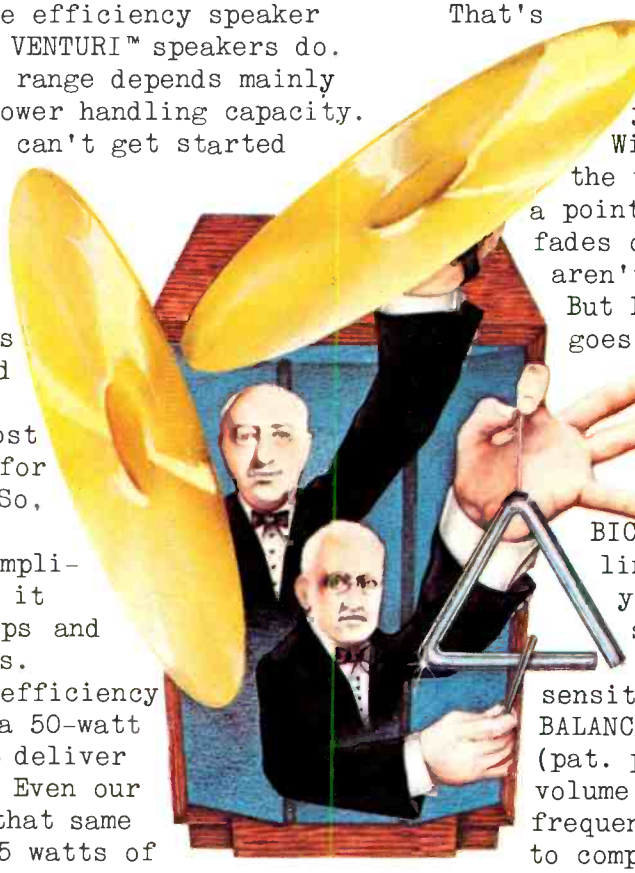
We give you the softest soft to the loudest loud. Choose any model. You won't get 'clipped.'

Today's best recordings can reproduce music's full dynamic range, from the softest soft to the loudest loud. Most of today's popular low and moderate efficiency speaker systems can't. But BIC VENTURI™ speakers do.

A speaker's dynamic range depends mainly on its efficiency and power handling capacity. Low-efficiency speakers can't get started without a good deal of input power. And, they tend to get stifled when driven beyond their capability.



BIC VENTURI speakers are efficient! They need as little as one fifth the amplifier power of most air suspension systems for the same sound output. So, you can listen louder without pushing your amplifier to the point where it starts clipping the tops and bottoms of musical peaks.

Today's popular, low-efficiency speakers require about a 50-watt per channel amplifier to deliver lifelike sound levels. Even our Formula 2 will deliver that same sound level with only 25 watts of amplifier power; the Formula 4 with 20 watts and our Formula 6 with only 9 watts! With BIC VENTURI, your amplifier can loaf along with plenty of reserve "headroom" to reproduce musical peaks cleanly, effortlessly. It's as if your present amplifier suddenly became two to five times as powerful. BIC VENTURI can handle lots of power, too. A typical, low-efficiency system is rated for a maximum safe power input of about 50 watts. Feed it more power and you're likely to push it into distortion, or even self-destruction!

With a BIC VENTURI you can turn up the power, without distortion or speaker damage. Even our compact Formula 2 can safely handle 75 watts per channel. With that much power feeding it, it will deliver 210% more sound output than a low-efficiency system will at its power limit. Drive our super efficient Formula 6 at its maximum, and it will deliver nearly 1300% more sound power!

That's the loud half of the story. With soft music (or when you turn down the volume) you want to hear it soft. With most speakers, turn down the volume slowly and you reach a point where the sound suddenly fades out because the speakers aren't linear anymore.

But BIC VENTURI's are. The sound goes smoothly softer, without any sudden fadeout, retaining all the subtle nuances that add to the character of the music.

But, even though BIC VENTURI speakers remain linear, there is a point where your ears do not. At lower sound levels, your ears lose their bass and treble sensitivity. So, our DYNAMIC TONAL BALANCE COMPENSATION™ circuit (pat. pending) takes over. As the volume goes down it adjusts frequency response, automatically to compensate for the ear's deficiencies. The result: aurally "flat" response, always!

Our Formula 2 is the most efficient of its size. The Formula 4 offers even greater efficiency and power handling. And the most efficient is the Formula 6. Hear them at your dealer.

BRITISH INDUSTRIES COMPANY,
Westbury, N.Y. 11590.
Div. of Avnet, Inc.
Canada: C.W. Pointon, Ltd., Ont.

BIC VENTURI

Check No. 7 on Reader Service Card

WE HAVE CHOSEN THIS RATHER UNORTHODOX WAY TO PRESENT THE NEW B·I·C™ TURNTABLES—BECAUSE THE NEW B·I·C TURNTABLES ARE RATHER UNORTHODOX.

Traditionally, new audio equipment (new anything for that matter) is introduced with orthodox "product shots".

In the case of the B·I·C 980 and 960 we're breaking that mold. We're taking you inside and underneath—because much of the real beauty of these instruments lies in the innovation and engineering that's there.

In the exploded view at left you see a combination of things not found in any other turntable—a belt drive system and a record support post. Never before has there been a belt drive turntable with automatic multiple play capabilities. Only B·I·C has this combination.

At right you can see the B·I·C program panel. With it you can operate these turntables manually. Or you can elect to play a single disc automatically. Or you can repeat a single disc as many as 6 times. Or you can play from 2 to 6 discs in series.

For the first time one turntable combines the advantages of a manual unit with the convenience of perfect automatic record handling—without sacrificing playback performance.

The Worm's Eye View

The underside of the turntable is revealing.

Compare it with the underside of any unit you choose and you'll be struck by the simple, clean appearance of the B·I·C

Many moving parts found in turntables with automatic features have been eliminated. (We've sold and serviced millions of automatic record players over the past 37 years and one thing we've learned is that simpler is better and less is more.)

The motor is a 24-pole, 300 RPM unit. It has the torque to move the platter to playing speed in ⅓ a revolution. The 1800 RPM units used in automatic turntables are simply no match for its smoothness, silence, and durability.

Only B·I·C has a 300 RPM 24-pole motor.

The 4 shock mounts at the edge of the unit plate form an acoustically damped interface between the unit plate and base. These hollow rubber, spherical cushions were designed specifically for B·I·C Programmed Turntables.

Conventional units use metal springs.

Other Intriguing Features

The B·I·C tone arm includes features you won't find on any other arm at any price.

The cartridge shell can be adjusted so that optimum 15° tracking can be achieved no matter how deep or shallow your cartridge body is.

Cueing time can be adjusted for from 1 to 3 seconds via a knob on top of the unit.

Seven other adjustments can be made from the top of the instrument which permit easy fine-tuning of the tone arm system, to a greater degree than has ever been possible before.

The control tabs and linear scale for anti-skate and tracking force adjustment are unique.

The cycle button which controls play is unique.

Etc. Etc.

Dependability

B·I·C Programmed Turntables are made in the United States, in our own factories. We mention this because quality control is probably *the* most important factor in building this kind of equipment. The fact that the specifications for these turntables have been created and quality controlled by B·I·C is more important than you might guess.

Also, the considerable investment you are making in a B·I·C turntable is going into the turntable—not into import duties, currency fluctuations, and transportation.

Performance

The B·I·C 980 and 960 bring you an order of performance which is both outstanding and fast becoming *essential* in the new era of 4-channel reproduction.

They are bound to be copied.

For the time being, however, they are absolutely unique in their field—fundamentally different from any other turntable, be it fully automatic, single-play automatic, or manual.

We barely have space here to hint at the things you should know about these turntables.

Your audio dealer has a comprehensive 26-page booklet about them which includes performance figures, dimensions and details about the B·I·C 2-year warranty.

Get this booklet . . . or write for more information to Dept. A, British Industries Co., Westbury, N.Y, 11590.

We think you ought to compare turntable features before you buy. And if you compare ours with any and all others you're considering (price no object) we'll be happy. We think you will be too.

B·I·C™

The 980 and 960 are identical except for the 980's electronic speed and pitch control circuitry and its lighted strobe. Accessories available include solid oiled-walnut wood base — matte black molded base — and hinged dust cover. The 980 will sell for approximately $200. The 960 for about $150.

Check No. 8 on Reader Service Card

Audioclinic

Joseph Giovanelli

Rise Time

Q. What is meant by "rise time"? How does rise time pertain to the sound of an amplifier?—Rawn Stafford, Gainesville, Florida

A. "Rise time" refers to the amount of time required for a pulse fed into an amplifier or other device to produce full amplitude at its output. Hopefully, this will happen as soon as the pulse enters the amplifier. In fact, however, there is a certain amount of time required for the various circuits to produce their outputs.

The faster the rise time, the better the equipment will reproduce transient sounds such as percussion instruments.

Pink Noise

Q. What is "pink noise"? How is ⅓-octave pink noise used in testing equipment?—Paul C. Lutz, Louisville, Kentucky

A. If one built a noise generator, chances are that the noise would produce signal over the entire audio spectrum. If one devised 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 ⅓-octave "pink noise" is a special case of such pink noise, where the spectrum is divided into very narrow segments, each of which is ⅓-octave wide.

Such pink noise segments are often used to evaluate the performance of equipment because its waveform is often difficult for equipment to reproduce, especially with transducers, such as loudspeakers. The waveform produced by the speaker or other device is compared to the waveform of the "pink noise" which feeds into the device under test. The closer the input and output waveforms appear to be alike, the better is the equipment under test.

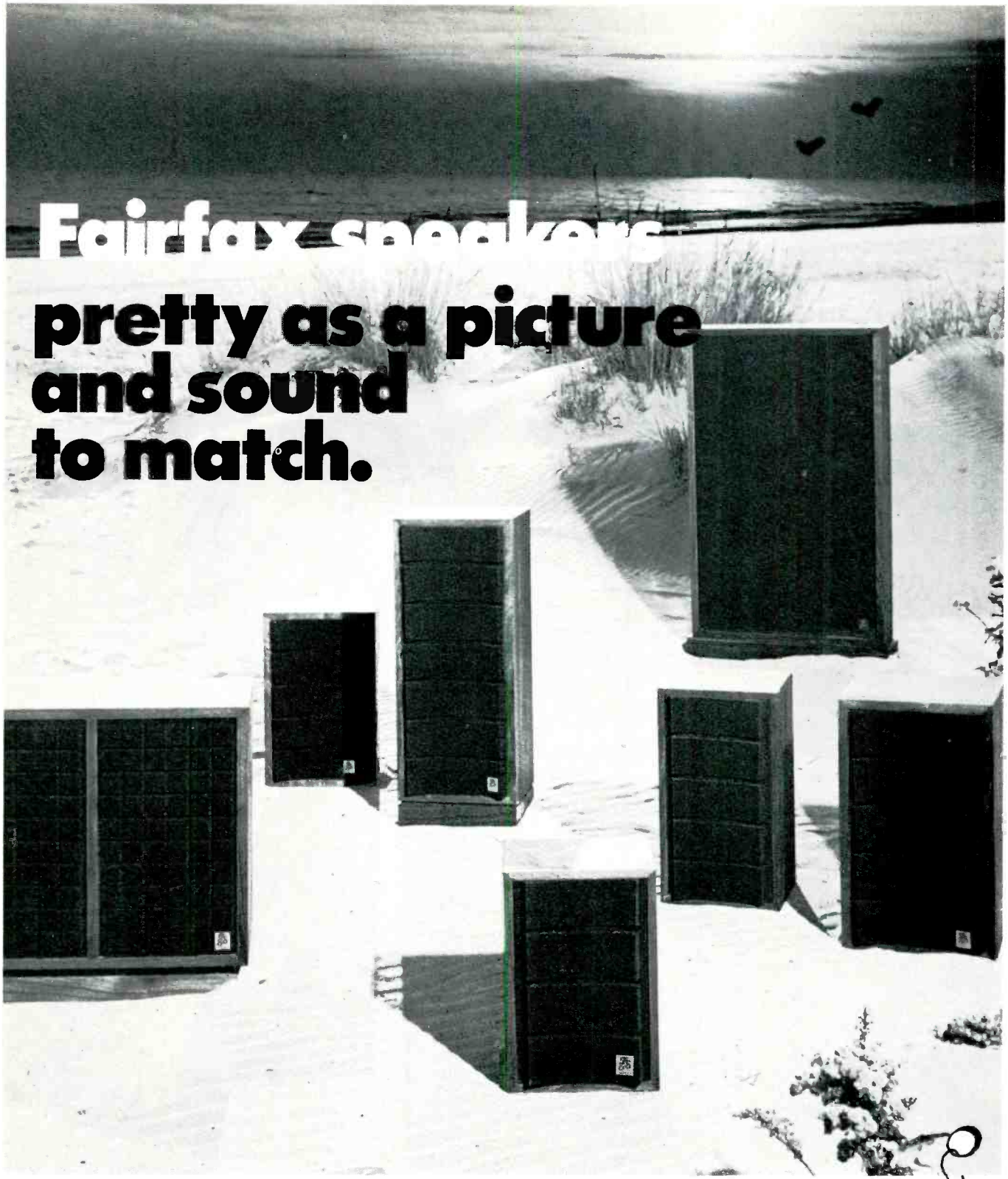
Listening rooms contain very sharp peaks and dips in their frequency response. They are often narrower than a ⅓-octave portion of the audio spectrum. However, these ⅓-octave segments represent a good compromise between performance and the complexity of the controls required on equalizers designed to correct for these peaks and dips of listening rooms. What happens is that signals are transmitted by means of calibrated transducers, and picked up at some other point in the room to be adjusted, by suitable, calibrated microphones. The signal consists of pink noise. A room equalizer, consisting of ⅓-octave boost and cut modules is used, and the controls are adjusted for best overall frequency response at some given listening point in the room. Note that the equalizer modules are made to match the segments of the pink noise used for calibration.

Connecting VU Meters to a Power Amplifier

Q. Could you tell me how I may attach two VU meters so that I can monitor the sound level from my stereo system? My equipment comprises a Dynaco PAT4 preamplifier, Dynaco Stereo 120 power amplifier and KLH 5 speakers, Sansui AM/FM tuner and a Miracord table.—Phillip E. Kalanz, Victorville, California

A. VU meters are connected across the speaker terminals of each channel. When calibrating, they should show you proper channel balance. Their calibration can be made to show when the amplifier is driven to maximum power output or can be set for a zero VU reading at some listening level which you would not want to exceed. If this listening level represents the lower power requirement, this is the best way to use the meters. I will assume that this is what you want to accomplish.

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.



To listen to a Fairfax Supersound system is to listen with no distortion and no coloration. You hear only the natural sound and presence of the source, with true pitch, zero overlap and total musical balance.

Sound is not the only area where a Fairfax Supersound speaker system outshines the competition. Our cabinetry, cut and crafted in our own factory, is made of the finest American oiled walnut veneer, and the craftsmanship rivals that of the finest furniture makers.

Fairfax speaker systems are recognized (and sold) throughout the free world as superior sounding speakers.

You owe it to yourself to make a side-by-side comparison test of a Fairfax speaker with any other speaker you're considering.*

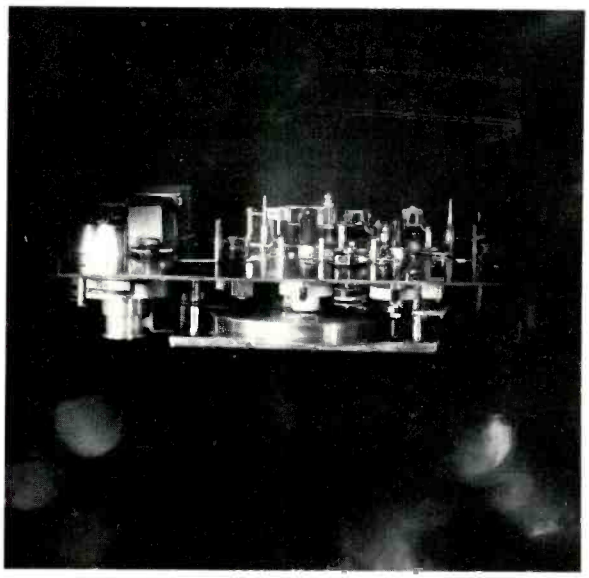
FAIRFAX fss THE SUPERSOUND LINE

FAIRFAX INDUSTRIES INC.
900 Passaic Avenue,
East Newark, New Jersey 07029
In Canada: Omnimedia Corp. Ltd., Lachine, Quebec

*If your dealer is not a Fairfax dealer and you want to make the comparison, have him contact us and we will send him a pair of speakers for your evaluation. No other speaker manufacturer has the confidence to make such a claim.

Check No. 12 on Reader Service Card

The only cassette deck in town.



All cassette decks offer convenience. And simplicity of operation. Now let's separate the men-decks from the boy-decks. There is only one moderately priced cassette deck which offers performance specs not touched by any other cassette deck in the world (except our own more expensive 450). The TEAC 360S.

For openers, it has a memory rewind counter (to simplify your "search" time), a Light Emitting Diode (to warn you of sudden peak levels during recording), separate 3-position bias and equalization switches (to adjust for different types of tape).

Yes, but what about the *sound?*

We thought you'd never ask. Because of our new transport drive system, the TEAC 360S has an incredible 0.07% record and playback WRMS wow and flutter—which is an engineer's way of proving the 360S is virtually free of noise which has characterized most cassette decks.

Now add Dolby* Noise Reduction circuitry, enhanced by Dolby calibration controls and tone generator, and what do you have?

The only cassette deck in town. (Present TEAC company excepted.)

Check it out first thing.

The TEAC 360S.

TEAC®

The leader. Always has been.

*Dolby is a trademark of Dolby Laboratories, Inc.

TEAC Corporation of America—Headquarters: Dept. A-42A, 7733 Telegraph Road, Montebello, California 90640—TEAC offices in principal cities in the United States, Canada, Europe, Mexico and Japan.

Tape Guide

Herman Burstein

Adjusting Bias

Q. When adjusting bias on the left channel of my Ampex AG-500, the VU meter reading increases with adjustment, even though peak output on tape has been reached. The right channel will peak and the indicator shows an output drop on the VU meter as the bias peak is passed. Both channels are recording OK, but monitoring from the left channel is guesswork due to the VU needle standing halfway to O VU. Can you please advise me on troubleshooting?—Howard Levi, Chattanooga, Tennessee

A. Possibly the record calibration of your VU meter, left channel, is incorrect. This is suggested by your statement that the VU pointer fails to reach O when recording on the left channel.

From your description, I am doubtful that you are adjusting bias correctly. Using an input signal of about 1,000 Hz (Ampex sometimes recommends other frequencies), bias is to be adjusted until *output* signal reaches maximum. It is sometimes recommended that bias be further *increased* until signal output drops about ½ dB. Thus a correct adjustment of bias would call for the VU pointer going up when the meter is set to read bias but down when the meter is set to read output signal.

Possibly on your left channel you are mistaking a bias decrease for a bias increase. A bias decrease would cause signal output to increase slightly, using optimum bias as a reference.

Playback Equalization

Q. I have a question about playback equalization at 15 ips. Is the NAB curve for 15 ips the same as for 7-1/2 ips? I have found that when recording at 15 ips on my tape machine, a modified TEAC A-4010S, I can get a flat-sounding record-playback response by reaching behind the machine and disconnecting the equalization cable between the transport and the recording electronics. (This does not affect playback equalization, merely record equalization.) I have never had occasion to run a curve at 15 ips with the above-mentioned cable unplugged; the only criterion I can judge it by is that it sounds good. And good sound is what the whole game is all about.—Name withheld

A. I don't know why you get sound more apparently flat to the ear with the record equalization cable unplugged. At 15 ips, the record equalization (treble boost) isn't nearly as much as at lower speeds, so that unplugging the cable may not make much audible difference. Also, unplugging the cable may compensate for some other fault, such as a deficiency in treble response due to a worn playback head.

The NAB playback characteristic is the same at 15 and 7-1/2 ips; the only, and slight, difference in the equalization provided by the playback preamp might be to allow for differences in the playback head's response at very low and very high frequencies at the two speeds. What basically differs between the two speeds is record equalization. At 15 ips, less treble boost is required in order to compensate for losses that occur in recording. The means of adjusting record equalization at 15 or 7-1/2 ips is as follows. First, the machine's playback equalization is adjusted to provide flattest possible response when playing a standard test tape for the speed in question (it is presumed that the machine has first been adjusted for correct azimuth, and that heads, guides, etc. have been cleaned and demagnetized). Then the record equalization is adjusted so as to provide flat response on a record-playback basis (after first setting bias in accordance with the manufacturer's recommendations).

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.

Introducing Dual's new generation.

A matter of subtle refinement rather than radical change.

If you've known previous Duals, our new generation will look familiar. Which is not surprising since no radical change has been made in design or technology.

Dual, after all, is the multi-play turntable that music experts—record reviewers, audio engineers, hi-fi editors—have long preferred to use in their personal systems.

The reason is simple: Dual provides superior performance (with the added convenience of being fully automatic). And because of Dual's proven reliability, many owners are reluctant to give up their original Dual; even after ten years of constant use.

Through the years Dual has introduced many "firsts" among automatic turntables: pitch control; separate anti-skating scales for different stylus types; gimbal tonearm suspension, and rotating single-play spindles.

Dual engineers have never strayed from their original concept: to build every Dual turntable with more precision than you are ever likely to need. For example, even the lowest-priced Dual can track flawlessly at one gram.

Another Dual policy: refinements introduced on the higher-priced Duals typically appear later on the lower-priced models. For example: illuminated strobes, rotating single-play spindles, low capacitance tonearm leads and the special anti-skating scale for CD-4.

With these subtle refinements, each Dual remains the most advanced multi-play turntable in its price class. Radical change, after all, is necessary only when one is radically behind. Dual®

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Dual 1226, $159.95

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Check No. 39 on Reader Service Card

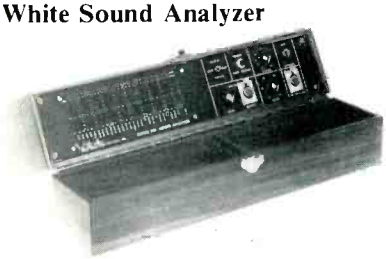
What's New In Audio

Benjamin Turntable

The Elac/Miracord 820 automatic turntable features simplicity of operation—by setting the turntable speed for 33 1/3 or 45 rpm, the tone arm automatically sets stylus drop point. Other features include a pressure-formed platter driven by a four-pole asynchronous motor; variable pitch control with built-in stroboscope ring, and calibrated anti-skate mechanism for eliptical and conical styli. Price: $129.95.

Check No. 60 on Reader Service Card

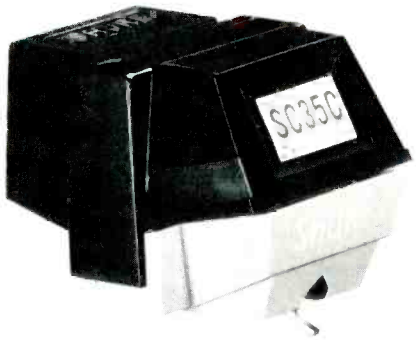
White Sound Analyzer



Model 140 is a real time analyzer featuring an LED graphic display, 11 high by 28 wide in 27 one-third octave channels from 40 Hz to 16 kHz. Each of the channels consists of a double-tuned filter for maximum rejection of out-of-band noise, followed by a converter and an appropriately weighted smoothing network. A high-gain front-end, which can be calibrated for display of true dB-SPL using a standard dynamic microphone, provides a dynamic range of 40 dB-SPL to 110 dB-SPL in six 10-dB steps. A line input is provided for analysis of line-level signals, as well as a pink-noise generator, which provides flat output from 40 Hz to 16 kHz at either high level or mic level. Price: under $2500.

Check No. 61 on Reader Service Card

Shure Stylus for 78s



The SC35C cartridge and SS78E stylus are specifically designed to play 78 rpm records. In most cases, says the firm, the combination will produce better tonal quality and less surface noise because the large elliptically-shaped stylus tip plays a different section of the disc's groove than a standard conical tip does. This cartridge and stylus assembly can be mounted in any equipment which permits tracking at the proper 4-to-5 gram range. They can play all lateral 78 rmp discs or can be wired to play the vertically modulated "hill and dale" electrical transcriptions. Price: SC35C, $24.00; SS78E, $12.00.

Check No. 62 on Reader Service Card

Braun Loudspeaker

The L 810A is a three-way acoustic suspension system employing two active 8-in. high compliance woofers said to produce optimum transient response and improved low mid-range dispersion. The midrange driver is a 2-in. soft-dome acoustic suspension system using a single layer voice coil and 5-lb. magnet structure. The tweeter is a 1-in. soft dome, driven by a 15,000 Gauss magnet, whose specifications are said to result in excellent dispersion and transient response at low distortion level. Frequency response is 20-20,000 Hz DIN; crossover frequencies, 500/4,000 Hz; impedance, 4 ohms: minimum amp power required, 20 watts (rms); size, 25¼ in. H x 12¼ in. W x 11¾ D; choice of finishes and grilles. Price: $299.50. Optional floor stand (LF 700): $37.50.

Check No. 59 on Reader Service Card

Audio Response Analyzer

Communications Co., Inc.'s ARA-412 response analyzer converts almost any oscilloscope into a real-time audio analyzer covering the frequency range from 40 Hz to 16 kHz with 27 parallel bandpass filters. It can be used for testing speakers, mics and tone controls, as well as adjusting crossovers, tape heads, and equalization. The display range is 27 dB, which can be shifted continuously over the entire measurement range. Outputs are vertical to 150 mV d.c. input to any 'scope, horizontal to 500 mV d.c. external sweep input to any 'scope. Price: $1295.00.

Check No. 64 on Reader Service Card

Literature

The new 1974 catalog from Brookstone offers 68 pages of high quality, hard-to-find hardware. The collection includes unusual craftsman's hand tools, small power tools, outdoor gear, garden tools, cutlery, welding and soldering equipment and more. All products are covered by a full money-back guarantee and are available only by mail. For a year's subscription to the catalog (six issues), send 50¢ to: Brookstone Co., 4113R Brookstone Bldg., Peterborough, NH 03458.

AKAI Tape Recorder

The 4000DB is the Dolby version of AKAI's popular 4000DS. It features three separate heads for instantaneous monitoring, SOS, SWS, and line/mic mixing. The deck is a three-motor, two speed, 7-inch component including auto shut-off, pause control and expanded scale VU meters. Price: $369.95.

Check No. 71 on Reader Service Card

Vor Disc Cleaner

The VAC-O-REC is an electric-powered, automatic record cleaning device which uses mohair brushes to loosen micro-dust particles. Vacuum cleaning action then removes the dust. As the record is slowly rotating in the unit, a static reduction system operates simultaneously, reducing electromagnetism from as high as 20,000 volts to near-neutral voltage.

Check No. 70 on Reader Service Card

Telephonics Headphones

Model TEL-101F utilizes the Fixler Effect patents, under license, for discrete quadraphonic listening. Each phone contains two high velocity, wide-frequency range dynamic drivers. An integral electrical network is user-adjustable for both channel separation and "room size." The TEL-101Fs are compatible with all standard amp headphone jack impedances. Frequency response is 20 Hz to 20 kHz and the 'phones weigh 20 oz. An optional "Quadramate" ($25.00) permits the 'phones to derive four-channel sound from stereo sources and has controls for channel separation and "depth." Price: $75.00.

Check No. 72 on Reader Service Card

Nagy Tape Splicer

Faster cutting and better splices are promised with the Model 6S25 Nagy Tape Splicer, which incorporates a self-sharpening shear, replacing the razor. A precision dovetail groove secures the tape during splicing, while the block itself may be secured via ⅛-in. mounting holes. The Model 6S15 handles cassette tape. Price: $16.95.

Check No. 73 on Reader Service Card

Behind The Scenes

Bert Whyte

THE MOST remarkable thing about the 1974 Consumer Electronic Show was its relative similarity to the 1973 CES. Held as usual in mammoth McCormick Place in Chicago, the changes in this year's show could accurately be characterized as moderate. There was a little less extravaganza, less "hoopla," the usual aura of optimism somewhat subdued. When one considers the profound political, economic and social upheavals this country has experienced in a year's time, changes which inexorably are changing our way of life, the relative stability, the "sameness" of this 1974 CES augers well for our industry. In spite of rising prices and some "belt-tightening" here and there, the high fidelity industry apparently is going to maintain the momentum it has enjoyed for the past decade.

As is usual, attempting to cover the CES is a drag. Between the vastness of McCormick Place and hotel-hopping in seach of the demonstration rooms of the various audio manufacturers, it is inevitable that you just can't "catch everybody's act." So my apologies in advance, and no slight intended . . . to those exhibitors whose demonstrations I simply was unable to attend.

For some months previous to the CES, it was predicted that at the Show there would be an extreme proliferation of universal receivers incorprating IC chips for CD-4, SQ, and QS. Not only did this not fully materialize, it also appeared that there was a mild, but general diminution of interest in quadraphonic sound. *Audio Times*, an industry publication, headlined a story "CES spotlight shifts back to two-channel." I thought this statement was a bit strong, but there was no arguing that some prominent manufacturers did not show any new quadraphonic equipment. A number of industry people expressed disappointment in the slow growth rate of quadraphonic sound, while others felt that quadraphonic sound had advanced faster and had made a greater impact than stereo in similar time spans. At any rate there was still plenty of quadraphonic equipment on display, even if some of it was not quite up to full complements of four-channel IC chips. For example, CBS claimed that at the CES there were 80 items of audio equipment with SQ decoding circuitry. They further stated that no less than 20 new quadraphonic models did indeed have SQ ICs with full-logic decoding capability. Some of these chips were in receivers with regular discrete CD-4 and QS circuitry. As you might expect, Panasonic/Technics and JVC showed several models of quadraphonic receivers utilizing CD-4 IC chips. Understandably, Sansui had several receivers, incorporating their QS Vario-matrix IC chip. But it must be said that no company was marketing a quadraphonic receiver with IC chips in all the four-channel formats.

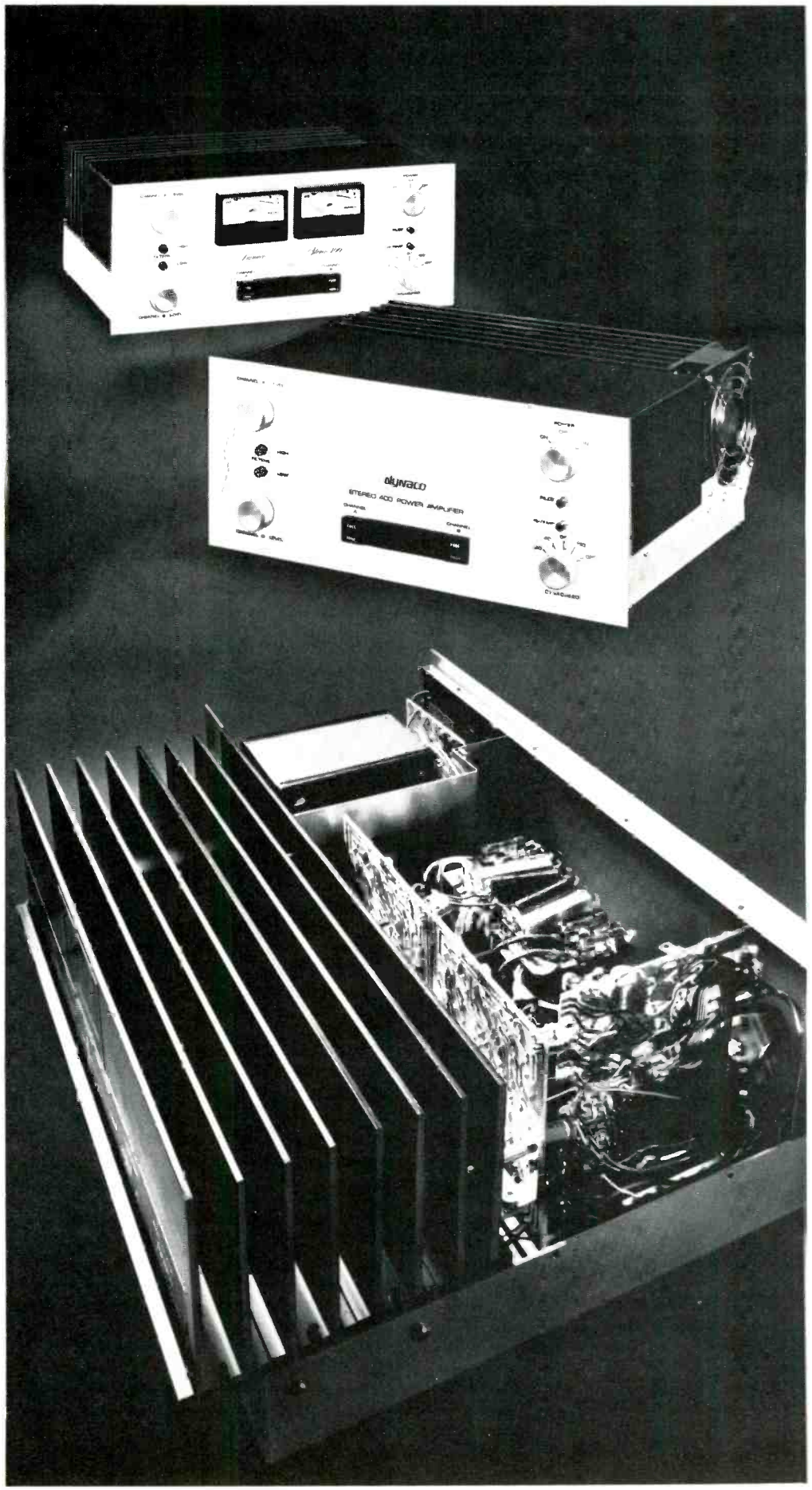
There is no doubt that stereo receivers made a big impression at the Show, with a number of companies putting a strong promotional push behind their offerings. The trends in the stereo camp seems to be bigger and better high end products featuring high amplifier power. Pioneer, Marantz, and Sylvania had units with up to 125 watts continuous power per channel at 8 ohms.

However, by far the biggest stereo news at the CES was that the FCC has approved Dolby FM broadcasting utilizing a 25 microsecond pre-emphasis, instead of the present 75 microsecond pre-emphasis. FM broadcasts of the type proposed will be allowed without notification or application to the FCC. The 25 microsecond technique was detailed in these pages some months ago. Briefly, the lowered pre-emphasis of high frequencies reduces the dangers of overmodulation during transmission. However, present FM tuners and receivers with 75 microseconds de-emphasis, would obtain a dull sound if such a change in transmission were made independently. Dolby B-Type noise reduction broadcasts normally appear brighter if the listener is not equipped with a Dolby decoder. By having a station broadcast with the 25 microsecond pre-emphasis *and* Dolby B encoding, high-quality compatible reception is obtained by all listeners. The listener with conventional FM receiving equipment will benefit by a reduction of high frequency distortion, an increase in program level, or both. The listener equipped with the 25 microseconds de-emphasis circuit and a Dolby B decoder will obtain considerably improved signal-to-noise ratio, full program dynamic range, better reception in weak signal areas, and reduced likelihood of interference. Broadcasters who transmit with this technique can provide listeners with a signal quality which otherwise would require an increase in transmitter power by almost 20 times. At the Show, Marantz and Tandberg stole a march on the competition with receivers equipped for 25 microsecond de-emphasis. (See Marantz 4400 test in this issue.—*Ed.*) I believe there is also a Lafayette tuner similarly equipped. Needless to say, many stations are investigating this new way to better quality FM, and in fact during the Show, Chicago's prestigious WFMT was broadcasting with Dolby B/25 mS.

One of the most interesting new quadraphonic developments was a new type of SQ decoder called the Tate DES (Directional Enhancement System). The system uses an IC chip developed by Martin Wilcox, former chief engineer of Sinclair, who, in association with Wesley Ruggles, will be manufacturing the chip. Destined initially for OEM users, in about six months their own brand of decoders should be available. In essence their DES goes beyond the most sophisticated logic decoders, and they claim channel separation of 40 dB. Since the best stereo phono cartridges just about reach 35 dB separation, this is really an eyebrow-raising statement! Nonetheless, in my opinion, and the opinion of others who heard the system, we had to conclude that this does indeed furnish extraordinary separation, even with difficult SQ recordings containing simultaneous information on all four channels. Nor could any pumping or breathing of the system be detected, although it must be admitted that our listening span was necessarily limited. No prices were quoted, but if the Tate DES can be marketed at a reasonable figure, SQ will have gained a formidable weapon.

Four-channel open-reel tape recorders, many of them in the higher price brackets, were noted in profusion from the likes of Teac, AKAI, Dokorder, Pioneer, etc, etc. I still ask the question . . . and not in a nasty way . . . what do the owners of these machines record on these units, and do they, in fact, record in the quadraphonic mode?

YOUR ULTIMATE AMPLIFIER



The Dynaco Stereo 400

It's all you've ever wanted in an amplifier. Power—400 watts at 8 ohms, 600 watts at 4 ohms; unsurpassed stability with any speaker; cooling capacity without equal; unmatched protection for both amplifier and speakers; and sound quality that draws raves from solid state and vacuum tube fanatics alike. A thousand square inches of heat sink—1.2 pounds of aluminum for each output transistor—plus space for an optional fan. Relay DC protection, plus exclusive DYNAGUARD™ speaker saver and a host of additional safeguards make the Stereo 400 the most reliable, as well as the best sounding amplifier extant. Optional illuminated meter kit—$75. Build it in 3 or 4 evenings with Dynaco's easy step-by-step instructions, and the simplicity of a single full color pictorial diagram. Still dubious? Send $2.50 for the detailed manual. $449 kit; $599 assembled.

Build the kit and save!

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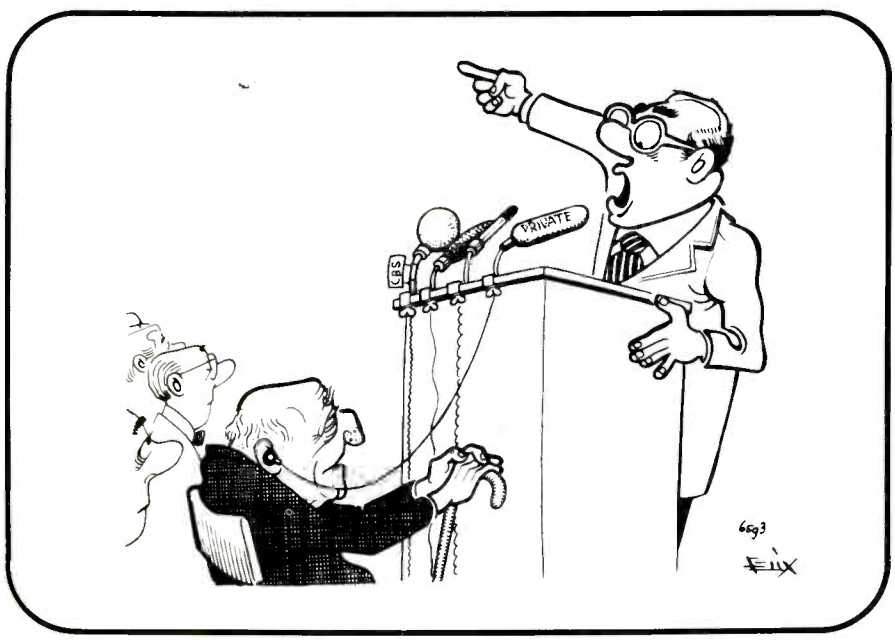
At the Bose demo room, they were introducing their new quad pre-amplifier, presumably a companion unit for their huge 1801 amplifier. The interior was on display, and the precision layout of the components on modular printed circuit boards was a delight to the eye. A feature of the unit is that optional plug-in modules for decoding SQ (full logic) or CD-4 demodulating are available.

At the Infinity room, the center of attraction was an updated model of their tri-amplified Servo-Static speaker system. Complicated and expensive though it may be, this is one of the most impressive sounding speakers extant. On a lesser scale in size, their new Monitor column-style speaker was a very clean performing unit, especially when driven by Infinity's unique Class-D switching amplifier. I visited the Infinity plant on a recent trip to the Coast, and gained a good insight into the manufacture of their interesting products. I plan on reporting on this visit very soon.

One of the most interesting and provocative exhibits this year was that of Braun, whose loudspeakers are imported from Germany by the Analog and Digital Systems company of Cambridge, Mass. Their Braun LV1020 is a tri-amplified acoustic suspension system, employing a 12-in. woofer driven by its own 55-watt amplifier, 2-in. mid-range unit driven by a 30-watt amplifier, and a 1-in. tweeter driven by a 15-watt amplifier. An electronic crossover and input and level controls for each amplifier are incorporated in the enclosure. The result is a smooth, uncolored sound, with fine transient response and good solid bass in a moderate-sized enclosure. I should mention that the Braun loudspeaker *drivers* are imported into this country, with the cabinets being made here for most of the line. Okay, this is a fine high quality speaker, but imagine if you can, a speaker system smaller than a loaf of bread. It is a two-way, bi-amplified *car* speaker, with a 1-in. soft-dome tweeter and a 4-in. long excursion woofer. There is a little black box power conditioner which converts 12 V car voltage into 60 volts to drive the power amplifiers. Since this is a stereo system, another little black box contains four power amplifiers (150 watts rms total), two active equalizers, and two electronic crossovers. When one of the Sheffield direct-disc recordings was played through this system, the very clean, high-powered output from these diminutive speakers was nothing short of amazing. As if this wasn't enough, ADS showed a digitally controlled pre-amplifier quite unlike anything I'd ever seen before. Approximately 4-in. high, by 4-in. wide, by 10-in. in depth, there are no visible controls or knobs. Instead, there is a sort of plastic faceplate, with red digital readout, and with various functions such as volume, balance, bass, treble, etc. marked out on the face of the plastic. Touching the marked function, with a pressure of less than a gram, causes two tiny gold balls to come together and complete a circuit. For example, if you touch "volume increase," the digital display actually shows the increase in decibels! Conversely for attenuation. You can do endless tricks with this device, and an option will be a *wireless* remote control permitting adjustment of a quadraphonic system from the optimum seating position in the listening room! Delivery of this unit is expected in the fall, at about the 500 dollar level.



In my February 1974 article on the Burwen Labs Dynamic Noise Filter, I suggested to Dick Burwen, that a consumer version of his device would likely be well received if he could produce one for a reasonable price. Sure enough, at the CES there was the Burwen exhibit showing the Model DNF 1200 Dynamic Noise Filter for $249.95. Dick Burwen tells me he sold quite a few of the units at the Show, and his headphone demo was very effective. Dick has just sent me one of his new units, and I will report on it in the near future.

You can always hear good music and sound at the Crown International demo room and this year was no exception. My good friend Clyde Moore, the genial sales V.P., was showing production models of his OC-150 stereo output control center, along with prototypes of his new electronic crossover. A big Crown four-channel tape deck was furnishing music for the newly updated versions of the Auralinear 212 speaker system. These are hybrid units . . . dynamic woofer up to 350 Hz, and 12 special electrostatic panels carrying on up to 30 kHz. These panels will put out huge sound pressures without arcing, and the transient response and cleanness of this system is truly exceptional.

Things That Caught My Eye Around the Show . . .

Manual turntables everywhere . . . an obvious trend and many companies are jumping on the bandwagon with some very sophisticated designs. On the other hand, the new BIC record changer is unusual in that it is belt driven, and the rumble is said to be very low. Dolby B cassette decks get fancier, more complicated, offer some impressive specs, and the average price now must be reaching $350 and beyond. My Cerwin-Vega friends were showing a new brute force monitor speaker system, and as usual the walls were bulging from their incredibly loud, but very clean sound. Audio Research demonstrated their Magneplanar speakers in a much larger room this year, and with noticeably superior results. A super smooth, unobtrusive sound. Not at the Show, but in nearby Elk Grove Village, Bang and Olufson were showing their new Beogram 4002 phono playback system, certainly one of the most sophisticated and physically beautiful designs I've encountered. More on this unit when they become available.

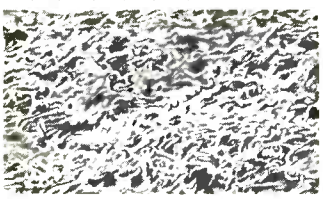
There we have it, the 1974 CES. A little subdued this year, wearisome as ever, but ultimately worth the endless trekking to see and hear the newest our industry has to offer.

How to make the sound system you bought sound like the sound system you bought.

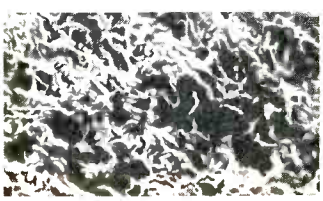
INTRODUCING NEW TDK AUDUA OPEN-REEL TAPE.

No matter how much time, effort, or money you put into your sound system, chances are it's not giving you peak performance—the level it was designed for.

Much of that gap in performance can be attributed to the inconsistencies you find in most low-noise, high-output tapes. The shape of the magnetic particles, the density and uniformity of the coating, all contribute to that total performance. And the more inconsistencies, the fewer overtones and transient phenomena you hear.



Audua coating: tight, fine, dense.



Other premium tape coatings: random, sparse.

Audua's different from anything you've ever heard before. In fact, you'll probably find that it's capable of delivering the finest sound of any open-reel tape you can buy, anywhere. Even better than our own highly rated SD. That's why SD's been discontinued.

Audua was designed to provide higher output and lower noise levels. That's because TDK designed a unique process of uniformly applying Audua's ultra-fine particles. Particles that are only 0.4 microns long and with a length-to-width ratio of 10:1. In addition, that process gives Audua a significantly better high-end frequency response.

Here's why: take a good look at the two micro-photos. Audua is denser and more uniform. It can capture more delicate harmonic overtones and transient phenomena than that other premium tape.

So try Audua. It could make your sound system perform like the sound system you paid for. Or maybe even better.

Check No. 37 on Reader Service Card

TDK®

TDK ELECTRONICS CORP.
755 Eastgate Boulevard, Garden City, New York 11530

Murray G. Crosby

It is with deep sorrow that I report the passing of Murray G. Crosby, one of the great minds in our industry, and a dear personal friend. Mr. Crosby died on June 8, 1974 at his home in Syosset, New York. He was 70 years old.

Murray was one for the foremost pioneers in FM radio technology and for many years engaged in communications research, principally in frequency and phase modulation, for Radio Corp. of America Laboratories in Riverhead, N.Y. After a stint with Press Wireless, he founded his own company, Crosby Laboratories in 1948. In 1953, Murray developed his compatible "sum and difference" method of stereo FM multiplexing, generally acknowledged by the engineering fraternity as the superior system of multiplexing. Because of FCC insistence on the retention of SCA facilities, the Crosby system lost out to the G.E./Zenith multiplexing system, with its 16-dB poorer signal-to-noise ratio on FM stereo broadcasts. It is ironic, that Mr. Crosby died the same week that the FCC gave permission for the use of the 25 microsecond pre-emphasis in Dolby B-type FM transmission, which together restore about 13 dB of that S/N ratio.

Mr. Crosby was justly honored for his achievements. In 1940 he was presented with the Modern Pioneer Award of the National Assn. of Manufacturers. In 1966, he was the recipient of the Mervin J. Kelly Award from the Institute of Electrical and Electronic Engineers, for "outstanding contributions and advances to the art of telecommunications."

Active for many years in the affairs of the IEEE, he was a Fellow of that organization, as well as a Fellow and Honorary Member of the Audio Engineering Society.

Since 1961, Mr. Crosby had been engaged in engineering, consulting, and inventing. Holder of over 200 United States and foreign patents, his last patent, on a sub-audible coding system for statistical verification of FM radio and TV commercials, was issued to him the day before he died.

Murray was a quiet, affable man, with a great sense of humor. We shared a mutual love of the sea, and I have fond memories of many boating trips we made together. It was an honor to have been a friend of such a brilliant man. He will be missed.

Bert Whyte

JVC's exclusive SEA prevents wasted watts!

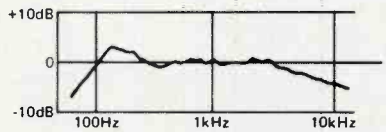
$50 out of every $100 you spend on a hi-fi receiver may be on wasted sound!

Poor room acoustics . . . thin walls . . . low ceilings . . . unusual room layouts . . . individual characteristics and mismatches of the various components can all rob you of the sound you're paying for.

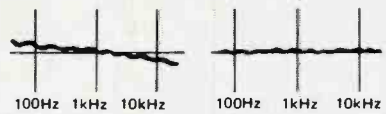
That can't happen with a JVC receiver featuring our exclusive Sound Effect Amplifier . . . SEA . . . circuitry which gives you complete freedom and control over sound throughout the entire audio frequency range. SEA allows you to adjust the acoustic response of the typical home listening room to provide a flat and uniform response. Just look at the curves in two typical rooms before and after room equalization. SEA divides the audible spectrum into five crucial frequency zones or ranges permitting you to compensate for room acoustics, poor room layout or to match sound characteristics of the different components. It even provides an unlimited choice of tonal balance to suit your personal tastes for various kinds of music . . . allowing you to create your own sounds when listening or while recording.

So don't pay for **wasted sound** — control it with SEA — a patented graphic equalizer tone control system only in JVC components.

JVC HI-FI the best value your money can buy.

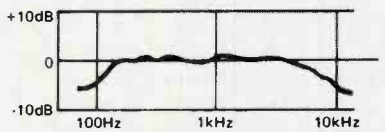


Transmission Characteristic of a Room Where the Lows Tend to be Emphasized

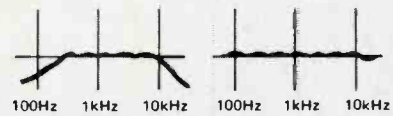


Corrected by conventional Tone Controls

Corrected by S.E.A.



Transmission Characteristic of a Room Where the Both Lows and Highs Tend to be Absorbed



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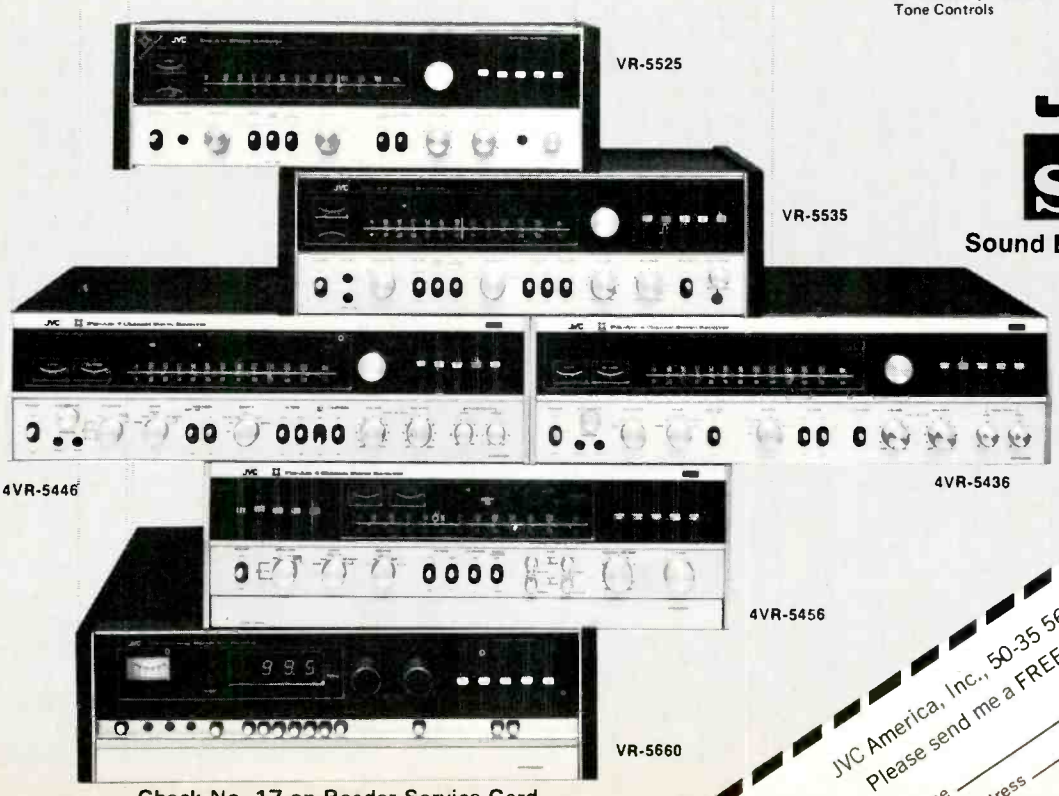

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Rimsheen

As one Japanese map and guide sheet puts it for its Japanese users, Hellow again! No matter that the spelling is off; the intent is clear—*moshi moshi* in the local language. But in Japan the Japanese don't use the vernacular for headings and salutations if they can find an English word—even if they must invent the English.

It's wonderful. The body of texts is of course in Japanese characters. But the categories, the titles, the eye-catching slogans, are now almost universally in our language, as are the delicacies offered in stores and the items of the popular Japanese menu. Such a creative people! The intuitive tradition of many centuries, the elegance, the artistic sensitivity, are far too strong to be lost in the shuffle to go Western. Their "Western" food, everywhere, is aboslutely delicious—and so different. Very Japanese. And the language called English is the same.

I laughed myself sick over Japanese English when I was there, but the laughter was backed by respect, of the same sort that we in audio must accord the Western-derived Japanese hi-fi equipment now so prominent in our own markets. It is a strong, intelligent, and creative use of English that leads these people into such endearingly amusing, such delightfully uninhibited exploration of a foreign mode of expression. It's the same creative use of electronics technology that brings us the hi-fi, so familiar to us from AKAI to Yamaha (Zenith having dropped its Japanese line a while back).

Take, for instance, Mix Pigg. Yep, that's precisely what it said on the menu of a busy Osaka (I think) noontime eatery. You could also order Mushroom Pigg. Then there was a list of goodies under the general category SPECIAL SERVES SET. You could have a Sand Wich Set or a Hot Dog Set. Also a Sand Wich Hamberger Pizz. And more. My colleague Ivan Berger, of *Popular Mechanics*, was immediately intrigued by the Cheese Berger, since he had once found a similar berger in a place called Ivan's somewhere in our own Southwest. The Ivan Berger.

For dessert there was a special—Tropical Ice Cream (a Special Serves Set?). Relationship to a baked Alaska? I didn't try it. In fact, I ended up with a plain old Chocolate Sundae, but had to leave most of it because the lines of waiting Japanese behind every seat were getting longer and longer. The place was jammed and when my fast-eating friends left me, there I was, the only non-Japanese anywhere in sight. This was strictly Japanese eating, I assure you. The name of the crowded sundae joint was NICE ICE CREAM. So you see what creative English is like.

Which reminds me of the batteries of cold drink dispensers, automatic change-making, which line up at the entrance to every famous shrine, temple, garden, railway station or other tourist spot (Japanese tourists) beside the big parking spaces full of fat busses. The favorite brand, in many lovely fruit flavors, is called MY SODA, in English, right on the pop-top cans. But MY SODA is always flanked by Pepsi and Coca Cola, same cans, same English. It's all one big integrated culture, just like our hi-fi shops (and theirs) where Marantz and Scott line up next to Sony and Pioneer. Or is it?

One could almost speak of the young Rome gobbling up Greek culture in its haste to expand—but let's not, because this is different. Japan is both very young and very old, which is a curious state of national existence. Wolfing down a new outside culture—yes, even unto Mix Pigg. But by no means abandoning some 2500 years of pretty much isolated traditional civilization, untouched by Western ideas, to all intents and purposes, until the day before yesterday. The conversion to Westernism, the gobbling up of Western ideas and technologies and language, is sudden, all-out, and violent and it is far from completed.

The longer one stays in Japan, the more one realizes that this extraordinary energy of conversion, the seemingly uncritical and headlong rush into Western ways, is the product of this very contradiction between old and new. Like the almost violent hybrid vigor out of two crossed plant lines, distinct but related, these two highly developed civilizations of ours all but unknown to each other for 25 centuries or so are suddenly crossed, in less than *one* century and mostly the last quarter of that! A true flare-up, a supernova.

It is the smaller, older culture, dormant for so long, that has produced the hybrid energy. Our own has provided the fuel but it is theirs which runs on it. We are passively affected, mainly by the feedback of products and ideas.

Sometimes this concentration is more than we can take. We simply are not geared for such intensity. Last week I got a succinct 'phone report on

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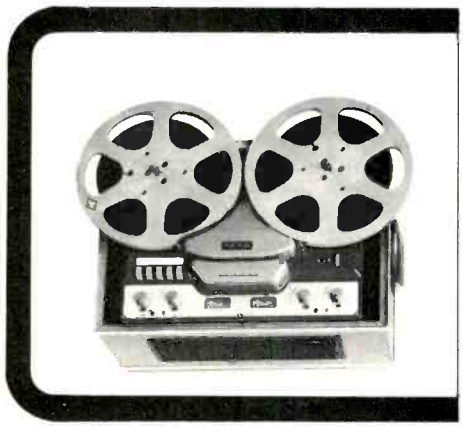

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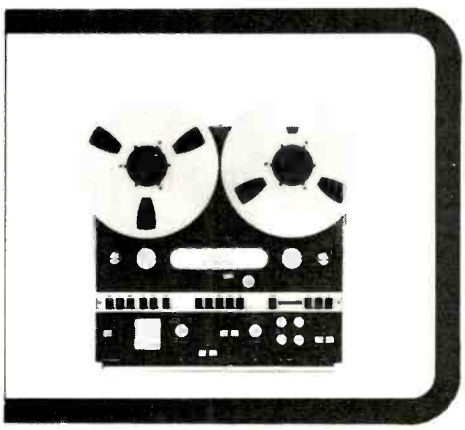

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a Japanese tape recorder motor that had failed me at 7½ ips, though 15 was OK. Yes, they said, the slow speed windings were gone. But they wouldn't touch the thing. Only Japanese fingers could get into *that* motor! If we did fix it, we would charge 100 times the cost of a new motor. Exasperation! And it is, indeed, a beautiful motor, too fine for our clumsy repair fingers. I'm not sure what the lesson is but it's part of the picture. Maybe it was my bungling that made it fail? My mind is still open.

On Japanese color TV (fresh and new in every hotel room) the commercials are as rampant as ours and much gaudier. Instead of one-minute plugs, theirs run only about ten seconds—but they come 15 or 20 in instant succession, all in moments. Hyperactivity! No time to go any slower. Such interesting shapes and designs, even so, especially in the dramatic Japanese written characters, ornamental without even trying.

Maybe I'm nuts but I found the same thing in the Tokyo business streets—beautiful to look at in all their color and variety, consummately artistic, those photogenic characters splashed over dozens of tall vertical signs and hugely built into the tops and sides of buildings in vivid colors, the sidewalks below them awash with overflow goods parked along the curb, and around and between, that carefully tended greenery and extreme neatness which no amount of Westernized hurry has yet forced aside. A color-conscious and form-conscious civilization still, as it has been for centuries. I only wish we had one hundredth of that feeling for our own street displays. (Of course, admittedly, I can't read the Japanese characters on the signs so they are for me an abstract art. Would the Japanese feel the same about our billboards? I doubt it.)

For all the Tokyo smog, which is bad and gags the lungs, as it does in all the big cities, and for all the industrialization, which renders endless miles of landscape into factory and power-line scenery, these people have not lost their sense of cleanliness and order, which is next to godliness. So little dirt! So much color. Such pervasively beautiful greenery, cultivated and luxuriant in even the most overbuilt areas, in the middle of city streets, in verdant arrangements around parking lots, between crowded hovels, in front of stores, everywhere flourishing and neat. Vacant lots? They are all made into rice paddies, three-inch-deep lakes with incredibly perfect rows and rows of bright green rice shoots, all hand planted, reflecting the sky and the clouds and trees and factories. Ah, for a rice paddy in Times Square.

And the elevated superhighway down the East Coast industrial corridor is tinted Pompeian red on its concrete sides—suddenly, it is handsome. And the omnipresent narrow gauge electric railways sport shiny, clean trains in fruit flavors—I saw peach, lime, grapefuit, lemon, pear and raspberry. And not a graffito in sight—who needs them. Everything in Japan is color coded and the emergency EXIT signs are green, not red. Why not? They don't say stop, after all. They say GO (when & if). Reasonable, yes? If you think Japanese.

Also quite reasonable to say yes, yes!, beaming, when actually you mean no. It is not good manners to say no, in one word or in many. And it is good manners, and considerate of the other person, to tell him the things that please him. So they do—and so snafu.

It is all extremely reasonable, if you can only look at it the right way. Very polite and very thoughtful. But it can sometimes get in the way of Progress, as our businessmen know. No? Yes. The Japanese have lived with politeness for centuries. Their language itself is built for factful circumlocution and can scarcely be forced into a blunt, factual statement of any sort; can Japanese English be different? This is much more profound than mere word meanings—it is a mystifying clash of temperament and way of life, as between East and West, and no amount of translation can resolve the mystery.

For instance, after a long day of factory visiting, our big Japanese bus heads back towards the "hotaru" (as you say to the taxi drivers)—the hotel. Dinner, says our JTB guide, Tami, will be at six-thirty. Good-natured groans from us—can't we make it seven? No engagements for the evening. And the dining room, after all, is open at least until ten. A half hour more to rest, a bit more late daylight to look around with. Yes, yes! beams Tami, all smiles. Yes, surely understand. And so we relax, happily. Oddly enough, though, dinner occurs at exactly six-thirty. You figure it out.

One learns simply to wait for results, to see what happens. As a Westerner, you really do not know the results of communication, until you see them. English or no, here is a fundamental aspect of the old civilization that has scarcely changed in the few moments since Westernism came to this little country. Can we object? From the other viewpoint, remember, *we* tend to be blunt, tactless, self-centered and, above all, inconsiderate of other people's feelings. One *must* proceed with tact and care—that is what civilization is all about, after 2500 years.

We can't possible make an issue of

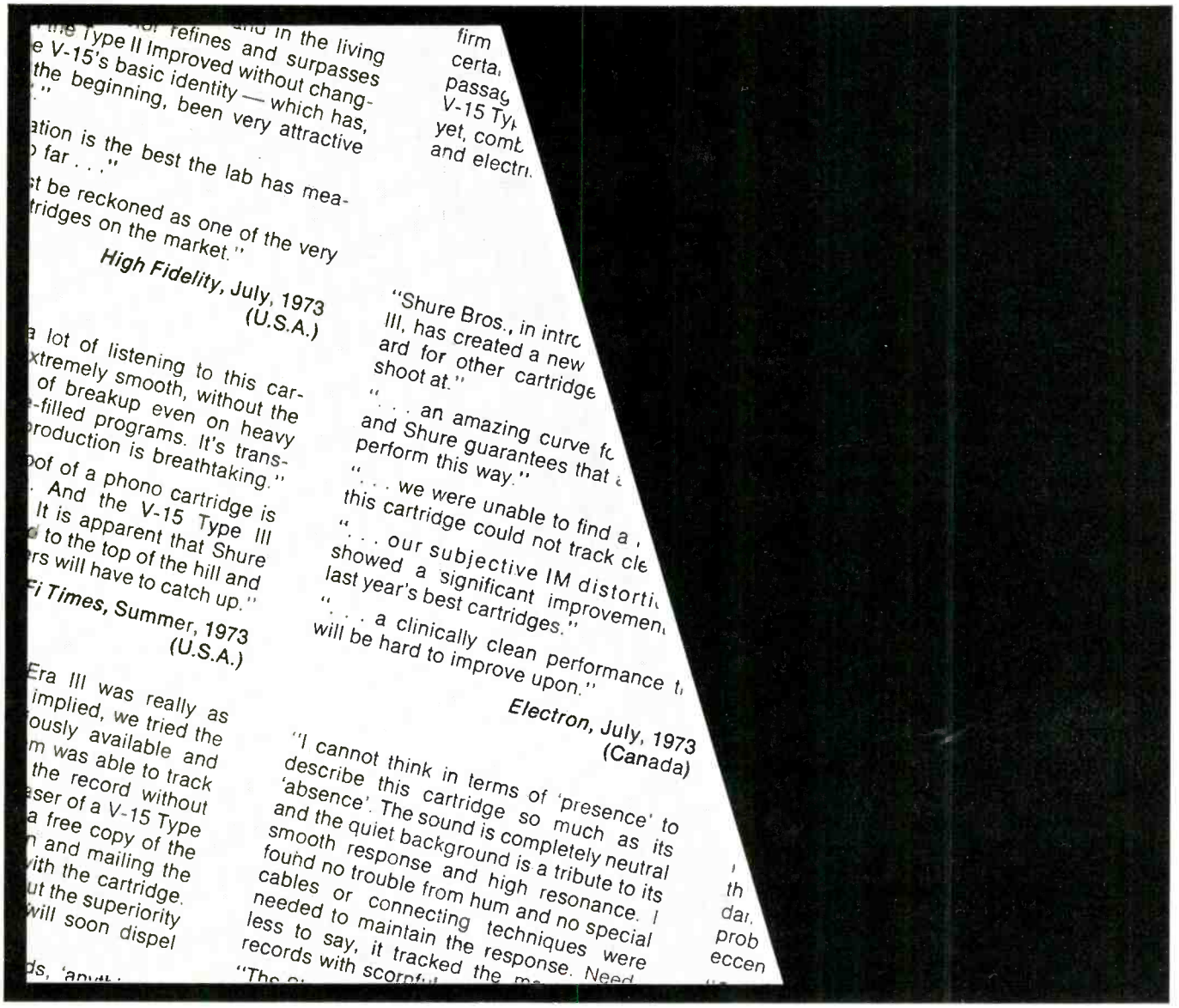
Glossary of Japanese English Seen and Heard 1974

Radies and genrmen	Ladies and gentlemen
Glass	Grass
Grass	Glass
Flame	Frame
Frame	Flame
Unfortunatery	Unfortunately
Reyi-able	Reliable
Chisso	Chips (electronic)
Bonanza	Crossword Puzzle
X	Prototype
Especiary	Especially
Froating on Lubber	Floating on Rubber
Discleeto soundo	Discrete Sound
Reary enshoyed	Really Enjoyed
Need youa hairf	Need your help
Rimsheen	Limousine
Dizhitaw	Digital
Eel	Yield

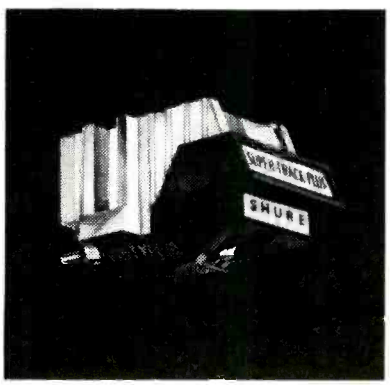
Typical misunderstanding:
English statement: *"It should go well with the meat."*
Japanese answer: *"Yes—strawberries!"* (Ichigo means strawberries.)
Japanese statement: *"It is just next to the door."*
English meaning: *Next door.*
Japanese sound: *All four phrases of the "Big Ben" tune on chimes.*
Japanese meaning: *Coffee break—at 3:20 p.m. for ten minutes.*

Auto models (car names):

Bluebird	Fellow Max	Cedric
Sunny	Laurel	Lancer
Violet	Gloria	
Cherry	Skyline	



Aw shucks, folks...



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right and wrong out of this. The problem is simply one of communication, for useful results *and* for good human relations. The human relations come first, as the Japanese have long understood. Work that out, establish a mutual tolerance (no matter how difficult it may seem) and the rest follows. The Japanese deal in people. We think we deal in facts, in self-evident truths; we think we are wholly objective, etcetc. Not necessarily! Our language does deal bluntly in direct fashion and this can be an enormous advantage. Or it can be all too dangerous. Even at home, after all.

Every morning, we were summoned to that bus at a precise moment, say 9:20 a.m. If one of us was not there, the guide personnel immediately became agitated, because we were *supposed* to be there, and it was their responsibility if we didn't appear. Inevitably, several of us would wander off for a moment of morning air, to buy film, visit the rest rooms—we had the time; we'd be right back. Practical American experience told us it really wouldn't matter and we were right—the bus was invariably late, usually by 40 minutes or so. But it *did* matter. And so we took to arriving on time, simply because we liked the guides, we appreciated their intense efforts to make things go, and we did not want them to be agitated. It was that simple.

Philosophically, too, we really didn't mind waiting. Always something going on around us, plenty to watch. Americans are extremely good at casual improvisation, when things seem to be going wrong. The Japanese viewpoint is that *they shouldn't go wrong*—bad planning. Both attitudes have merit.

Given all this, you can perhaps see why the Japanese do such extraordinarily precise and careful work. That beautifully complex motor, the marvelously neat and calculated inside design of Japanese hi-fi, the same in their astonishingly automated factories. Things must always be *right*. And the penalty when they are not is that painful thing, loss of pride, face. We have it too, of course. But not such a degree. Most assuredly, it is a remarkable spur to human production and ingenuity! No wonder my motor repair man was exasperated in New York. How are you going to cope with that kind of thinking? In terms of wires, no less! It just ain't natural, from an American viewpoint, but it is both natural and productive in its own Japanese environment.

The Engrish ranguage? Most curiously, the Japanese transpose R and L sounds, though they can produce both. I found, too, that their language is audibly easy for our ears; once you learn a word, you can pick it out from a Japanese conversation. (Not so, for instance, with French.) and once you have caught the rules of transposition, you can spot the adopted English too, notably in discussions of audio where English terms are used by the hundreds. At the JVC demo in the Osaka Audio Fair, I could get the gist of what the man was telling his Japanese audience both the context and through such tell-tale phrases as "discleeto soundo"—discrete sound. Like the Italians, the Japanese add a final vowel to our closed-off word endings.

The amusing part of the Japanese English comes largely inadvertently, out of the transpositions of L and R, leading to all sorts of improbable terminology and startling meanings not intended—see glossary. Especially when the earnest speaker becomes so eager that, like anyone speaking a foreign language, he slips a bit in his linquistic thinking. But the anomaly slips over into print as well—perhaps the Japanese ear *hears* L and R as the same? We roared, one day in the bus, as a big sign went by that said FLESH FRUIT. It was flesh, all right, but we did not attempt to explain the implications of sinfulness. Sometimes the L or R or even a C or G gives was to a Y sound in mid-word or at the beginning. You wondered last month what a Rimsheen was? A limousine. Out at Tokyo airport, Chicago on the P.A. became Shi-yai-o. After a few days of unexpected meanings, I took to quietly writing down the linguistic addlements I picked up en route. At one point I made the mistake of passing my notes across the bus aisle to our editor and his wife, who promptly burst into suppressed merriment; it was much too sudden an exposure, all at once.

We agreed to publish a glossary and you will find it attached, for your pleasure, with the most friendly respect from us over here to those who have so valiantly plunged into our tough ranguage as though it were their very own, which it almost is. Nippongrish? No more odd than English after swallowing (and altering) both Latin and Norman French! If the British could convert "Marie la Bonne" into Marlybone, if in South Carolina "Beau Fort" ends up as "Byoo-fut", if my Connecticut neighbors have converted "Tower Dale" into Taradiddle and the family Choinière into "Schneer"—present pronunciation—then surely a rimsheen out of Checker is as viable in Tokyo as in Shi-yai-o itself. Even with refthand dlive, and keeping to the yong side of the load.

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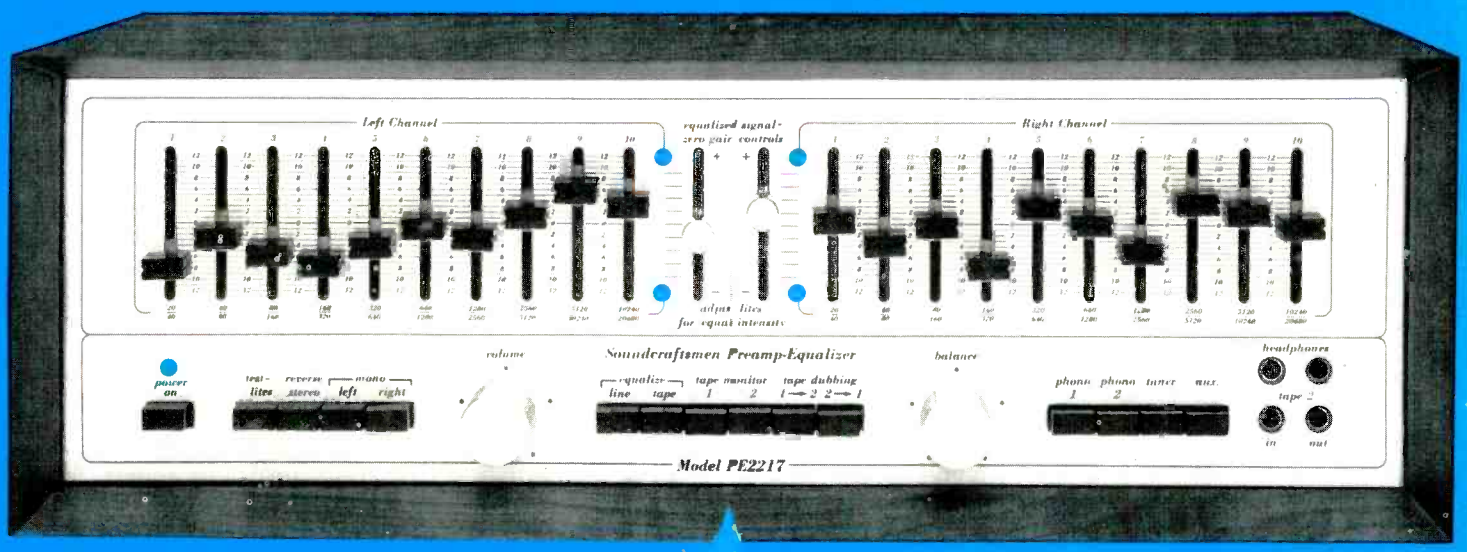

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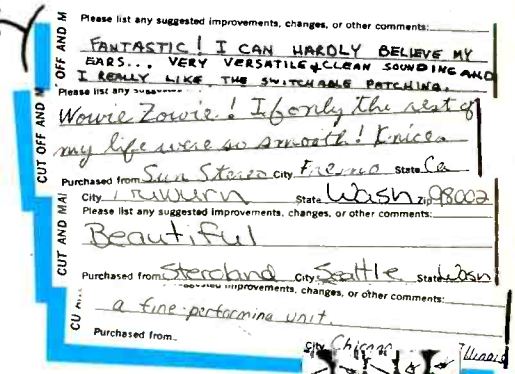

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Editor's Review

THE CONSUMER Electronics Show was held in Chicago's McCormick Place again this June, and broke all previous records in number of attendees, exhibitors, and space used, according to the Electronics Industries Assn. which sponsors the semi-annual event. The basic trend, if trend there was, was toward higher quality products—both in the "no compromise" category and in the "dollars versus features" group from which most of us must purchase our systems. A good many of the new products might well have been predicted before the show, in that they were logical advances of existing technology, rather than revolutionary scientific breakthroughs. One example of this is that many of the new four-channel receivers had all three quadraphonic systems, rather than just one as most did last year. Logical but not revolutionary. Two-channel receivers generally had more power, more flexible tape and speaker facilities, tuner sections with less distortion and greater separation, and overall appeared to be somewhat better bargains than in years past. Logical advances, but not revolutionary.

Speakers too were predictable—with better, more controllable tweeters and of larger size for fewer accompanying design compromises in bass response. There was a stack of front-loading cassette decks, which require less room in an audio installation as you can put an amp or tuner right on top of one. The features of these decks, while a far cry from what was even dreamed of a few years ago, were almost standard in that one could find the same fine features at almost every maker's booth. While I wouldn't want a cassette deck without good transport control, Dolby NR, extended frequency response, switchable bias and EQ, etc., these features are no longer revolutionary and their insertion into decks across the board is simply logical. How far cassettes have come! (Footnote here: Several decks now have a third head for monitoring.) Open-reel decks are looking better and better too, with more sophisticated logic, syncing, and many with 15 ips as top speed. O-R decks have benefited greatly from the new and better transports; with some units you can literally play the Minute Waltz on the speed/direction buttons and not wind up with polyester confetti. But again these are logical advances, rather than startling breakthroughs.

Several products do rate a special mention for true design breakthroughs, however. Three firms are reported to have FET *power* amps: Yamaha, Kenwood, and Sony Corporation. These are apparently beyond the prototype stage now, though not yet ready for final release to the buying public. (Incidentally, I recently had a brief preview of the Yamaha version, and if what I heard was any indication, these new amps have extraordinary listening qualities.) Dick Sequerra has finally stopped making his tuner better, and we were very pleased to be able to publish a test report on it last month. There were some hot new tape formulations from 3M (Classic in all three formats), Superscope (Ferri-chrome in cassette only, which is said to be quite similar to the 3M cassette offering, while the 3M O-R and cartridge formulations are not dual layer), Capitol (The Music Tape in all three formats), TDK (Audua in open reel), BASF (LH Super in cassette), and Nakamichi (EK in cassette, to be available shortly).

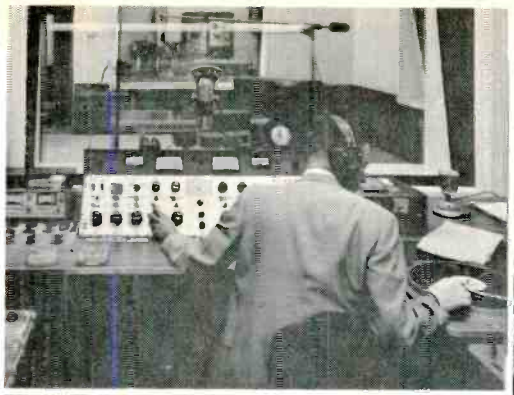
There were a couple of new spin-outs in the turntable race; B&O and Philips showed units with rather sophisticated logic-control mechanisms, while BIC displayed two American-made belt-drive, multi-play units. Philips was also demonstrating their new motional-feedback speaker system, while Leslie held forth with their new DVX system, which is the subject of an article by Ben Bauer this month. All in all, a pleasing show.

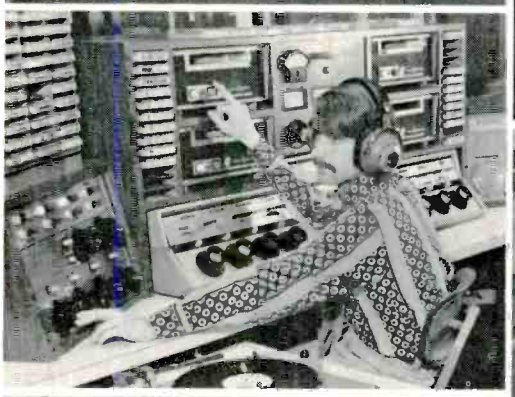
FCC Approves Dolby FM-Casts

FM stations are now free to use a combination of Dolby B-Type nose reduction and reduced pre-emphasis (25 μS, instead of 75 μS), says the Federal Communications Commission, without application or notification to the Commission. Such a change in pre-emphasis (the amount by which high frequencies are boosted during broadcast) lowers the possibility of overmodulation, but would also lower high frequency response of present FM tuners, resulting in a subdued sound. Reception of a Dolby B-type encoded FM signal without decoding results in a signal with boosted high frequencies. A combination of the two, however, results in relatively flat signal, and listeners with conventional equipment should benefit by a reduction of high-frequency distortion and/or higher program level.

The greatest benefits, however, go to those listeners with a 25-μS de-emphasis tuner and a Dolby B-type unit: better S/N, greater dynamic range even at high frequencies, better reception in fringe and weak-signal areas, and reduced possibility of interference. There are a number of top-level tuners and receivers which now incorporate the 25-μS de-emphasis and more are coming to the market right along. Dolby Labs has worked up a compensator circuit, which appears easy to build, inexpensive, and requires no power. The parts should be readily available. It naturally needs to be used with a Dolby B-type nose reduction unit.

E.P.





In response to the needs of the recording and broadcast industries, Stanton creates the new calibration standard ....the 681 TRIPLE-E....

A definite need arose.

The recording industry has been cutting discs with higher accuracy to achieve greater definition and sound quality.

Naturally, the engineers turned to Stanton for a cartridge of excellence to serve as a primary calibration standard in recording system check-outs.

The result is a *new* calibration standard, the Stanton 681 TRIPLE-E. Perhaps, with this cartridge, the outer limits of excellence in stereo sound reproduction has been reached.

The Stanton 681 TRIPLE-E offers improved tracking at *all* frequencies. It achieves perfectly flat frequency response to beyond 20 Kc. It features a dramatically reduced tip mass. Actually, its new nude diamond is an ultra miniaturized stone with only ⅔ the mass of its predecessor. And the stylus assembly possesses even greater durability than had been previously thought possible to achieve.

The Stanton 681 TRIPLE-E features a new design of both cartridge body and stylus: it has been created for those for whom the best is none too good.

Each 681 TRIPLE-E is guaranteed to meet its specifications within exacting limits, and each one boasts the most meaningful warranty possible: an individual calibration test result is packed with each unit.

STANTON

For further information write Stanton Magnetics, Inc., Terminal Drive, Plainview, N.Y. 11803.

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CASSETTE TRANSPORT PROBLEMS

Neal Rayborn*

THERE HAS been significant technological advancement and improvement in cassettes and cassette machines over the past several years. The interface between the cassette and machine, however, is an area that has received very little attention or discussion—yet this interface is critical to the successful functioning of the system.

The secret to successful interface is mechanical alignment, in addition to the usual azimuth-zenith head alignment. The area of mechanical alignment most critical to proper tape handling and guidance, which is essential in reliable usage of longer-length quality cassettes, includes the following components: (1) record/play head guide; (2) erase head guide; (3) capstan, and (4) pinch roller. If one or more of these components are not correctly aligned, they can render a premium quality cassette useless after one pass.

The observations made in this article are based on several years of experience gained in our product test lab. For the tests during this period we purchased, through retail outlets, numerous cassette machines produced by a wide range of manufacturers.

Overall, we found 50 percent of the machines we purchased were improperly aligned. As might be suspected, the percentage varies from the most expensive decks to the more inexpensive portables, but even among the most expensive decks, 25 percent were in need of realignment.

This article is intended to provide cassette users with: (1) factual information on proper alignment of cassette machines, (2) the means to detect and diagnose the various types of alignment problems, and (3) guidelines for what to do once the problem is discovered.

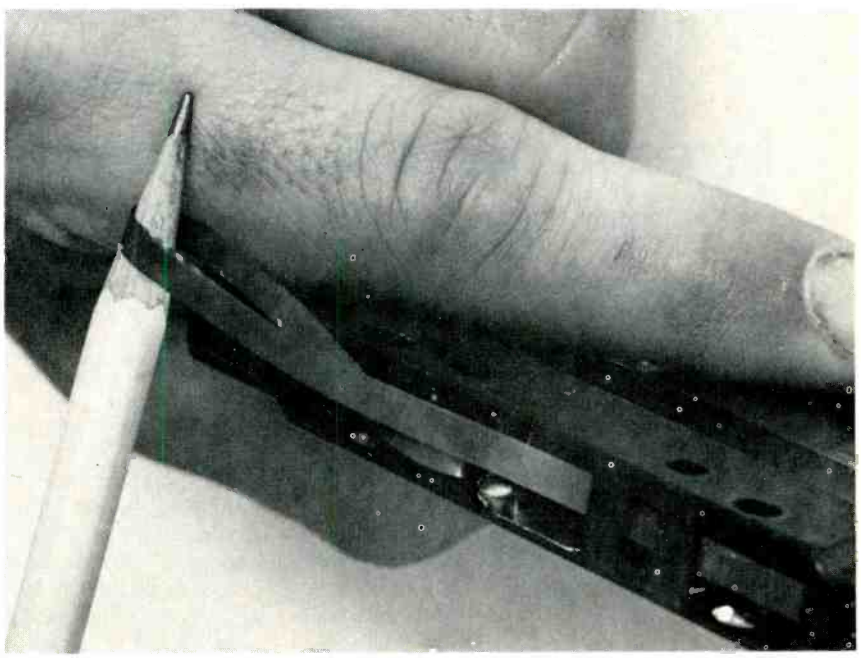

Fig. 1—Tape with a ragged edge is a common indicator of a machine alignment problem. Severe edge damage can result in a seized or jammed cassette.

*Consumer Plant Manager, Memorex Corporation

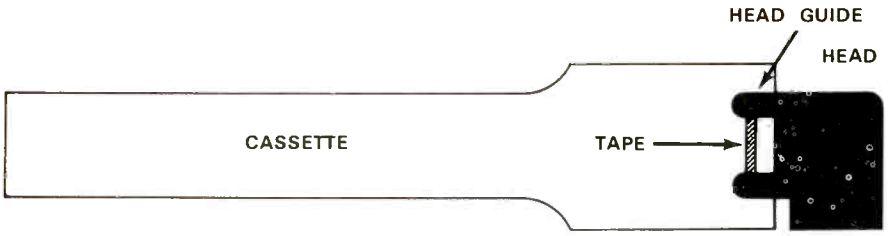

Fig. 2—An accurately aligned head guide will position the tape exactly in the center of the cassette, as shown here.

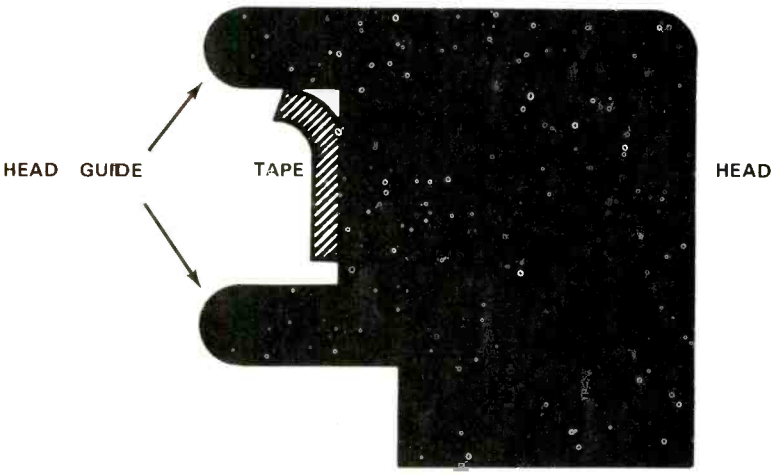

Fig. 3—If the head guide is either too low or too high, it will stretch or bend the tape edge.

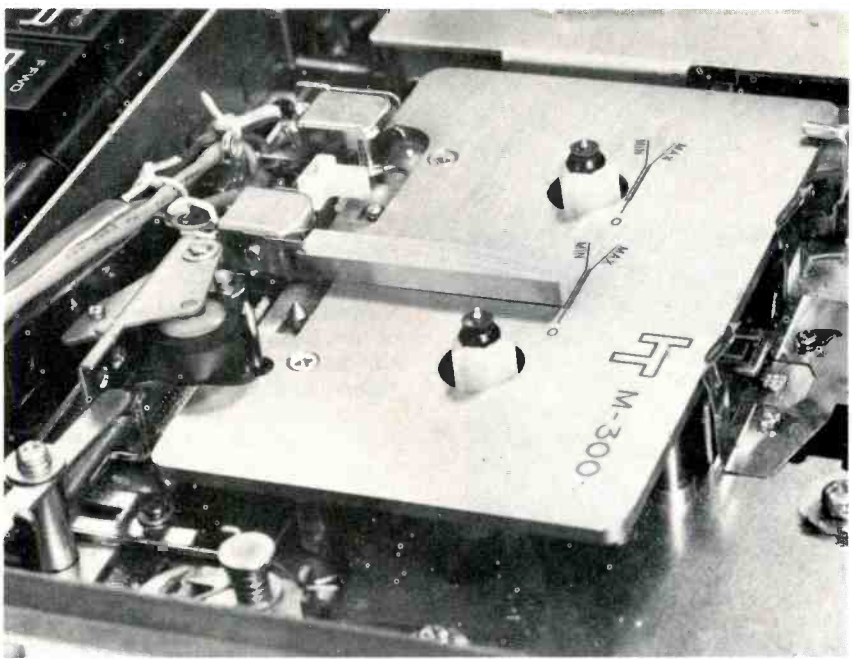

Fig. 4—The metal gauge finger on the mechanical alignment fixture serves two purposes. It checks head guide alignment by sliding between the head guides when correctly aligned. Secondly, it checks head penetration, indicating proper penetration on the lines scribed on the surface of the plate.

Detecting and Diagnosing Alignment Problems

The first and most important step in the diagnosis procedure is to test the machine with a premium quality cassette. A poorly-constructed, bargain-basement variety cassette can produce symptoms similar to those of a misaligned cassette machine, making accurate diagnosis difficult, if not impossible. Just as machine alignment and tape path are critical, so is the tape path and guidance system within the cassette. It is the thinness of cassette tape that makes it very susceptible to edge damage, and therefore necessitates a precisely-aligned guidance system.

The major indicator of a machine alignment problem is tape edge damage. This may initially appear as a signal variation in one channel or can be visually observed as an uneven or ruffled edge on the tape. (See Fig. 1.) Edge damage, if severe enough, can result in a seized or jammed cassette, often characterized by tape spilling out of the cassette and being wound around the capstan or pinch roller. This type of total failure is most common with the 90- and 120-minute cassettes, since they have thinner tape than the 30-, 45-, and 60-minute cassettes.

It seems popular among some cassette machine manufacturers to condemn the longer lengths (C-90, C-120) as unreliable and to discourage their use. This is true if 3-for-$1 variety cassettes are used and/or machine alignment problems exist. There is, however, no reason to avoid using the longer lengths if they are of high quality construction, and if the machine is well aligned.

Another type of misalignment, which may or may not produce the usual edge damage, (i.e., stretch edge), is capstan-pinch roller misalignment. A severe misalignment of these two vital components will usually drive the tape off one side of the pinch roller, often creasing or folding the tape in the process. This usually interrupts the recording to a very noticeable degree.

Head Guide Alignment

An accurately aligned head guide will position the tape exactly in the center of the cassette, as illustrated in Fig. 2. If the guide is too low or too high, it will stretch or bend the tape edge (See Fig. 3). The easiest way to check the alignment of the head guides is with a mechanical alignment fixture. Information Terminal Corp., 323 The Soqual Way, Sunnyvale, Calif. 94080, sells such a fixture (M-300) for approximately $85.00. The fixture is

simply a metal plate that is positioned in the machine where a cassette is normally placed. The top of the plate should line up with the lower guide. There is a metal gauge finger which serves two purposes. First, it checks head guide alignment. If the head guide is not correctly aligned, the gauge will not slide between the head guides (See Fig. 4). Second, it is a check on head penetration. There are lines scribed on the surface of the reference plate which, when used in conjunction with the gauge finger, will detect excessive or insufficient head penetration.

If the head guides are incorrectly positioned, they must be repositioned by adjusting the head either up or down. However, the azimuth of the head must be maintained; azimuth being the perpendicularity of the head gap to the tape edge. An alignment tape must be used to check the azimuth. This is a reiterative process, requiring that one go back and forth between the mechanical alignment gauge and the alignment tape.

The process of aligning the head should only be attempted by those with proper equipment and experience since it is a delicate process.

Capstan—Pinch Roller Alignment

The ideal machine has the axis of the capstan and pinch roller perpendicular to the plane of the cassette. Deviations from true perpendicularity will result in the tape being driven either up or down by the action of the capstan pinch roller (See Fig. 5). Typical tape damage resulting from such misalignment is illustrated in Fig. 6.

This type of misalignment is very difficult to diagnose, since it is often erratic and inconsistent. It depends upon many variables, such as tape thickness, pack size, and take-up tension of the machine. The best way to diagnose this problem is to watch the tape pass between the capstan and pinch roller. The tape should track in an even line and should not oscillate up and down or track with part of the tape above or below the pinch roller. Improper tracking is often most pronounced just after starting to play a cassette in the middle. With some machine designs it will be difficult or impossible to observe the tape passing between the capstan and pinch roller. The only alternative is to repeatedly start and stop a cassette in the center of the pack, then, using a pencil placed through the hub, slowly rewind the tape while watching for damaged sections, such as that shown in Fig. 6.

If your machine has evidence of capstan/pinch roller misalignment, correcting the problem can be a major job. The easiest problem to correct is a worn pinch roller or bent pinch roller assembly. The roller and supporting bracket are often serviced as an assembly, and replacement of this assembly may correct the alignment problem. If it does not, the misalignment may be caused by a worn capstan bearing, a bent capstan shaft, or misalignment of the assembly as it came from the manufacturer. Correction of this more serious problem may require shimming the support plates for the capstan or pinch roller, bearing replacement, etc.—all of which should be left to those with experience and skill in this area.

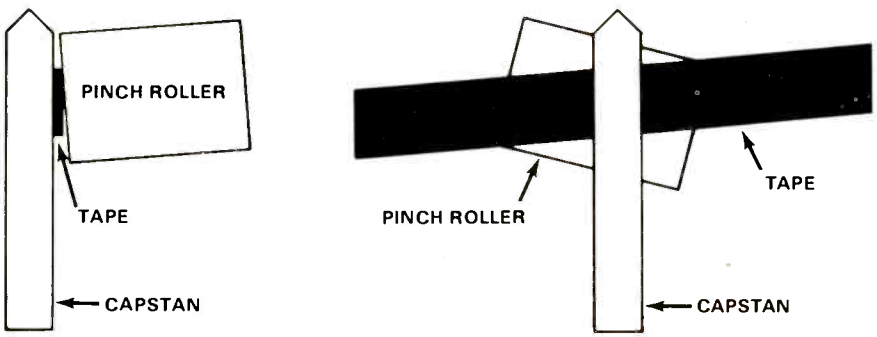

Fig. 5—Both the capstan and pinch roller should be perfectly perpendicular to the plane of the machine. Deviations will result in the tape being driven up or down, as shown here.

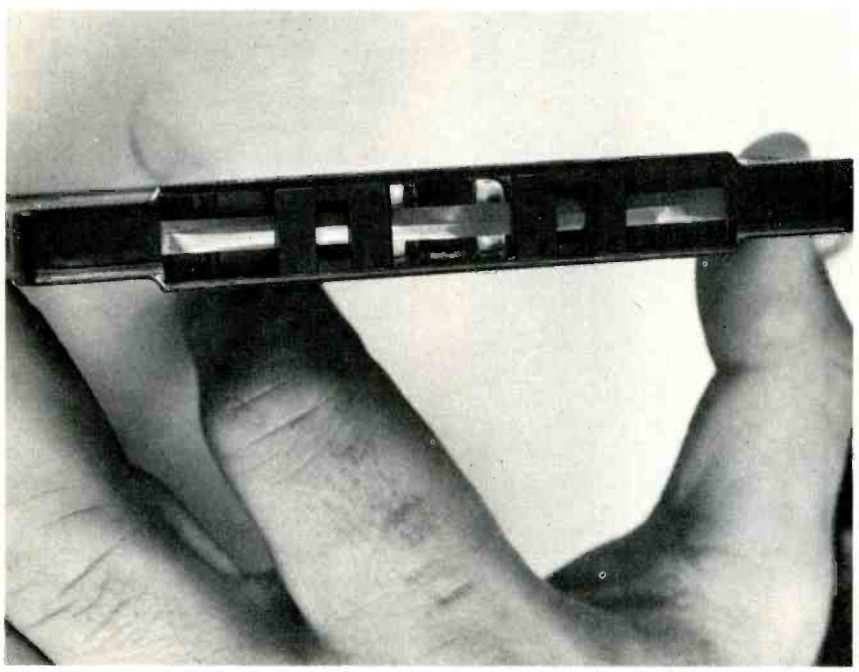

Fig. 6—A crease along the center of the tape is an indication of tape damage resulting from misalignment of capstan and pinch roller.

Selecting a Competent Service Technician

Most tape machine repair facilities do not possess an alignment gauge nor the knowledge to use one. Certainly before submitting your machine to a repair service for realignment, you should determine the competency of the person who will be doing the work. If the service man cannot satisfactorily answer questions on head guide and capstan/pinch roller alignment and the resulting effects on tape damage, don't hand over your machine. You may have it returned in worse condition than before "servicing."

It is possible to check the alignment by purchasing an alignment gauge, as previously noted. Although somewhat expensive, the gauge may pay for itself by reducing tape damage or by saving an irreplaceable recording.

Speaker Tests — Impedance

Richard C. Heyser

AS A READER service, AUDIO is presenting capsule summaries of the tests used in our speaker reviews. While some of the discussion may be a bit technical, we feel that many readers may want to know why these tests are performed, how they are made, and what to look for in the data that is presented. We begin these summaries with a discussion of impedance measurement; the others will follow as space and time permit.

The first measurement AUDIO makes on speaker systems is that of the magnitude of the electrical impedance as a function of frequency. The reason we provide a complete plot of this data is that there are many tell-tale performance clues contained in such a complete measurement which you can use for your own evaluation once you know what to look for.

The measurement is made by driving the speaker from a constant current source and plotting the voltage drop as a function of frequency. Enough measurement data is provided to be technically meaningful. Thus, if a tweeter level control changes the impedance, we provide measurements capable of letting you see what happens.

For the greatest majority of speakers, the phase of the impedance may be uniquely determined from the magnitude. They are, in other words, minimum phase. Because of this, the magnitude is sufficient for the needs of the review. If it were not, then we would also plot the phase.

The simplest piece of information you can gather from the impedance is the lowest value presented to the power amplifier. We identify conditions we feel may warrant your consideration in such things as paralleling speakers for patio use.

The next thing to watch for are resonance peaks. These are perfectly natural and do not indicate problems if they are present, but watch for changes in resonance frequency with level control. If changes occur, some interaction may be suspected between the crossover characteristics and level-control setting. An inductance-capacitance crossover network is constant impedance only if properly terminated by a resistive load. Shortcuts in level-control design show up quickly with this plot.

Other more interesting observations can be made when you use the impedance plot in combination with the frequency-response measurements. That is why AUDIO uses the same graph paper for the frequency scale of these measurements. A sealed-box, direct-radiator speaker, usually called an acoustic-suspension system has a second-order characteristic in low frequency response when properly designed. That is, the response should fall off at a uniform 12 dB per octave on the low end and rather quickly approach this slope on the SPL scales AUDIO provides. This type of speaker system should have only one resonance peak in the low frequency impedance. The design of such a system involves an interplay of parameters, and there are certain alignments of parameters which yield the response characteristic the designer intended. The position, magnitude, and shape factor of the impedance resonance is a strong indicator of what the designer actually achieved. The exact characteristics are too complicated to describe here because of the variety of alignments, but as a general rule the frequency of impedance resonance should be at or near the low frequency cutoff and have neither an excessively high nor low "Q" if acoustic-resonance effects are to be avoided.

A phase-inverter loudspeaker system, either using a vent or its acoustic equivalent of a "drone cone" passive radiator, is a fourth-order system under normal alignment. That is, the ultimate slope in response is 24 dB per octave. More degrees of freedom are available to the designer of such a system, and this is shown as a double hump in the impedance plot. Under proper alignment, the system resonance, from the acoustic point of view, is at neither of the impedance resonance peaks but is, in fact, close to the geometric mean frequency of those peaks. That is, approximately at the impedance dip between the peaks. Thus, a properly designed vented system should have its acoustic cutoff occurring near the frequency of impedance minimum between resonance peaks and should be going down at around 24 dB per octave. If, as is sometimes the case, a vented speaker dies at 12 dB per octave starting well above the proper point, it generally means that the vent is "chuffing" fruitlessly and the bass will be a bit anemic. On the other hand, impedance peaks close together and of high "Q" are warning signs of a boom box.

The lower resonance peak in a phase-inverter speaker may be associated with resonance of the woofer if the system is poorly aligned and in that case may be where maximum cone excursion occurs. If this frequency is so low as to lie in the range of record warp components, then the speaker may simply drive itself into nonlinearity at higher sound levels. This effect can vary from a distinct tremolo on piano material to an unpleasant burbling and mushy bass under extreme conditions. If an impedance resonance lies below about 20 Hz, then you should consider using a rumble filter to remove subsonic signals. It makes poor advertising copy, but very good sense, when you know what to do to keep the drivers in a linear region of operation.

Occasionally you might see significant ripples in the impedance plots which do not occur at or near the stated crossover frequency. Sometimes this is an indication that two or more of the speakers in a multi-speaker system are "talking to each other." This means that a driver which should have cut off, such as a midrange, may in fact be acoustically loading a driver in another frequency range, such as a tweeter. A favorite backyard fence for such acoustic chatter is either a tweeter or midrange without a rear cover talking to the other through back pressure in the enclosure. This invariably shows up on the pressure phase spectrum of frequency response but the impedance plot also indicates its presence.

The lowly impedance plot may thus be seen to provide a bit more insight into a speaker design than you may have thought possible.

A Primer On Choosing Tape

William A. Manly*

WHICH TAPE DO I BUY? is an oft-heard question which has never been fully answered. This is attested to by the number of pamphlets, booklets, and articles aimed at an answer. The reef which most of the unwary ground upon is that the selection of a tape rightly starts with the machine! Many people asking this question have made the wrong first choice, and so they will never be completely satisfied with the second. An important point to remember is that no one else can make your choice for you if you are a discriminating user.

Before we get to the choice-making process, a little painless (we hope!) education is needed to define some terms, and to describe what we will call the "Audio Box" approach to understanding tape performance specifications.

Audio from Tape—A Noisy Signal

The first term is "noise." The dictionary defines this as "any disagreeable sound." This is true, but we want to get a little more specific than that, since noise is the floor of our box. We will separate noise into two components, called "frequency" and "amplitude." The noise in any system can be represented by a single line on a graph where vertical directions (in mathematical terms the "ordinate") represent the amplitude, and horizontal directions (the "abscissa") the frequency. This type of graph is called a "Bode Plot" for the man who invented it. Units on the abscissa are in Hertz, or cycles per second, and on the ordinate, usually in decibels (abbreviated "dB"). The Hertz (abbreviated Hz) is easy to understand as this represents the pitch of any audible note. The dB is a rather slippery character, as it represents the logarithm of a ratio, and is, therefore, a relative quantity—but relative to what? There's the kicker. The answer is that it is relative (or "referenced") to anything you want it to be relative to, which is what makes it such a stinker. We'll make it a bit easier by generally referring other levels to the "Standard Output Level" defined by several organizations, which defines this level as "Zero dB." Level set and frequency response standard tapes are available with this level recorded upon them.

Noise is generated by the tape, by the electronics of the tape machine, and in the heads. If the machine is well designed, tape noise will always have a greater amplitude than head and electronics noise. For all but first quality machines the reverse is true, making low-noise tapes a waste of money, so here is the first maxim: Be certain that your machine *deserves* low noise tape before you buy it. Look at Fig. 1. This is a picture of noise, plotted amplitude vs. time rather than frequency. Figure 2 shows two sine (single frequency) waves of different frequencies. Now look back at Fig. 1. The noise is seen to be the sum of a large number of sine waves of differing frequency. These can be separated from the noise one at a time and their amplitudes plotted against their frequency. For a

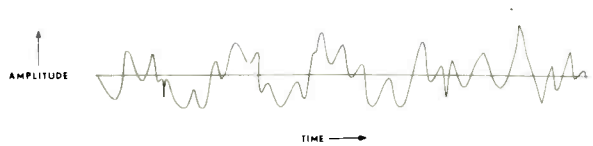

Fig. 1—A noise waveform, frequency range about an octave.

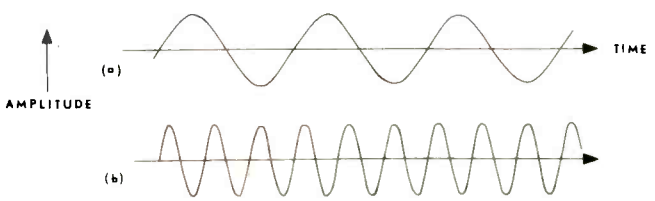

Fig. 2—Two sine waves of different frequencies.

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Cobaloy Co., Arlington, Texas

typical tape-limited audio system, the result is like Fig. 3. The frequencies are plotted logarithmically, meaning that the distance from 20 Hz to 200 Hz is the same as the distance between 2000 Hz and 20,000 Hz. This line is the lower limit to sounds we can hear, since once the signal amplitude drops to that of the noise, the signal tends to get masked by the noise. Thus we have established the floor of our "Audio Box."

Particles and Paint

Let us digress a bit to find out how the tape noise comes about, so that you can understand just what a "Low Noise" tape is. Almost all tapes are composed of a very high quality paint (similar to a lacquer), pigmented (colored) with tiny acicular (needlelike) particles of magnetic material, and coated on a base material of plastic film. The most common types of plastic for the base are cellulose acetate (or just acetate) and polyester terephthalate (or polyester for short). At present, most tapes are made with polyester base. The needle-like particles have a length ranging from about 8 microinches (200 nanometers) to about 50 microinches (1¼ micrometers—pronounced micro-meters). These particles are so small that they are single-domain, i.e., always permanently magnetized with the north-seeking pole at one end and the south-seeking pole at the other. Application of an external magnetic field can cause the poles to swap ends, but can never demagnetize them. These particles are *oriented* in the tape, meaning that they are arranged so that they point in the direction of tape movement across the head. When the *tape* is demagnetized, half of the particles have their N-pole in one direction, and half in the other. When all of the particles have their N-poles pointing in the same direction, this is called *saturation*, and is the strongest signal that is possible on this tape. Other signals, of varying strength, are somewhere in between these two extremes.

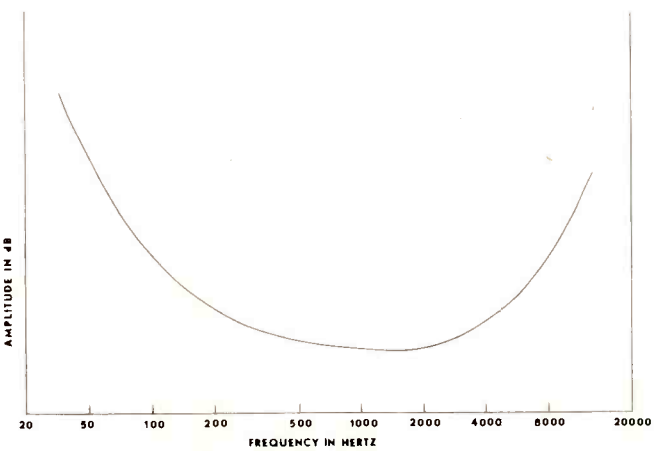


Fig. 3—Bode plot of noise amplitudes vs. frequency for a typical "tape limited" audio tape system.

The Picture-Sound Analog

At any one time, the magnetic field going through the playback head comes only from those particles near the head gap. In a standard ¼-inch tape, using a full-track head, the number of particles involved is about 10 million. In a 4-track (stereo) cassette, the number is about ½ million. This change by a factor of 20 is the primary reason that a good signal-to-noise ratio is more difficult to get with cassettes. In the same way that a newspaper picture is built up with individual dots, or a television picture with individual lines, the audio signal from a tape is built up with the individual fields from each of these particles. Even with the tape completely demagnetized, there is some field fluctuation which goes into the playback head, and we call this tape noise. If the particles are smaller, we can increase these numbers given above, and we call this a "Low Noise" tape. If we cut the track width, as in going from full-track ¼ in. to quarter-track ¼ in., we cut the number of particles and thus decrease the signal-to-noise ratio. If the speed of the tape decreases, the number of particles "seen" per second decreases, and this decreases the signal-to-noise

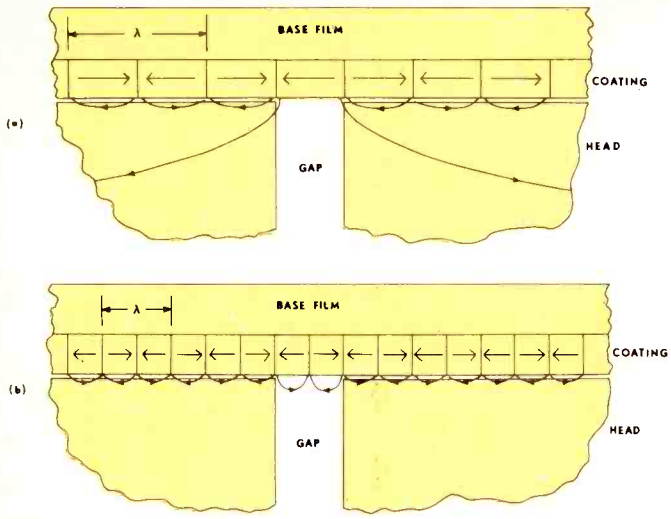


Fig. 4—(A) Simplified picture of a recorded signal passing a playback head. Wavelength is twice the playback gap length. **(B)**, Same, but with wavelength equal to the playback gap length.

ratio. So—low speeds, narrow tracks, and large particles give a poorer signal-to-noise situation.

The sides of the "Audio Box" are shown in Fig. 3. They are simply the lower and upper frequency limits to the sounds we can hear. Their exact location depends on the age and sex of the listener and a number of other individual characteristics, but the outside limits are generally given as 20 Hz and 20,000 Hz.

The Top of the Box

The top of our "Audio Box" is defined by wavelength-sensitive magnetic effects in both the recording and playback processes. A simplified picture of the recorded signal can be imagined as a series of bar magnets passing by the playback head gap (see Fig. 4-a). The wavelength of the recorded signal, denoted by the Greek letter Lambda (λ), is comprised of two of the bar magnets end-to-end. The North-seeking poles are at the arrow heads. The magnetic flux coming out of each of the magnets is shorted through the head surface and returned to the magnets, except for one magnet over the gap, which is sending its flux through the head, and is thus being played back. Now note Fig. 4-b. If the wavelength is no longer than the playback head gap length, no signal is sent through the head, and the signal, though recorded, is not played back. This sets a short wavelength limit on the recorded signal, which amounts to an upper frequency at a given tape speed. Playback head gap lengths are from 100 millionths of an inch (2.5 micrometers) long on higher speed machines down to about 40 millionths of an inch (1 micrometer) long on cassette machines.

Now look at the recording process, where we create those little bar magnets in the tape coating. The first thing to remember is that except for machines which use a combination record/playback head, the record gap lengths are much longer—500 millionths of an inch (12.5 micrometers) to 1 thousandth of an inch (25 micrometers).

The audio signal is recorded by adding it to a large supersonic signal called bias and sending both to the record head. The bias acts in an analogous way to the power steering on your automobile. Bias does all the heavy work in magnetizing the coating, while the audio signal does the steering to control the amount and direction of magnetization. Like power steering, bias must be in proper adjustment, and we will see why it must be adjusted to match the tape in use.

In order to magnetize a piece of ferromagnetic material (like a tape coating), one must expose it to a field greater than a threshold field called the coercivity. Coercivity is sometimes sloppily called coercive force. The bias, which is about 10 times larger than the maximum signal, is used to raise the peak field produced by the head to the point where the smaller signal will record on the tape. The bias is necessary, since in its absence only the very largest signals would be recorded.

Returning to Fig. 4, the bar magnets are pictured as being rather elongated, which is the best shape for bar magnets. All bar magnets try to demagnetize themselves, and this effect gets worse the shorter and fatter the magnet. Here is where we lose a lot of short wavelength (high frequency) signal. As we shall see, making elongated, slim bar magnets is more difficult the shorter the wavelength, and it finally becomes impossible.

Now look at Fig. 5. All four parts show a record head in contact with a tape moving in the direction of the large arrow. The cucumber shape at the trailing edge of the gap is the zone where the bias field peaks go from values higher than the coercivity to values lower than the coercivity. This shape is called the "recording zone" and it changes drastically with the bias amplitude, as Figs. 5-a through 5-d show. The amount of bias is nearly always (on audio machines) adjusted for either maximum sensitivity (sensitivity is playback level divided by record level) or lowest distortion, or some combination of the two. When the coating thickness is about half the record gap length, both these conditions occur nearly simultaneously, as in Fig. 5-c. This is sometimes called "optimum bias," but this is a poor term. The best short wavelength bar magnets are formed under conditions as in Fig. 5-a, where the bias is small or non-existent. The maximum output

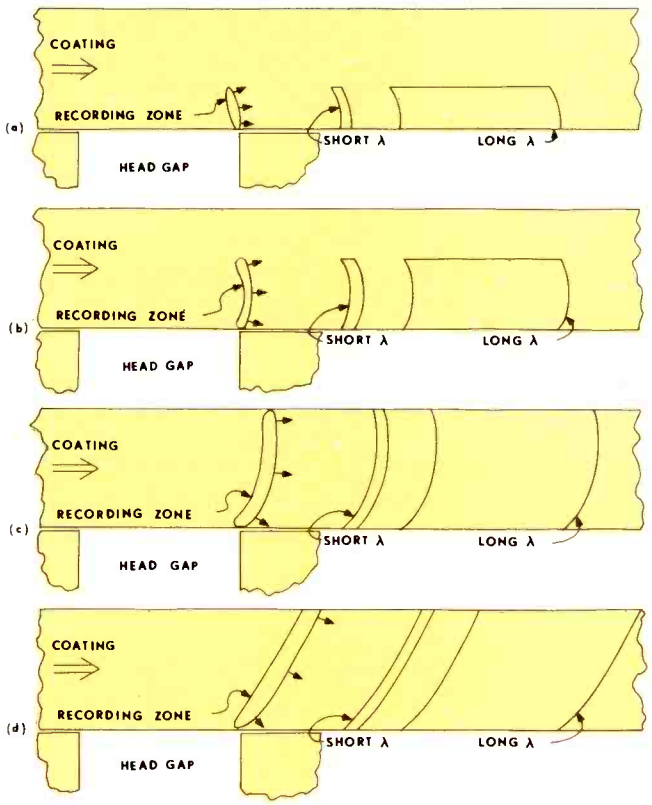
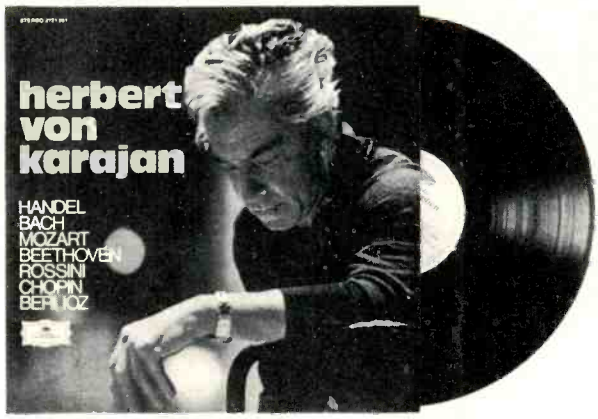


Fig. 5—(A) Tape passing the record head, with recording in progress. Bias very small. Note the shape of the recorded signals as a function of wavelength. **(B)** Same, but with a moderate underbias condition. **(C)** Same, but with bias at maximum sensitivity or lower distortion setting (there is very little difference between these two with this ratio of coating thickness-to-record gap length). **(D)** Same, but with tape in overbias condition.

He listens to it with AR speakers



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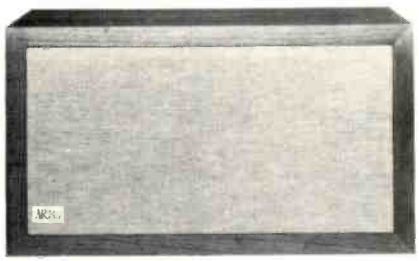

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at medium wavelengths comes in condition Fig. 5-c when all the particles are being magnetized in the same direction.

Now, this part is a little involved, so pay close attention. Since the bias is used to get over the coercivity threshold, the shape of the recording zone depends not only on the amount of bias, but upon the coercivity of the tape. High coercivity tapes are normally called "High Energy," but this term is not necessarily accurate when used this way. If the bias is adjusted per Fig. 5-c with a normal tape, and a high coercivity tape is placed on the machine without re-adjustment, the recording zone will look like Fig. 5-b or 5-a. The result is higher distortion, lower sensitivity, and an excessive output at short wavelengths (high frequencies). Thus, high energy tapes can improve the frequency response, but a price is paid. By re-adjusting the bias (sometimes done with a front-panel switch), the recording zone goes back to Fig. 5-c, giving a smaller high-frequency gain (or sometimes none at all), but reducing the distortion and increasing the sensitivity. Some high-energy tapes have the best of both situations by using a high-coercivity layer next to the head and a standard coating next to the base film. Such a tape is compatible with standard tapes, but has an increased short wavelength response because the external layer next to the head is biased similarly to Fig. 5-a, while the thicker internal layer is biased similarly to Fig. 5-c. This is at a single bias setting, and is a consequence only of the difference in coercivity between the two layers.

A few more items about the playback process, and we are ready to put all this together to form the top of our box. Figure 6 shows a similar situation to Fig. 4, but the tape and the head are not in intimate contact. The loss of signal is very pronounced in this case. A separation of 1 wavelength causes a loss of over 50 dB. This is about equal to the total dynamic range of your recording system! In the case of cassettes, where 15 kHz is equal to a wavelength of 50 millionths of an inch, a tiny dust particle on the tape can momentarily lose the whole high end. 50 millionths of an inch is about equal to two wavelengths of visible light. It is a distance so tiny as to be

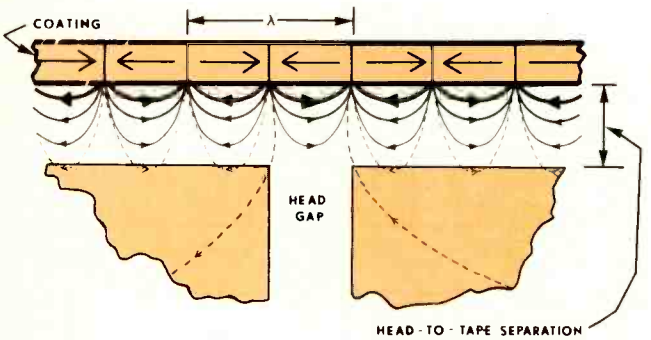


Fig. 6—Tape passing the playback head, illustrating extreme losses due to head-to-tape separation.

visible in the best of optical microscopes only with great difficulty. What this means as far as the tape is concerned, is that the surface of a slow-speed tape should be very smooth, even shiny. If surface roughness is visible, it will not have a good "high end." Also, a tape which sheds oxide that collects on the head will have large intermittent losses of the high frequency signals.

Playback heads have an inherent loss of signal at the low-frequency end because they are sensitive to the rate-of-change of the signal (which is less the lower the frequency). At extremely long wavelengths, there is an additional loss due to the fact that only a small fraction of the wavelength is in contact with the head at any one time, and much of the flux

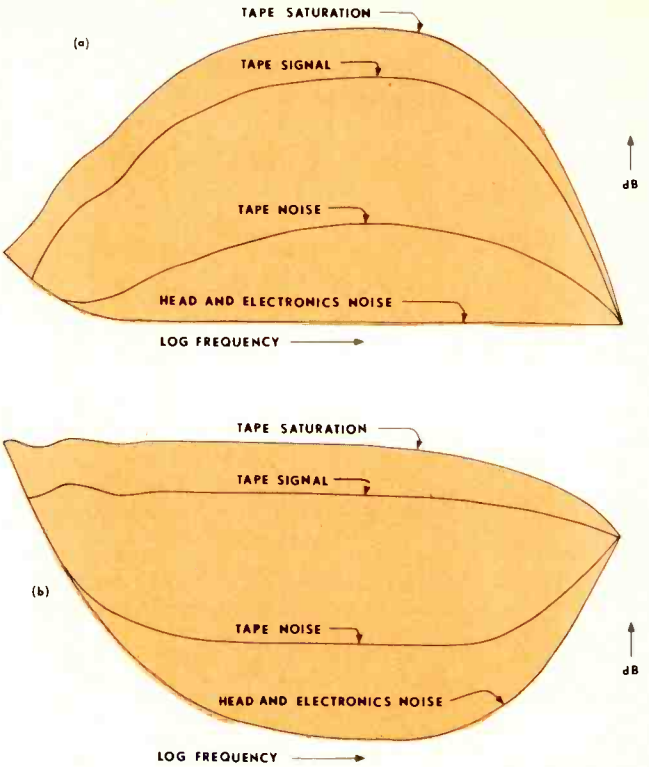


Fig. 7—(A) The complete "Audio Box" in an unequalized condition. (B) Same, but equalized.

escapes to the air. There are also some interference effects at long wavelengths which cause a wavy frequency response (these waves are called "head bumps").

You can see by the last two paragraphs that the output is eventually going to fall off to zero at both the long wavelength (low frequency) end and the short wavelength (high frequency) end. The noise output falls off as well, but all outputs eventually get so low that the electronics and head noise predominate. The frequency response can be corrected by proper electronic equalization, but the things we have talked about control the dB range between noise and maximum output at any frequency.

At midrange, the maximum output is controlled by the saturation of the material, explained previously. The long and short wavelength phenomena discussed above are further limitations, causing severe roll-off in the frequency response at both ends of the spectrum. These roll-offs are then corrected by electronic equalization, but such equalization brings up the noise as well, and this finally causes the signal-to-noise ratio to go to zero dB at some high and low frequencies. Figure 7 shows the completed audio box; 7-a is the situation before equalization and 7-b after equalization. Note that the signal-to-noise ratios are unchanged by equalization. The equalization only serves to flatten the frequency response. Note that the dynamic range (distance from noise to saturation) is severely limited at the high frequency end and less severely at the low frequency end. This high frequency limitation gets worse with slower speeds. It deteriorates over the whole spectrum when the track is narrower. A thinner tape coating will sacrifice some of the low and middle frequency dynamic range to get an increase at the high end. Note that in all these, the tape is not generally used all the way to saturation in the low and middle frequency range because of a large increase in distortion. There is usually little distortion

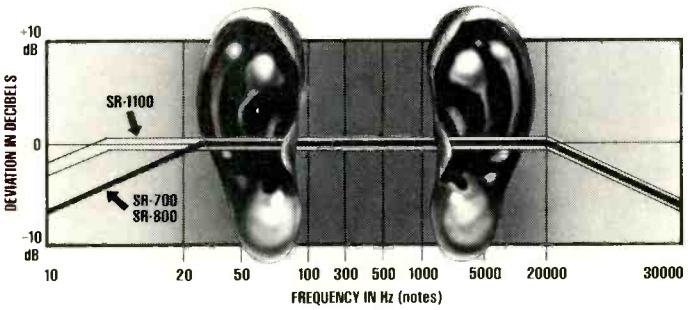
(Continued on Page 42)

THE HITACHI REPORT

No. 26 • Subject: Frequency Response • 2-Channel Receivers

After you read the truth about frequency response, you'll know how we operate. One of the most important specifications stereo shoppers compare is Frequency Response (FR). It's also one of the most misunderstood. So before we tell you how good the FR is on our 2-channel AM/FM receivers, we thought you'd like a simple definition.

Frequency Response refers to a sound system's (or individual component's) ability to EQUALLY reproduce all frequencies (bass, mid-range and treble notes) within a given range.



The average human ear can hear frequencies as low as 20 cycles per second and as high as 20,000 cps. Any quality system can reproduce notes in this range, but the important difference is how far each system deviates from EQUAL reproduction, as measured in decibels. One decibel being approximately the smallest change in loudness detectable by the ear. **Any more than minus 2 decibels of deviation creates significant loss of response in that particular frequency.**

Now that you know what you're looking for, look over the Frequency Response charts on our SR-700, SR-800 and SR-1100 AM/FM stereo receivers. NOTE: **The ideal FR chart would be a straight horizontal line, indicating "O" deviation, or EQUAL reproduction of all notes.**

As you can see, all three Hitachi receivers are within the tolerable deviation range. From there, just make sure each and every component you add is as accurate, since the **FR of a total system is no better than the weakest component.**

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SR-700
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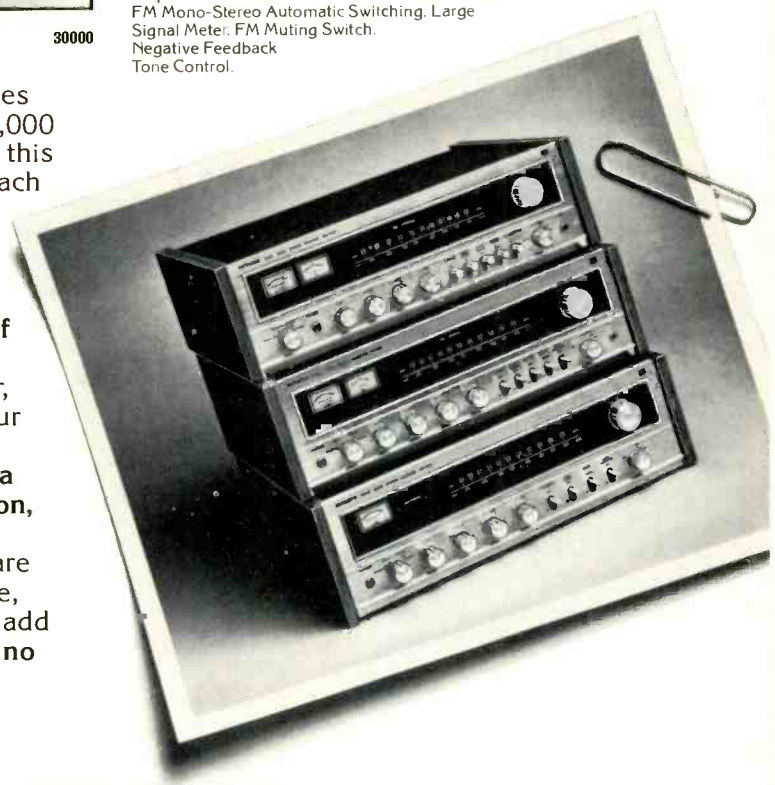
Tone Control.



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(Continued from Page 38)

for a saturation level high frequency signal, but its presence may cause distortion in any lower frequency signals present.

Happiness Is a Box That Fits!

Now that you have your box with its four adjustable sides, note there is only one principle for its use: The box should be large enough to contain all the audio that you want to record. Except for the more restricted uses, this is an ideal that is never quite reached, but the closer you get, the better the sound will be. A corollary to this principle is that buying more box than you need is not only a gross waste of money, but can actually give poorer results.

Some of the uses and box sizes are listed in Table I. Note that the low and high ranges, when multiplied, give a number close to 400,000. This is required for a balanced sound. The dynamic range required can be achieved either by adjusting the bottom or the top of the Audio Box, or both. Now note that the sizes of the Audio Boxes in Table I fall neatly into three categories: Restricted (first two), Medium (next three), and High Fidelity (last two). Now these are all rectangular boxes, so that odd-shaped thing in Fig. 7-b is going to have to be larger than these in order not to lop the corners off when the boxes in Table I are fitted in. This is where the advertisers can fool you, if they rate their systems so highly that all the corners are gone from the boxes.

TABLE I - Audio Uses and Box Sizes

Use	*Low Freq. Range, Hz*	*High Freq. Range, Hz*	*Dynamic Range, dB*
Voice: Tape letters, other controlled uses	200	2,000	20
Voice: Speeches & plays	200	2,000	30
Voice: Speech analysis & language study	80	5,000	30
Music: Background	70	6,000	25
Music: Popular & most Rock	60	7,000	30
Music: Classical & Specialty	25	15,000	50
Sound effects	25	15,000	50

TABLE II - Systems rated for Audio Box Size

Rating Scheme		
	HF	High Fidelity
	M	Medium
	R	Restricted
	+	Somewhat better
	-	Somewhat worse

Note: R+ and M- are the same; M+ and HF- are the same.

System	Rating
Battery-powered cassette (lowest cost)	R- to R
Battery-powered cassette (medium cost)	R to R+
Cassette stereo (depends on cost)	M- to HF
8-track cartridge	M- to M+
Open reel, 1⅞ - 3¾ ips (low cost)	R
Open reel @ 1⅞ ips	R
Open reel @ 3¾ ips	M
Open reel @ 7½ ips	HF- to HF
Open reel @ 15 ips (mastering)	HF+

Table II shows the approximate rating of most of the system types in use. Price in each category controls the exact placement. If the machine is a portable, subtract half a rating unit to a whole rating unit (this does not apply to the first two which are all portable).

Tape Selection

It is possible, with proper tape selection, to raise and lower the ratings in Table II by about half a unit. Some selections may only adjust the frequency range, while others may adjust mainly the dynamic range, but some will do both.

There are only so many things which can be done to adjust a tape for different characteristics. We will start off with a "standard" ¼-in. tape that has these characteristics:

Base film thickness—1 mil (25 micrometers)
Magnetic Coating thickness—0.4 mil (10 micrometers)
Magnetic material—gamma ferric oxide
Particle length—32 microinches (0.8 micrometers)
Saturation remanence—1000 gauss
Coercive Force—280 oersteds

Of these chracteristics, we have not mentioned the saturation remanence. This is a measure of the magnetic strength of the particles, their concentration, and how closely they approach being perfectly oriented. This measurement is proportional to the medium wavelength saturation output divided by the coating thickness. The coating and base thicknesses for a standard cassette tape are about half those given above.

There is one last tape problem we have not yet discussed. When the tape containing a signal is wound up in a reel or cassette, some of the signal will gradually record onto the adjacent layers. This is called "layer-to-layer signal transfer," or "print-through." It is made worse by time, high temperatures, high winding tension, thinner base films, and high head-to-tape speeds. Only the smallest of the particles are involved, so the "low-noise" (small particle) materials tend to have poorer print-through characteristics, but not necessarily. Obtaining a "low-noise, low-print" material is one of the triumphs of the magnetic material maker's art.

Base Film Material The advantates of acetate are low cost and the fact that it breaks cleanly and does not stretch. 1 mil thickness is the thinnest acetate available. It is getting difficult to buy tapes on acetate as most tapes are now coated on polyester, either tensilized or non-tensilized. The tensilized polyester stretches less than the non-tensilized. Other plastic films such as PVC are intermediate between acetate and polyester. The very thinnest bases (1/2 mil and less) must be on tensilized polyester.

Base Film Thickness The thicker bases are stronger and easier to handle and have less print-through, but less can be wound on a reel or cassette. As a rough rule of thumb, dividing the tape speed by two will allow a base film of half the thickness to be used, while maintaining about the same *audible* print-through. Remember that the longer lengths of tape are normally achieved with a thinner base material.

Magnetic Coating Thickness This has a complex effect on all the tape properties, and there is an interaction with the magnetic properties of the coating and the gap length of the record head. Generally speaking though, with everything else the same, a thinner coating buys an extended short wavelength (high frequency) response and dynamic range at the expense of higher distortion and reduced medium and long wavelength dynamic range. Cassette tapes have thinner coatings, and so may "long-play" types of tapes.

Magnetic Material As opposed to plain gamma ferric oxide, from which most tapes are made, other materials may give higher coercive force, or high specific output (a stronger magnet from a given size particle), or a smaller particle, or some combination of the three. Higher coercivity will give

(Continued on Page 46)

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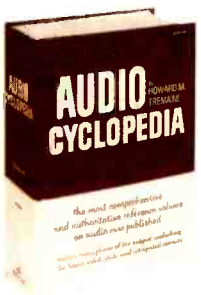

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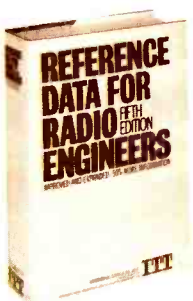

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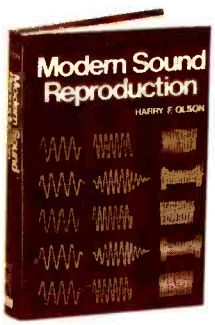

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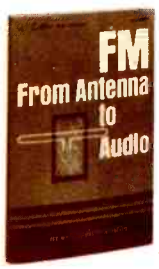

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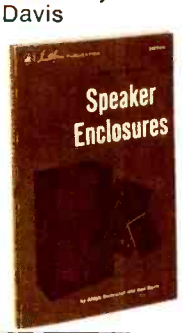

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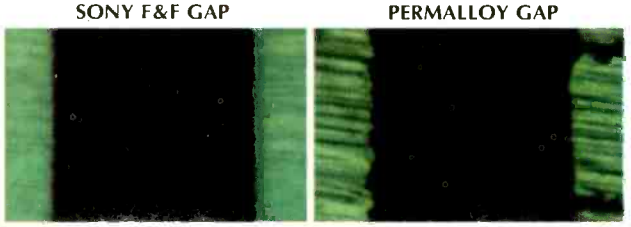

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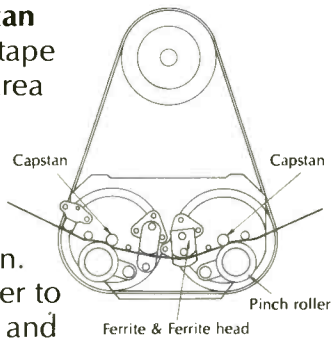

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(Continued from Page 42)
more short wavelength dynamic range, at the expense of higher bias requirements. Higher specific output gives an increased output of both noise and signal, independent of wavelength, which results in an increase in the dynamic range at both extremes of wavelength. A smaller particle gives a lower noise characteristic, which increases the midband dynamic range. Of the three main alternatives to plain gamma ferric oxide, cobalt doping (generally used in "high energy" tapes) gives a higher coercivity only; chromium dioxide gives a controllably higher coercivity and a higher specific output; and metal particles give all three in a controllable fashion. There are also small particle gamma ferric oxides with a higher coercivity. Lastly, an effect similar to a higher specific output can be obtained by putting "more pigment in the paint," called a "higher loading" by the paint chemists. This has the disadvantage of lowering the coercivity of the coating. The "high output" tapes normally use this method, plus a thicker coating.

Sorting Out the Sales Blurbs

Trying to decide which of these approaches (or combination of approaches) has been used in a particular case may be confusing even to the experts. Many times an analysis requires the availability of a complete test laboratory. Nevertheless, we will try to list some commonly used marketing names with the various improvements used.

Base Film material Usually named, but may use trade names.

Base film thickness The thinner tapes use such names as "long play" or "LP." The more tape on a reel or cassette, the thinner the base (usually).

Magnetic coating thickness A "long play" tape may have a thinner coating, as do "slow speed" and cassette tapes.

Magnetic material "Chromium dioxide" is self-explanatory. DuPont's trade name is "Crolyn," and several other names are used. "High energy" or "HE" usually means cobalt-doped iron oxide. It's a bit too early to know all the names which will be used for metal particle tapes—if they become available.

Other terms "Super Dynamic," "Extra Dynamic," "Ultra Dynamic," "Extended Range," "Ultra-High Fidelity (UHF)" and the like, usually signify a compromise of a smaller, high coercivity particle; a somewhat thinner coating; and a very smooth surface. The noise is usually lower and the short wavelength response extended. With proper choice of material, higher distortion can be avoided. "Professional" usually has about the same properties as "General Purpose," but the former are closer to being alike from reel to reel. These are standard tapes with no enhanced qualities. "Low Noise" is self-descriptive, but such tapes sometimes have extended frequency response and higher distortion. "High Output" is also self-descriptive, but usually has degraded frequency response and low distortion. There are a few "Low Noise, High Output" tapes, which are nearly standard but with increased dynamic range (higher top and lower bottom on the box). "Low Print" tapes have a special magnetic material with very few extra-fine particles. It is standard except for the low print-through characteristics.

Machine Format Selection

Playback Only For this application, you have little or no choice of the tape. Generally speaking, you should check to see what is available in each of the formats: open reel, cartridge, or cassette. Open reel still offers the best fidelity, then cassette, then cartridge (cartridge has more capability, but it is usually not exploited). Cassette units are more portable, and cartridge units are best for one-hand operation, needed in automobiles.

Recording Use If you will be doing any editing, then open reel is for you. The higher the speed, the easier the editing. Cassettes are very difficult to edit, and cartridges all but impossible. High fidelity also indicates open reels and high speeds. It takes a very good recordist to get anything but an amateurish sounding recording on a cassette, and very few cartridge machines record at all. Sound-on-sound and other musical effects also usually call for open-reel.

For recording in the field, the portability needs should be carefully balanced against the need for fidelity. Cassette units are very portable, and nothing else should be considered for voice recording. Some cassette units have automatic volume control, and are especially useful for recording conferences. Musical events are best recorded on reel-to-reel units, unless the portability of a cassette unit is an overwhelming consideration.

Fitting the Tape to the Machine

Working basically from Table II, we can now use our knowledge of tapes to enhance or degrade the quality ratings given. Why should we want to degrade? One word—cost. If you are merely sending taped letters, it's ridiculous to use a high quality tape. An inexpensive one will do as well. There is one trouble with "white box" or off-brand tapes though—you never know what you're getting. If you find one that is shedding badly or otherwise coming apart, hanging up in the machine, squealing, etc., it's best to discard it.

To employ the machine at its rated use according to Table II, utilize one of the "General Purpose" or "Super Dynamic" tapes. More consistent results will be had from a "Professional" or "Mastering" type tape. "Low Noise," "Low Noise, High Output," "Extended Range," "Extra Dynamic" or "Slow Speed" tapes can be used on top line machines with an "M" or "HF" rating to extend their rating about half a step. It's a waste of money to use these tapes on the lower cost machines.

If you need maximum playing time, go to a thinner base or "Long Play" tape. If the recording must be stored a length of times, a "Low Print" tape should be used. If you cut the speed to get longer playing time, use a "High Energy," "Ultra Dynamic," "Ultra High Fidelity," "Slow Speed," "Chromium Dioxide," or other "Extended Range" tape to try to maintain fidelity to some extent. Make sure that the tape is compatible with the machine. Some can't handle chromium dioxide. "High Output" tapes are useful on recorders which have run out of gain control or are marginal for recorded volume. "Low Noise, High Output" tapes should be used only on the better machines in this category.

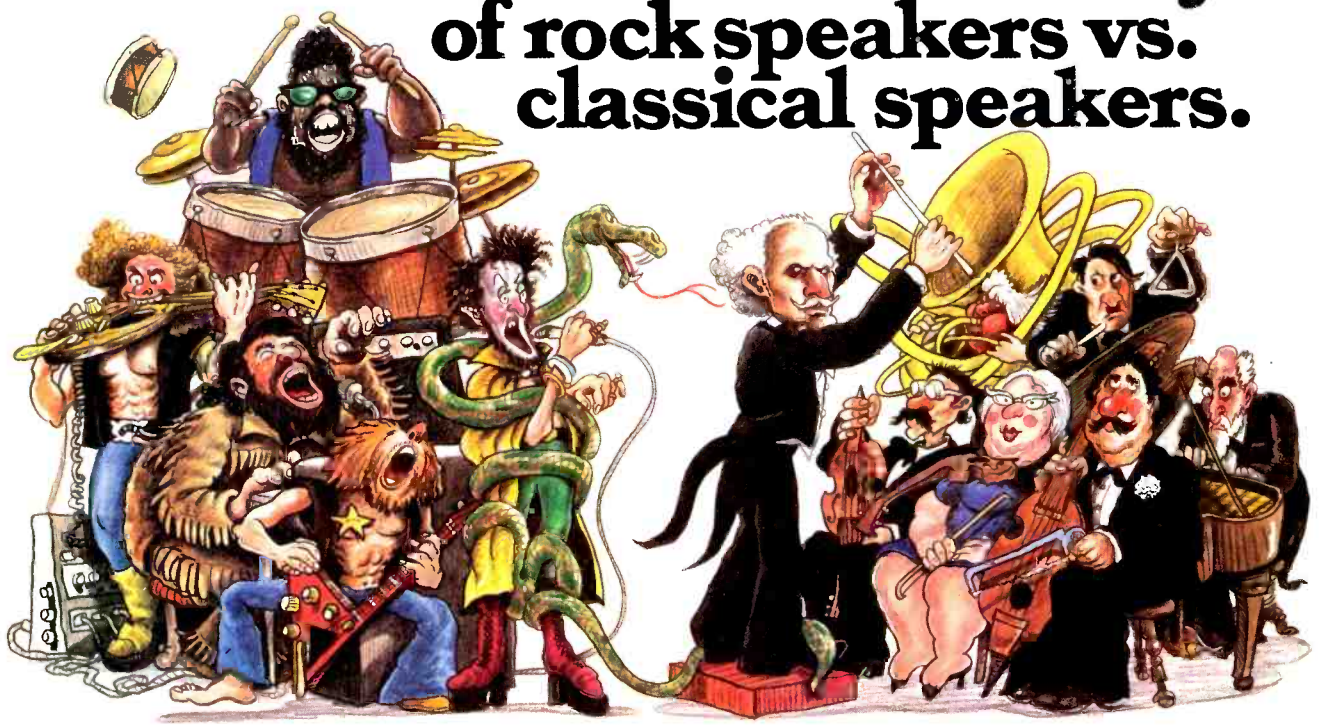
Experimentation Is Necessary

Nothing beats making a trial run of a different type of tape. If you can't hear any audible difference, use the lower cost tape. Always make sure that the tape you use does not squeal or deposit its oxide in globs on the heads and guides. A very small amount of dry shed in powder form is all right, but very much of this is aggravating. Use a brand of cassettes or cartridges which run smoothly and do not hang up. Good luck on your selections and recordings!

Acknowledgement: To William H. Orr, without whose encouragement this article would not have been written.

Credits: This was written when William A. Manly was Senior Physicist at Orrox Corporation. As of April 1, 1974 Mr. Manly is the Director of Product Development for The Cobaloy Company (A Division of Graham Magnetics, Inc.). It was written primarily as a booklet to be distributed by the International Tape Association, Inc., World Tape Center, Tucson International Airport, Tucson, Arizona 85734 (Executive Director, Larry Finley).

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.

Wrong: Freaky sound made even freakier by the speaker.

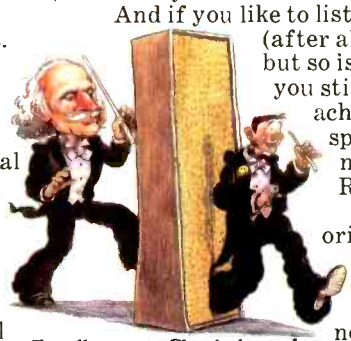
It's true that an aggressive treble and a heavy bass are characteristic of most rock music, even when heard live. It's also true that some record producers exaggerate these qualities, sometimes to a freakish degree, in their final mix of the recorded sound.

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. Delta Dispersion Base (patent pending) optional.

RECTILINEAR®

Rectilinear Research Corp., 107 Bruckner Blvd., Bronx, N.Y. 10454
Canada: H. Roy Gray Limited, Ontario

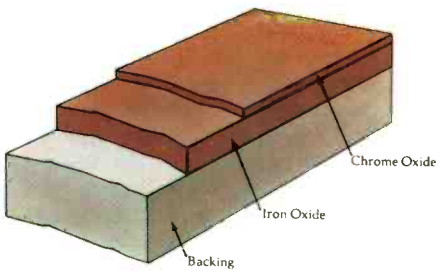
Check No. 27 on Reader Service Card

Introducing the Classic Cassette with ferri-chrome.

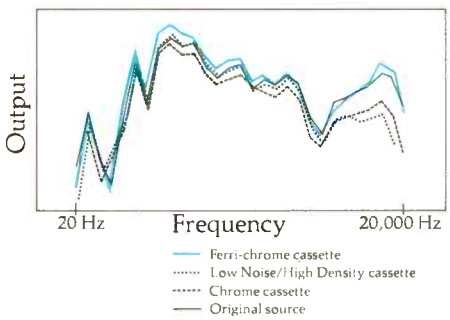
Truer than chrome. Truer than iron oxide. Compatible with all cassette recorders.

Its secret is a tape double-layered with oxide. Through advanced 3M technology, ferri-chrome literally combines the best characteristics of two coating formulations into one. Its chromium dioxide coating delivers high output and brilliant high frequencies; its gamma ferric iron oxide provides superb mid-range and rich low frequencies and low noise levels. Together they give you full-range performance you've never heard before in any cassette.

This ferri-chrome combination gives "Scotch" brand Classic cassettes



fidelity that often deceives the sharpest ear. Included in a variety of test procedures was the use of a Brüel and Kjaer Model 3347 spectrum analyzer. We began with the original play (record) of a broad-spectrum piece of music, first measuring output levels versus frequency from the record, then the Classic cassette recording of the record, and finally, the record recorded on our low noise/high density cassette and on our chrome cassette. Our graph shows the results:



Compatibility is another ferri-chrome bonus. It means Classic cassettes will deliver optimum performance on any quality machine. (On machines with a chrome switch position use the HIGH or NORMAL switch position.)

Along with Classic cassettes, we've also developed an outstanding Classic 8-Track cartridge and Classic open-reel tape. Both with their own special oxide formulation which offers sound brilliance beyond previously unsurpassed "Scotch" brand standards. Super quiet. Utterly responsive.

The Classics — cassette, cartridge, and open-reel tape — are quite simply and clearly the best we've ever made.

3M COMPANY

Scotch brand. The Master Tape.

Check No. 20 on Reader Service Card

A Dipole Speaker System

Benjamin B. Bauer*

EVERY SOUND engineer and hi-fi enthusiast learns early in his career that the selection and placement of loudspeakers has an important bearing upon the enjoyment derived from a stereophonic or quadraphonic system. In considering the desirable attributes of loudspeakers, one customarily thinks in terms of uniformly extended frequency response, freedom from distortion at high and low sound volumes, the ability to handle transient sounds and, finally, sensitivity or efficiency. But these desirable characteristics are of themselves insufficient to ensure superior performance. Another important characteristic, often ignored by the speaker makers and users alike, is the polar pattern, or directional response, of the loudspeaker. Everything else being equal, a loudspeaker with a polar pattern which is especially adapted for the particular application produces the superior sonic performance.

This paper describes a high-fidelity loudspeaker recently designed by CBS Laboratories for the CBS Electro Music Division in which proper attention has been devoted to the directional radiation properties required for optimum stereophonic and quadraphonic performance. The new loudspeaker is called the Leslie DVX series for "Dipole with Variable Axis," for the reasons detailed below.

Polar Response Patterns

A few words about the technical significance and practical implication of polar response patterns are in order. In considering what type of directional response capability one would expect from a loudspeaker, the facile answer is "omnidirectional," i.e., radiating equally in all directions. And, indeed, if one is mainly interested in monophonic sound reproduction and if the listening room has suitable acoustical properties, an omnidirectional loudspeaker probably is a good choice. But when listening to a stereo or a quadraphonic system, an omnidirectional loudspeaker is precisely what one does not want. Directional considerations for multichannel systems have been described in my article in the March, 1973, issue of AUDIO, and they need not be repeated here. But it turns out that some loudspeaker designers who have not studied the directional requirements of multichannel systems have spent much time and effort in developing omnidirectional loud-speakers only to find them mostly suited for the needs of the monophonic listener.

But even for monophony, an omnidirectional system often is not the optimum choice because the majority of rooms in which we listen to recorded music are far from ideal. An omnidirectional loudspeaker radiates sound equally all around, the sonic energy reaching the listener directly is only a small fraction of the total. The balance is heard after reflection from the room boundaries. Such sound becomes unduly colored by the boundary reflections which cause reinforcements and cancellations at low frequency and absorption at high frequency. By contrast, a loudspeaker with a properly controlled radiation pattern can be positioned to cover only the desired listening area in the room, and to provide only sufficient room reflections to contribute beneficially to the ambience without the latter becoming overwhelming. In this connection, the DVX loudspeaker is superior also.

Study of Polar Patterns

Our researches in the directional characteristics of loudspeakers date back to the early days of stereo, when we noticed that the positions of stereo images were significantly affected by the placement of the listeners relative to the loudspeakers. It is a common experience with conventional loudspeaker arrangements that the stereo-

*CBS Laboratories,
Stamford, Connecticut 06905

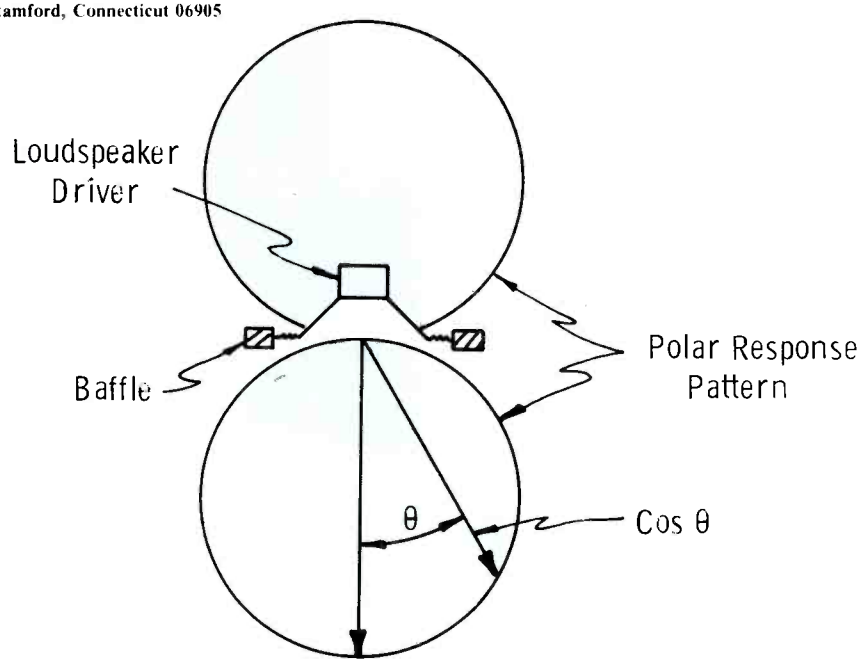


Fig. 1—A cosine "polar pattern obtained by mounting a loudspeaker driver on a dipole coupler," or specially-shaped baffle. The relative lengths of the arrows represent the radiation strength in various directions in space.

BEFORE WE MADE THE NEW YAMAHA RECEIVER, WE MADE THE ORCHESTRA.

The new Yamaha receiver and other stereo components emerged from a unique eighty-year involvement in music and sound.

Years ago Yamaha established new standards in wind instrument precision, piano sound, guitar craftsmanship, organ electronic technology.

Our engineers didn't just sit down and create those standards—they evolved them, and the same is true in their latest audio achievements.

To reach their goal of maximum truthful reproduction, they had Yamaha's three-quarters of a century sound experience to draw from.

And they developed new technology to match and exceed the kind of quality performance (low distortion) usually found on "separates" at the highest price levels.

A New Engineering.

They developed a new kind of engineering philosophy, too.

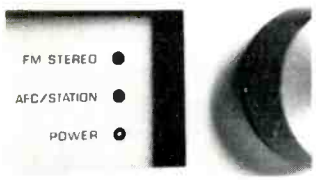
Because they conceived this quality standard not for just the highest priced Yamaha components, but for the whole line!

The result is low distortion performance, typically at .08%, available to receiver and amplifier buyers in all competitive price ranges.

Compare the specs on the new Yamaha components to any of their competition.

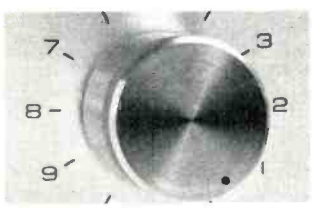
But don't stop there—compare them to your idea of an ultimate component selling for any price.

We're confident of the outcome.



The Powerful Truth.

The new Yamaha CR-800 receiver, for example, packs a powerful 45 watts per channel RMS (both channels driven, 8 ohms, 20-20 kHz) to give you the full force of a big crescendo, or full audibility of a delicate piccolo solo.

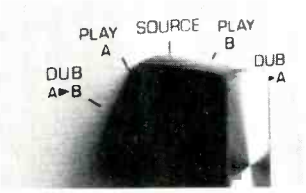


Sophisticated Tuner.

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).

A ten-position stepped loudness control takes speaker efficiency, room acoustics, and other factors into consideration, to give you the tonal balance of lows, middles, and highs you like at **all** volume levels.



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.

Homemade Philosophy.

The 800 fully incorporates all the years of electronics technology, metal working, machining and wood working pioneered by Yamaha in the music field.

Most of the various parts of Yamaha stereo equipment are made by Yamaha, in our own facilities, for stronger quality control.

And like Yamaha music products, Yamaha components are covered by an unusually long warranty—5 year parts, 3 year labor—and a national service and dealer network.

Audition the Yamaha CR-800, and all our new components, at your nearby Yamaha dealer.

YAMAHA

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Introducing the premium

Introducing the music tape BY CAPITOL. Simply the best blank tape you can buy for recording music. This extraordinary new premium tape performs with complete fidelity despite the unusual demands of music recording.

Now you can buy blank tape simply and confidently without being a sound engineer. Frankly, if you're recording a class or dictation, don't waste your money on the quality of the music tape BY CAPITOL. But if you're recording music, you can't really afford to buy less than the music tape BY CAPITOL.

Capitol XD27-G²? Never. Say goodbye to everyone else's pseudo-technical numbers and nomenclature. We've simplified the coding, the package and the whole business of buying tapes. Forget super vs. ultra vs. highest vs. dynamic. the music tape BY CAPITOL is made in one grade only. The finest. The best recording tape made. Extra high output/low noise for full dimensional sound.

The tape with an ear for music. What's the most demanding sound for a tape to reproduce?

It's music. Particularly the variety of pitch and sound levels found in symphonic music. The fortissimo of a kettle drum. The pianissimo of a harp. The timbre of a castanet. The bite of a trumpet. The sharp attack of a piano.

Ordinary recording tapes lose this range...this variety of sound. They round off an instrument's unique characteristics, its "color." They distort when the pitch is high. Or they create interference noise when the sound level is soft.

But not the music tape BY CAPITOL. You might say this tape has an ear for music.

Read between the lines. Signal-to-noise ratio (SNR) is really a way of charting a tape's performance limits. At what pitch (or frequency) will the tape distort? At what sound level (or amplitude) will you first hear unwanted noise?

Scientists can plot these performance limits on a SNR graph like the one below. The lines mark the outer limits of performance. Inside there's trouble-free recording. Outside, distortion and noise.

The larger the distance between the top and bottom lines, the better the SNR. And the wider the area covered, the better the tape's frequency response.

While no tape is perfect, the SNR graph, below, shows the superiority of the music tape BY CAPITOL over conventional tape. It's another reason we think the music tape BY CAPITOL is the best blank tape for music.

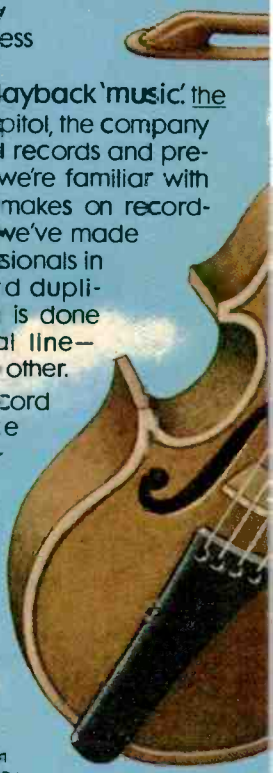
SIGNAL-TO-NOISE GRAPH

The secret is plenty of iron. Funny. You need iron to perform well. So does blank recording tape.

It's iron oxide particles that give tape the ability to record sound. We use only the finest grade oxide available. Each particle is smaller and more uniform. And we use them more efficiently. The result is greater sensitivity at both high and low frequencies and far less background noise.

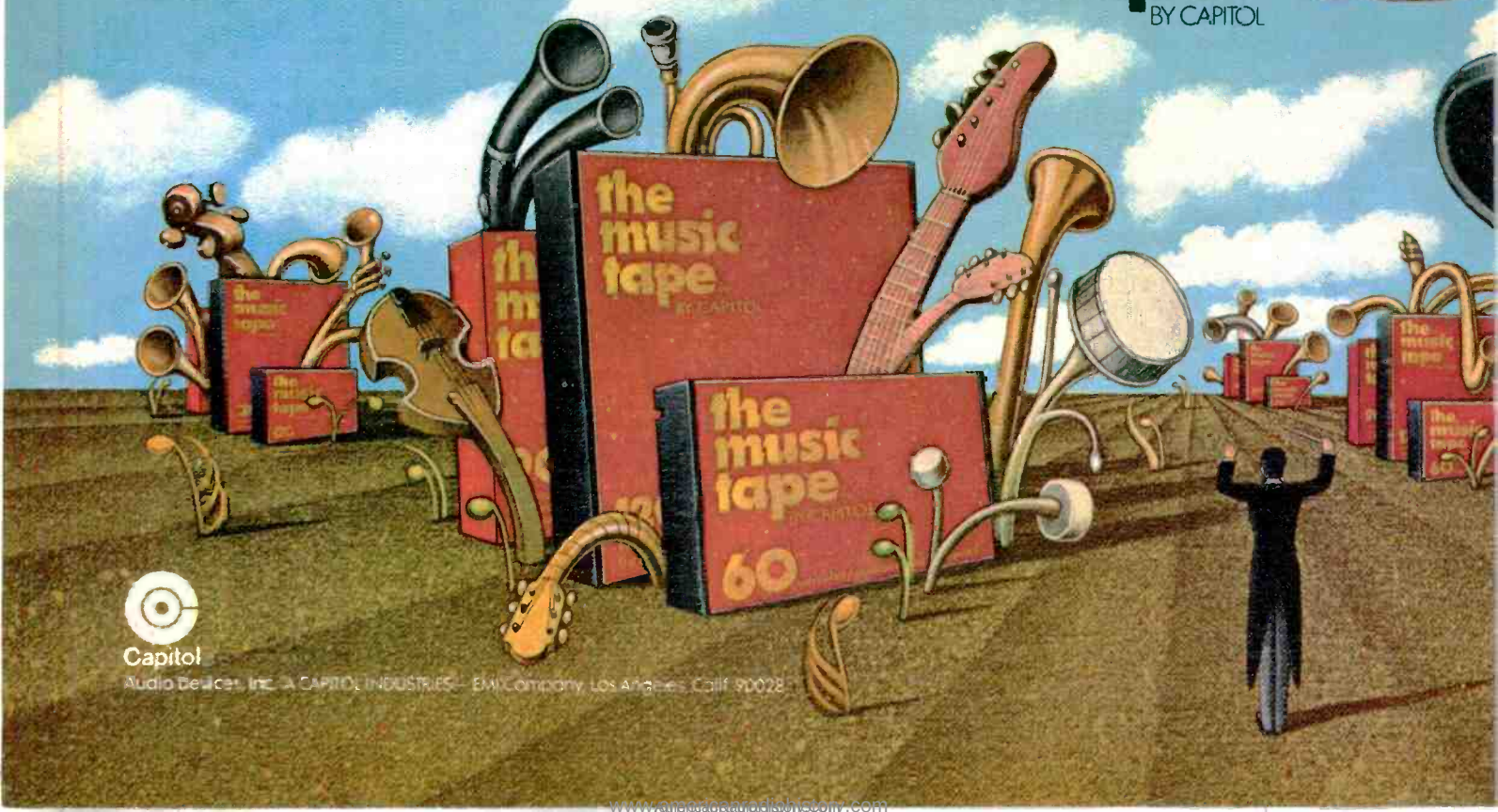
Say 'Capitol' and playback 'music.' the music tape is from Capitol, the company that produces Capitol records and prerecorded tapes. So we're familiar with the demands music makes on recording tape. Since 1948 we've made blank tape for professionals in music recording and duplicating. In fact, more is done on our professional line—Audiotape®—than any other.

The next time you record music, get the tape that's especially attuned to music. the music tape BY CAPITOL. Cassette, cartridge or open reel in the red and gold package.



When you record ordinary things, use an ordinary tape. But when you record music, record on the music tape™ BY CAPITOL

Check No. 2 on Reader Service Card



Capitol
Audio Devices, Inc., A CAPITOL INDUSTRIES - EMI Company, Los Angeles, Calif. 90028

blank tape attuned to music

phonic image is properly reproduced only when the listener is placed on the axis of symmetry. In this position the left signals originate from the left loudspeaker, the right signals from the right one, and any center signals (soloists, etc.) are perceived to originate midway between the loudspeakers. However, if the listener moves off the center axis, the intermediate sounds rapidly move toward the nearest loudspeaker, leaving a "hole in the middle." Such a stereophonic system is disadvantaged because the area over which a listener can enjoy the program in the manner prescribed by the recording director is very limited. Our study was directed to finding the means for broadening the area of accurate stereophonic perception.

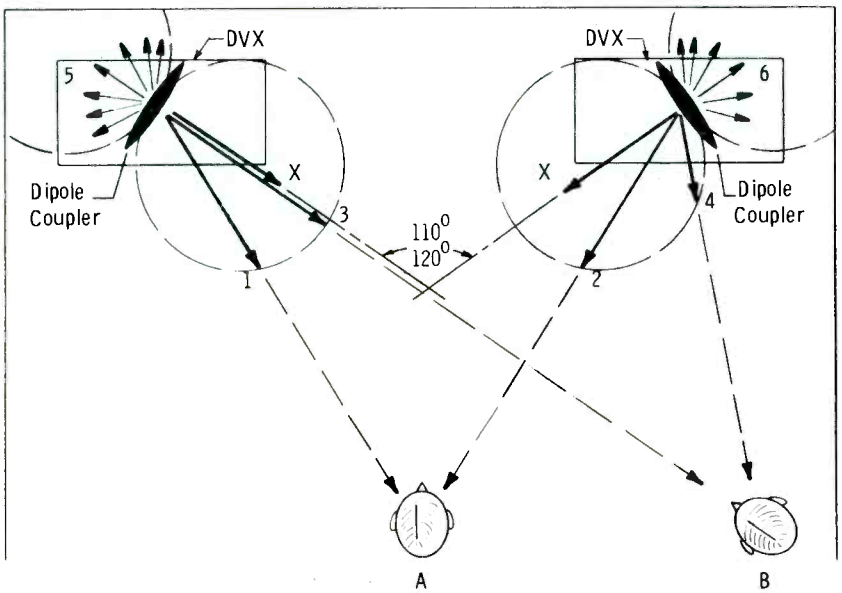


Fig. 2—Stereo arrangement of DVX loudspeakers.

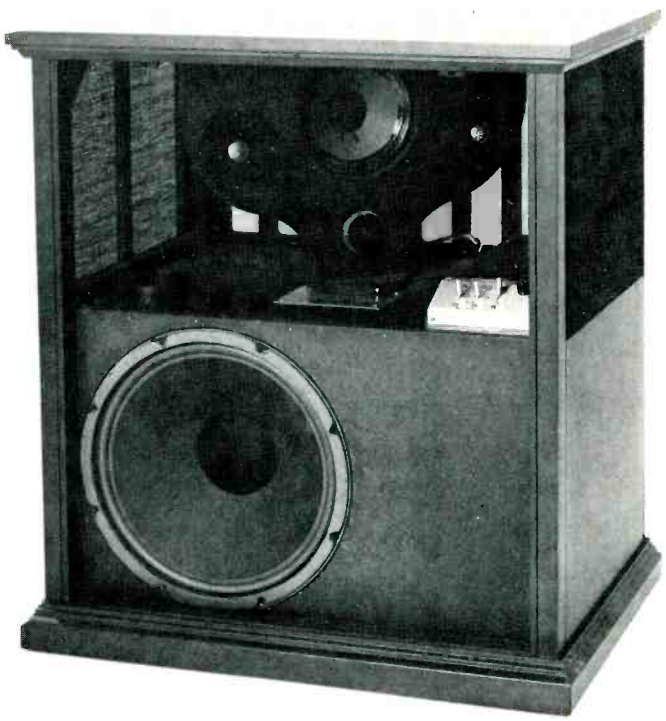


Fig. 3—View of the dipole coupler used in the upper section of the DVX loudspeaker.

The results of these researches caused us to conclude that for optimum stereo reproduction, the polar pattern of the loudspeakers should approximate the cosine law; in other words, the relative radiation as a function of the angular displacement from the axis, Θ, should be cos Θ. Such a pattern has the shape of two circles in contact with the acoustical center of the loudspeaker system, as shown in Fig. 1. Also, we found that this radiation function should be maintained at all frequencies above approximately 250 Hz, which is the range of frequencies most responsible for directional localization. In addition, the loudspeakers should be so oriented with respect to each other that their axes of maximum sensitivity intersect at an angle of approximately 110-120°, i.e., somewhat forward of the principal listening area, as shown in Fig. 2.

The cosine polar pattern with proper orientation allows us to obtain the following result: the listener midway between the loudspeakers, at A, is subjected to equal radiation strengths, as depicted by the arrows 1 and 2. As he moves off to one side, however, as depicted by position B, he becomes favored by the more distant loudspeaker because of the increased radiation vector 3, and correspondingly is "off the beam" of the nearest loudspeaker, as shown by the diminished vector 4. The differential radiation strengths compensate for the differential distances, so that the actual signal perceived from both loudspeakers remains constant over a wide area of the room. As a result of this compensatory action, correct stereo reproduction can be enjoyed over practically the full listening area.

The dipole coupler used in the upper section of the DVX loudspeaker, which is shown in greater detail in Fig. 3 (with the front grille removed), is seen to consist of a properly-shaped baffle which contains four loudspeakers: the upper one, 8 inches in diameter, reproduces the frequency range 250-1000 Hz; the lower one, 3 inches in diameter, carries the range of 1000-5000 Hz; and the two symmetrically-placed side-domed tweeters provide the desired response characteristics from 5000-20,000 Hz. (The latter ones do not provide the back radiation mode.) The baffle itself is so shaped that it matches the range of wavelengths being reproduced. The full range of frequencies, therefore, is handled with equal efficiency.

The baffle is capable of positional adjustment within the cabinet, the angular orientation being shown on a protractor at the base of the baffle.

Hardheaded.
The new Sansui SC-737.

Sansui's Exclusive Magni-Crystal Ferrite Record/Play Head

For years Sansui has produced hard-headed and solid stereo components. Our latest hard-headed development is the SC-737 cassette deck with new Magni-Crystal Ferrite heads. These super-hard heads are virtually impervious to wear, one of the major causes of tape deck quality erosion. Along with new heads the SC-737 gives you Dolby* circuits for quiet record and playback, bias equalization for standard or chromium based tapes, peak reading VU meters and a "Polarscope" tape travel indicator.

The SC-737's motor is something special, too. A 4-pole hysteresis synchronous type keeps speed constant regardless of voltage changes. Photoelectric shutoff and microphone mixing, including center channel input, make the SC-737 the cassette deck for even the most hard-headed audiophile. Hear it at your nearest franchised Sansui dealer.

*Dolby is a trademark of Dolby Laboratories Inc.

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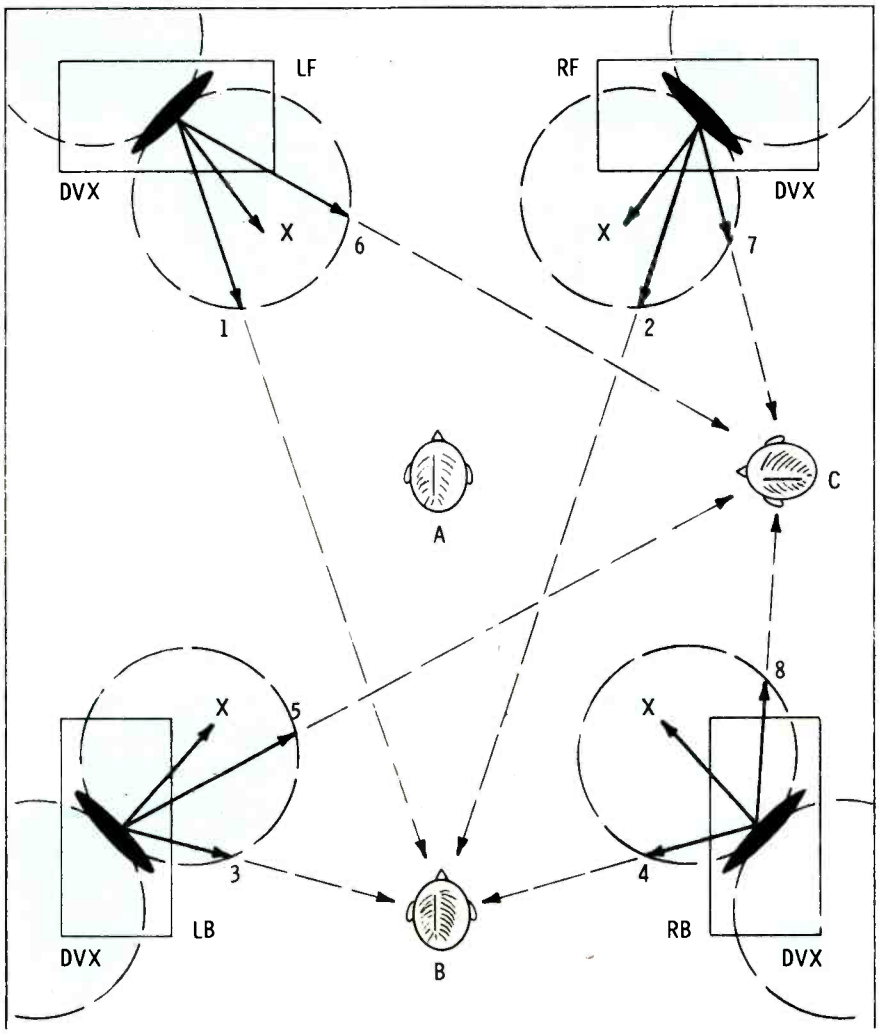


Fig. 4—Quadraphonic arragement of DVX loudspeaker.

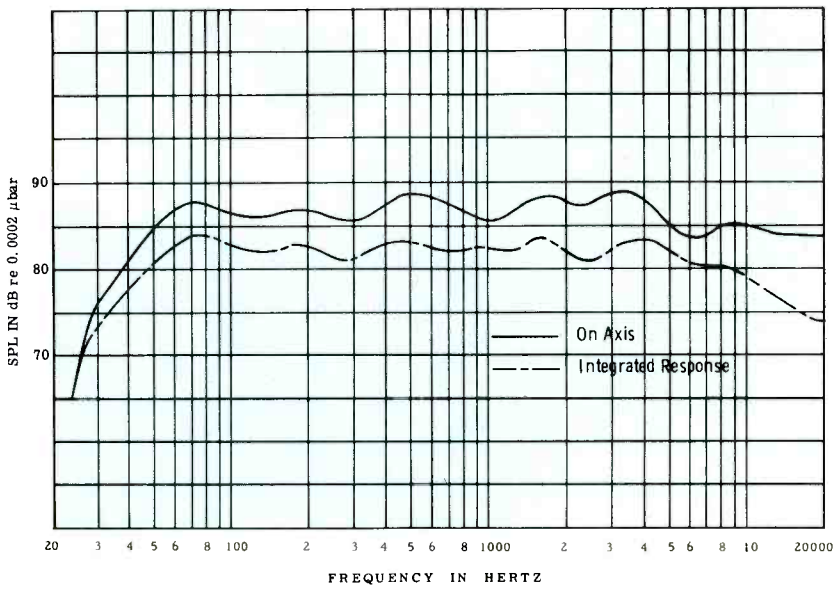


Fig. 5—Frequency response of DVX loudspeaker using 1/3-octave bands of noise.

To obtain the desired performance, the user places the loudspeakers in any appropriate baseline. He then adjusts the dipole coupler with respect to the listening area as shown in Fig. 2. After satisfactory results have been obtained, the user snaps the front panel back into place, and the system is ready for operation.

DVX In Quadraphonic Applications

The DVX loudspeakers are especially adaptable to quadraphonic arrangements. An example of a favorite placement is shown in Fig. 4. Here the four DVX loudspeakers are placed at the corners of the quadraphonic listening area, the two front loudspeakers, LF and RF, being placed against the far wall, while the two back loudspeakers, LB and RB, are placed against the side walls. For optimum quadraphonic performance, it has been found convenient to angle the dipole couplers in such manner that their axes point toward the center of the listening area. In this case, a centrally located listener, at A, receives the four loudspeaker radiations equally. If he moves to one edge of the listening area, e.g., to positions B or C, he is nearer to one pair of loudspeakers than to the other; but in each case he also continues to receive almost an "on-the-beam" radiation from the distant loudspeakers (as shown by arrows 1 and 2, and 5 and 6, respectively), while he is "off-the-beam" of the nearest loudspeakers as shown by the arrows 3 and 4, and 7 and 8, respectively. The relative radiation strengths again are compensatory of the differences in distance. Therefore, in quadraphony also, all four DVX loudspeakers are heard with equal efficiency over a wide listening area.

Performance Characteristics

In addition to its remarkable directional characteristics, the DVX is among the most carefully designed loudspeakers. The woofer is a 15-inch driver in a 3½ cubic foot enclosure loosely filled with fiberglass terminated by a low velocity (large) vent which forms a fourth-order Butterworth Filter. Counting the woofer and the three-way mid- and upper-end dipole coupler, the system has four separate frequency bands resulting in reproduction of excellent clarity. The dividing network at the upper right of the cabinet uses air-core inductors for the frequency-dividing function resulting in elimination of dividing-network distortion. Three frequency response switches are provided to control the response of the system which in its "flat" position is shown in Fig. 5.

Why nearly every record player is like a car that doesn't steer straight.

If you've ever driven a car with badly aligned front wheels or a defective steering mechanism, you know what we're talking about.

It's a queasy feeling when you can't make the car point in the same direction as the road is pointing.

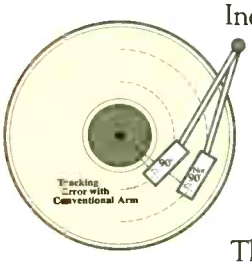
There happens to be a distinctly comparable problem with record players, except that it's a nearly universal deficiency, not just a malfunction.

Of course, in this case there's no human life at stake, only the fidelity of the reproduced sound. And sometimes the life of the record.

Like a car, the phono cartridge (or pickup head) should point where it's going. Right down the middle of the groove. Not at an angle to it.

A more scientific way of saying the same thing is that the head should remain perpendicular to the line drawn through the stylus tip and the turntable spindle.

Any deviation from this ideal is known as tracking error. It's measured in degrees and it causes distortion. Inevitably.



The trouble is that there's no way to avoid tracking error and the resulting distortion with any conventional pivoted tonearm. Why? Because the head swings in an arc and is therefore at a continuously changing angle to the groove as it travels across the record.

The problem has remained fundamentally the same since the Emile Berliner gramophone of 1887. It has been minimized, thanks to improvements in tonearm geometry, but it hasn't been eliminated.

With one important exception.

In the current line of Garrard automatic turntables, the top models are equipped with Garrard's unique Zero Tracking Error Tonearm.

This remarkable invention ends tracking error once and for all. The head is always properly lined up with the groove because it's hinged instead of fixed and keeps adjusting its angle during play. A simple idea, yes, but the engineering details took the world's leading manufacturer of turntables seven years to perfect.

The Zero Tracking Error Tonearm is a major technological coup, not just a glamour feature. You can hear the difference.

The "Acoustics" column of *Rolling Stone* magazine, for example, reported that the original Garrard turntable equipped with the new arm "sounded markedly 'crisper' than other turntables" under otherwise identical test conditions.

It's true. Just like a car that doesn't steer straight, tracking error can make a nasty sound.

It can even cause unnecessary record wear. The information engraved in the grooves of the new CD-4 discrete four-channel records is so finely detailed that it can be partially wiped out by a stylus that doesn't sit absolutely square and true.

Ask your nearest Garrard dealer about the Zero Tracking Error Tonearm.

It's absurd to tolerate a problem that somebody has already solved.

Top of the line: Garrard Zero 100c, $209.95.
Other Garrard automatic turntables from $49.95 up.
To get your free copy of the new 16 page full color Garrard Guide, write Garrard, Dept. G-9, 100 Commercial Street, Plainview, N.Y. 11803.

Garrard
Division of Plessey Consumer Products
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Check No. 13 on Reader Service Card

All About Q—

CONCLUSION

Don Davis*

Idealized Loudspeaker Geometry

Referring back to Fig. 6, we can write the following equation for a loudspeaker with idealized coverage characteristics (remembering that no such device exists in real life). (See Fig. 7.)

$$Q = \frac{180}{\text{ARC SIN } [(\text{SIN } \frac{\theta}{2}) \ (\text{SIN } \frac{\phi}{2})]}$$

To obtain the square coverage pattern Q we can use

$$Q = \frac{180}{\text{ARC SIN } [\text{SIN}^2 \ (\frac{\alpha}{2})]}$$

If, on the other hand, you had a Q you wished and needed to know the ideal square pattern for that Q, we can write

$$\alpha = 2 \text{ ARC SIN} \sqrt{\text{SIN } \frac{180}{Q}}$$

If, having a Q defined, and its idealized square coverage pattern, it is possible to assign an arbitrary horizontal or vertical angle needed and then calculate the other angle required to maintain the defined Q.

If you have selected the horizontal angle and need to know the vertical angle that would allow the Q to remain the same as that calculated for the square pattern, then

$$\phi = 2 \text{ ARC SIN} \left[\frac{\text{SIN}^2 \frac{\alpha}{2}}{\text{SIN } \frac{\theta}{2}}\right]$$

And, if you instead select the vertical angle and need to calculate the horizontal angle that would allow the Q to remain the same as that calculated for the square pattern, then

$$\theta = 2 \text{ ARC SIN} \left[\frac{\text{SIN}^2 (\frac{\alpha}{2})}{\text{SIN } \frac{\phi}{2}}\right]$$

For angles greater than 180°, one angle becomes 180° and the other angle must then fall somewhere between 180° and 360°

$$Q = \frac{360}{\text{angle}}$$

Classic Measurement of Q

In the noise measurement field a relatively standard measurement procedure has been in effect since 1953 (first outlined by Gross and Peterson in the 1953 edition of their *Noise Measurement Handbook* and later widely accepted). This method calls for a series of measuring points spaced about the sound source so as to allow each point to represent an equal area on the surface of the sphere. Because of the nature of the geometric pattern, only six such sets of uniformly distrib-

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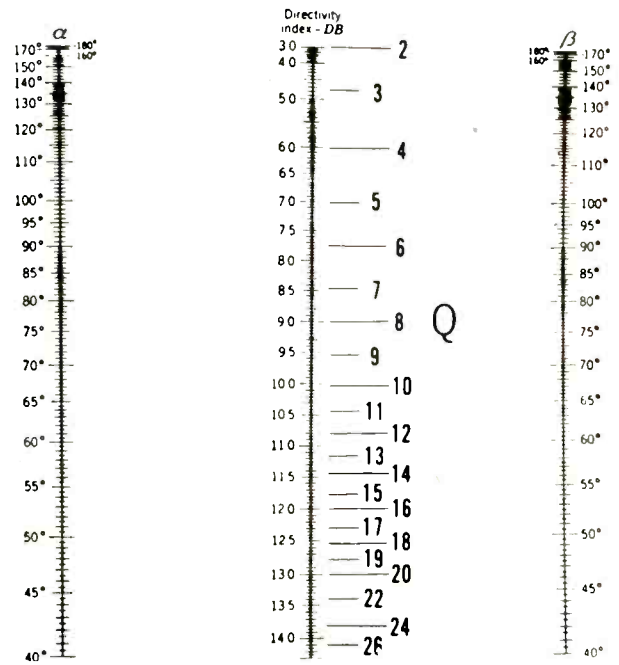


Fig. 6—Angular coverage, Q, and D_1 compared.

I FOR ANGLES FROM 180° TO 1°

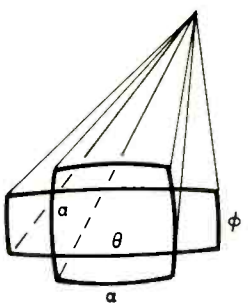
$$Q = \frac{180}{\text{ARC SIN } [(\text{SIN } \frac{\theta}{2}) \ (\text{SIN } \frac{\phi}{2})]}$$

II $$Q = \frac{180}{\text{ARC SIN } [\text{SIN}^2 \ (\frac{\alpha}{2})]}$$

III $$\alpha = 2 \text{ ARC SIN} \sqrt{\text{SIN } \frac{180}{Q}}$$

IV $$\theta = 2 \text{ ARC SIN} \left[\frac{\text{SIN}^2 \ (\frac{\alpha}{2})}{\text{SIN } \frac{\theta}{2}}\right]$$

V $$\theta = 2 \text{ ARC SIN} \left[\frac{\text{SIN}^2 (\frac{\alpha}{2})}{\text{SIN } \frac{\phi}{2}}\right]$$



IV FOR ANGLES > 180°; THEN ONE ANGLE = 180° AND THE OTHER ANGLE = SOME VALUE BETWEEN 180° AND 360°

Fig. 7—Geometrical aspects of directivity factor and directivity index.

uted points are possible. These six sets have 2, 4, 6, 8, 12 and 20 uniformly distributed points. Figure 8 shows the plane view of 10 points distributed on a hemisphere of unit radius. (First coordinate is on the x axis, second coordinate is on the y axis and the third coordinate is on the z axis.)

If we pick three sample points to locate from the plane view in Fig. 8 such as the bottom set of coordinates—x = 0.127, y = -0.934, and z = 0.333 as P_1; the top left set of coordinates—x = -0.333, y = 0.577, and z = 0.745 as P_2, and the center set of coordinates—x = 0, y = 0, and z = 1 as P_3, we can now plot them as shown in Fig. 9. The length of the vector

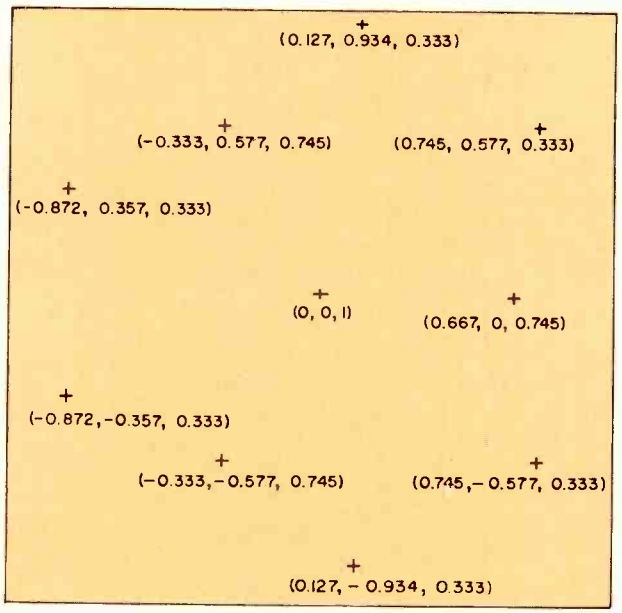


Fig. 8—Plane view of 10 points distributed on a hemisphere of unit radius.

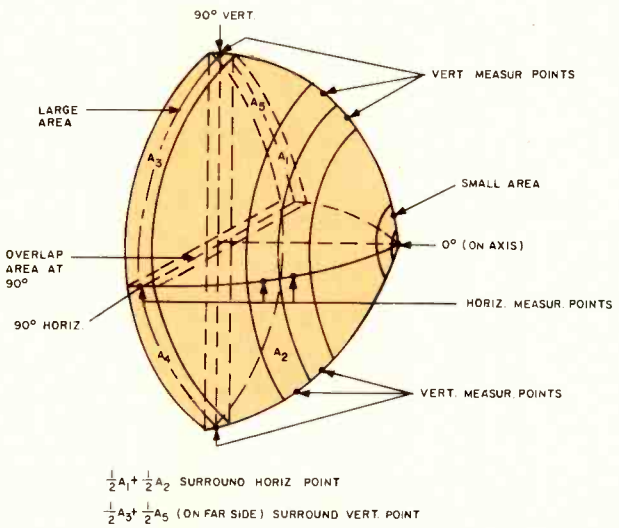


Fig. 9—Locating points on a spherical surface.

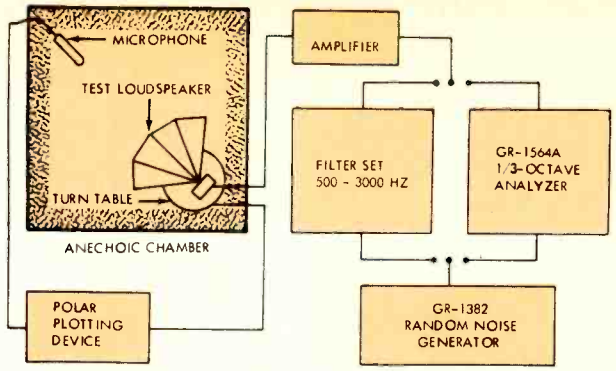
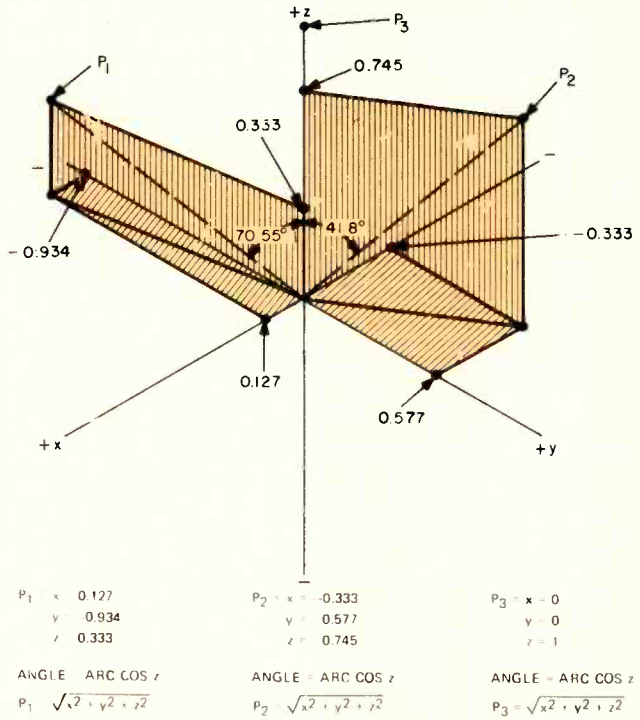
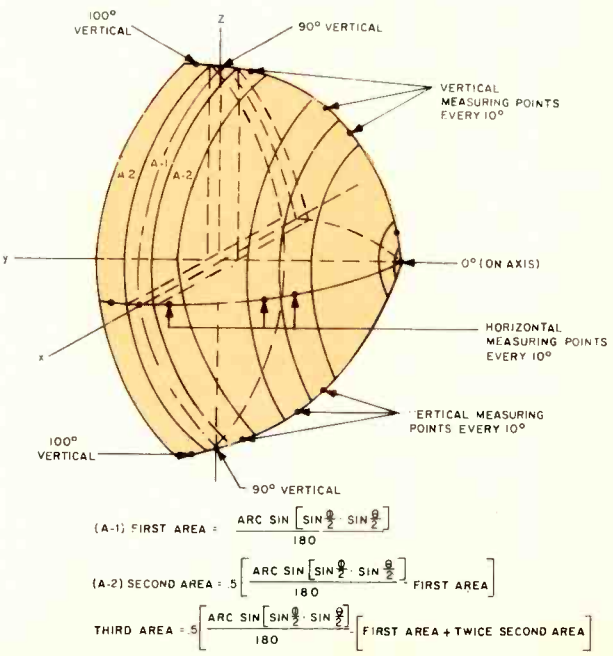


Fig. 10—Typical equipment set up for measuring Q and sensitivity of a loudspeaker in an anechoic chamber.



Areas associated with measuring points on horizontal and vertical polar plots.



Area formulas for A-1, A-2, etc.

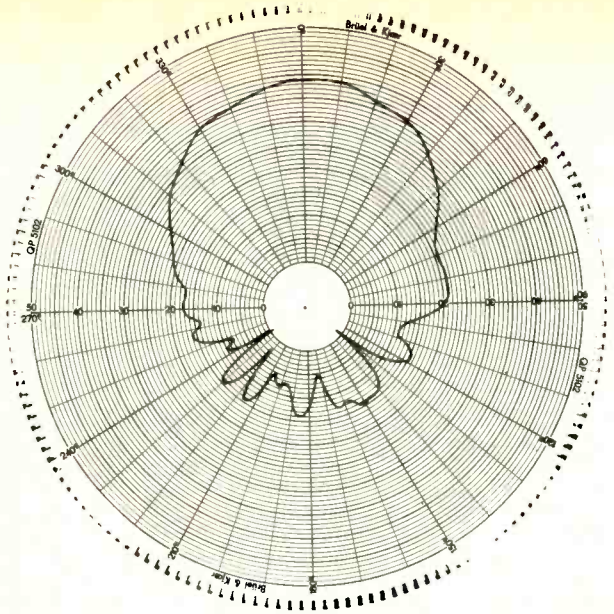


Fig. 11—Typical polar response of a very directional horn loudspeaker.

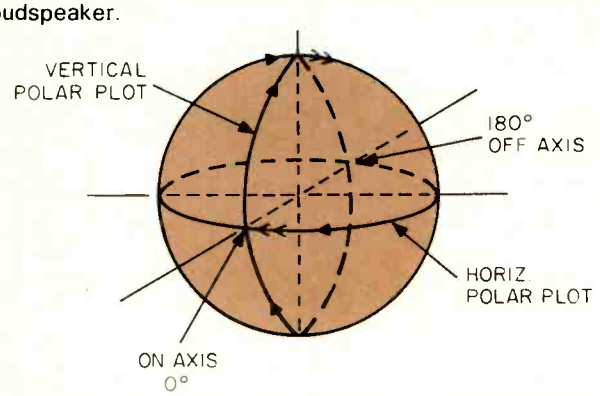


Fig. 12—Plotting horizontal and vertical polar responses.

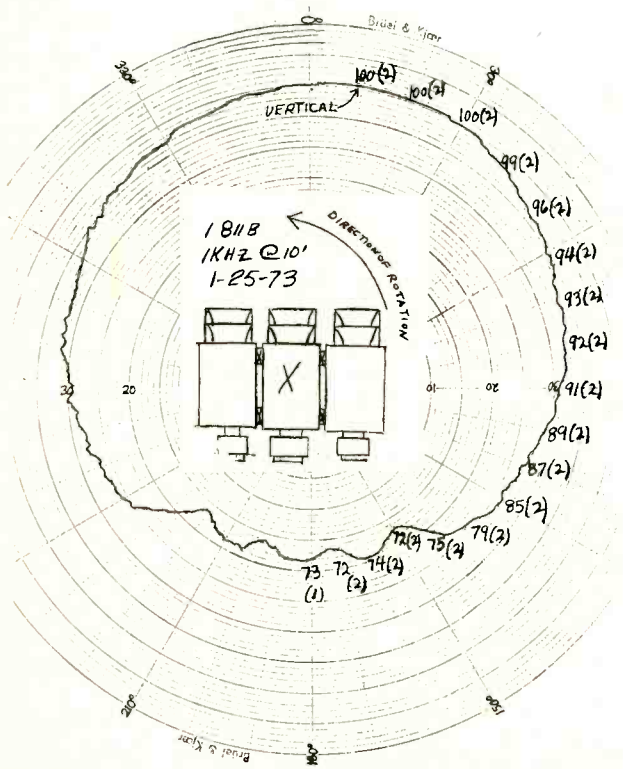


Fig. 13—An actual vertical polar response of a horn loudspeaker.

to P_1, P_2 and P_3 is found by the formula

$$P = \sqrt{x^2 + y^2 + z^2}$$

The angle between the z axis and the vector is found by

$$\text{Angle} = \text{ARC COS} \quad \frac{Z}{\sqrt{x^2 + y^2 + z^2}}$$

The dB-SPL measured at each of the 10 points is averaged by converting to power ratios, adding them, dividing them by 2 (because it is a hemispherical surface area) and then taking 10 log of the power ratio left, and subtracting from it 10 log the number of points sampled. This averaged dB-SPL for the hemisphere is identified by dB-SPL.

The dB-SPL for any given direction is determined and the dB-SPL is subtracted from it. The power ratio of this answer is the Q. It can be expressed as an equation:

$$Q = 10^{\left(\frac{\text{dB-SPL Directional} - \overline{\text{dB-SPL}}}{10}\right)}$$

Manufacturers of loudspeakers have not used this method but rather have concentrated over the years on gathering polar response data in only the horizontal and vertical planes. Various methods have been sought out to economically utilize the wealth of data at hand to calculate Q. While recognizing that the first attempts were crude, it should also be recognized that at the time these cruder methods were used, the alternative was no Q data at all.

Measuring the Q of Real Loudspeakers

Wolff and Malter, in a paper in 1930, were the first to describe the directional characteristics of loudspeakers, so far as this author is aware. A second giant step was taken by Hopkins and Stryker in 1947. (This work plus the papers by C.T. Molloy are heavily quoted by L.L. Beranek in his works.) It remained, however, for Bob Beavers of Altec to take the big jump to measure and assign values by frequency for a line of commercial sound loudspeakers. His method was an adaptation of the one used by Ben Bauer to measure the Q of microphones (See Bibliography). The author, by measuring Q indirectly in the field in reverberant spaces, helped in the construction and identification of the method used today.

Because real-life loudspeakers exhibit lobing (in some cases severe), it became necessary in a majority of the cases to average readings on a horizontal and vertical polar pattern every 10° in order to arrive at a resolution that correlated with field data taken to confirm the effect of Q and of Q multipliers. Fortunately, it was also found, at least for the higher quality commercial-type loudspeakers involved, that their symmetry between the horizontal and vertical axes was smooth enough to require only two polar plots per frequency of interest. Again, fortunately, though 1/3-octave bands were first employed, the 1-octave band intervals proved sufficient for planning the effect of Q by frequency on acoustic gain, articulation loss of consonants in speech, etc.

Therefore, a manufacturer who measures a horizontal polar plot and a vertical polar plot at each of the following center frequencies has sufficient raw material to adequately state coverage angles and Q (See Figs. 10-14): 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 8000 Hz. Because of the $\%AL_{CONS}$ formulas, the 1000 and 2000 Hz bands are felt to be the most important ones, and if only two frequencies can be measured, it should be these.

Since both a vertical and a horizontal polar plot are made at each frequency, the manufacturer must then process 16 polar plots in order to obtain the desired data.

Processing the Polar Plots

Start at the on-axis, 0° point on the horizontal and vertical plot. The SPL in dB-SPL is recorded and *weighted* according

Table I—Area "weightings" for "Q" measurements using standard horizontal and vertical polar plots.

Angles	# of Areas	Weighting
0° (on axis)	1	0.002417944
10° & 350°	4	0.004730189
20° & 340°	4	0.008955027
30° & 330°	4	0.012387354
40° & 320°	4	0.014989611
50° & 310°	4	0.016868154
60° & 300°	4	0.018165962
70° & 290°	4	0.019006744
80° & 280°	4	0.019477787
90° & 270°	4	0.019629373
100° & 260°	4	0.019477787
110° & 250°	4	0.019006744
120° & 240°	4	0.018165962
130° & 230°	4	0.016868154
140° & 220°	4	0.014989611
150° & 210°	4	0.012387354
160° & 200°	4	0.008955027
170° & 190°	4	0.004730189
180° (off axis)	1	0.002417944
	Total =	1.000000004

Table II—Spherical coverage.

Horizontal Data	Vertical Data
0 DEG. DB-SPL = 100.0	0 DEG. DB-SPL = 100.0
10 DEG. DB-SPL = 100.0	10 DEG. DB-SPL = 100.0
20 DEG. DB-SPL = 100.0	20 DEG. DB-SPL = 100.0
30 DEG. DB-SPL = 100.0	30 DEG. DB-SPL = 100.0
40 DEG. DB-SPL = 100.0	40 DEG. DB-SPL = 100.0
50 DEG. DB-SPL = 100.0	50 DEG. DB-SPL = 100.0
60 DEG. DB-SPL = 100.0	60 DEG. DB-SPL = 100.0
70 DEG. DB-SPL = 100.0	70 DEG. DB-SPL = 100.0
80 DEG. DB-SPL = 100.0	80 DEG. DB-SPL = 100.0
90 DEG. DB-SPL = 100.0	90 DEG. DB-SPL = 100.0
100 DEG. DB-SPL = 100.0	100 DEG. DB-SPL = 100.0
110 DEG. DB-SPL = 100.0	110 DEG. DB-SPL = 100.0
120 DEG. DB-SPL = 100.0	120 DEG. DB-SPL = 100.0
130 DEG. DB-SPL = 100.0	130 DEG. DB-SPL = 100.0
140 DEG. DB-SPL = 100.0	140 DEG. DB-SPL = 100.0
150 DEG. DB-SPL = 100.0	150 DEG. DB-SPL = 100.0
160 DEG. DB-SPL = 100.0	160 DEG. DB-SPL = 100.0
170 DEG. DB-SPL = 100.0	170 DEG. DB-SPL = 100.0
180 DEG. DB-SPL = 100.0	180 DEG. DB-SPL = 100.0

DB-SPL AVER. = 100.0
DB-SPL DIRECT. = 100.0
Q = 1.0

Table III—Hemispherical coverage.

Horizontal Data	Vertical Data
0 DEG. DB-SPL = 100.0	0 DEG. DB-SPL = 100.0
10 DEG. DB-SPL = 100.0	10 DEG. DB-SPL = 100.0
20 DEG. DB-SPL = 100.0	20 DEG. DB-SPL = 100.0
30 DEG. DB-SPL = 100.0	30 DEG. DB-SPL = 100.0
40 DEG. DB-SPL = 100.0	40 DEG. DB-SPL = 100.0
50 DEG. DB-SPL = 100.0	50 DEG. DB-SPL = 100.0
60 DEG. DB-SPL = 100.0	60 DEG. DB-SPL = 100.0
70 DEG. DB-SPL = 100.0	70 DEG. DB-SPL = 100.0
80 DEG. DB-SPL = 100.0	80 DEG. DB-SPL = 100.0
90 DEG. DB-SPL = 100.0	90 DEG. DB-SPL = 0.0
100 DEG. DB-SPL = 0.0	100 DEG. DB-SPL = 0.0
110 DEG. DB-SPL = 0.0	110 DEG. DB-SPL = 0.0
120 DEG. DB-SPL = 0.0	120 DEG. DB-SPL = 0.0
130 DEG. DB-SPL = 0.0	130 DEG. DB-SPL = 0.0
140 DEG. DB-SPL = 0.0	140 DEG. DB-SPL = 0.0
150 DEG. DB-SPL = 0.0	150 DEG. DB-SPL = 0.0
160 DEG. DB-SPL = 0.0	160 DEG. DB-SPL = 0.0
170 DEG. DB-SPL = 0.0	170 DEG. DB-SPL = 0.0
180 DEG. DB-SPL = 0.0	180 DEG. DB-SPL = 0.0

DB-SPL AVER. = 97.0
DB-SPL DIRECT. = 100.0
Q = 2.0

Table IV—RCA M1-10001C ribbon-velocity unidirectional microphone.*

Horizontal Data	Vertical Data
0 DEG. DB-SPL = 100.0	0 DEG. DB-SPL = 100.0
10 DEG. DB-SPL = 100.0	10 DEG. DB-SPL = 100.0
20 DEG. DB-SPL = 100.0	20 DEG. DB-SPL = 100.0
30 DEG. DB-SPL = 100.0	30 DEG. DB-SPL = 100.0
40 DEG. DB-SPL = 100.0	40 DEG. DB-SPL = 99.0
50 DEG. DB-SPL = 99.0	50 DEG. DB-SPL = 98.0
60 DEG. DB-SPL = 98.0	60 DEG. DB-SPL = 97.0
70 DEG. DB-SPL = 97.0	70 DEG. DB-SPL = 97.0
80 DEG. DB-SPL = 96.0	80 DEG. DB-SPL = 96.0
90 DEG. DB-SPL = 95.0	90 DEG. DB-SPL = 95.0
100 DEG. DB-SPL = 94.0	100 DEG. DB-SPL = 94.0
110 DEG. DB-SPL = 92.0	110 DEG. DB-SPL = 93.0
120 DEG. DB-SPL = 90.0	120 DEG. DB-SPL = 90.0
130 DEG. DB-SPL = 87.0	130 DEG. DB-SPL = 88.0
140 DEG. DB-SPL = 85.0	140 DEG. DB-SPL = 85.0
150 DEG. DB-SPL = 82.0	150 DEG. DB-SPL = 82.0
160 DEG. DB-SPL = 80.0	160 DEG. DB-SPL = 77.0
170 DEG. DB-SPL = 77.0	170 DEG. DB-SPL = 76.0
180 DEG. DB-SPL = 75.0	180 DEG. DB-SPL = 75.0

DB-SPL AVER. = 95.9
DB-SPL DIRECT. = 100.0
Q = 2.6

*From mid-range polar charts on page 168 *Audio Cyclopedia.*

to the area its center point covers compared to the area covered by the next center point. These are then converted into power antilogs and summed:

$$\left(\frac{\text{dB-SPL}_1}{10}\right) \quad \left(\frac{\text{dB-SPL}_2}{10}\right) \quad \left(\frac{\text{dB-SPL}_3}{10}\right)$$
$$10 \qquad + \ 10 \qquad \ldots \ 10$$

The same is then done for the vertical pattern.

This summed power level for both horizontal and vertical is then re-converted to dB-SPL by

10 log Summed Power Level $\overline{\text{dB-SPL}}$

10 log dB-SPL summed gives the average dB-SPL.

Choosing any given directional dB-SPL, for instance, the on-axis point, allows the calculation of Q for that direction.

$$Q = 10^{\left(\frac{\text{dB SPL} - \overline{\text{dB SPL}}}{10}\right)}$$

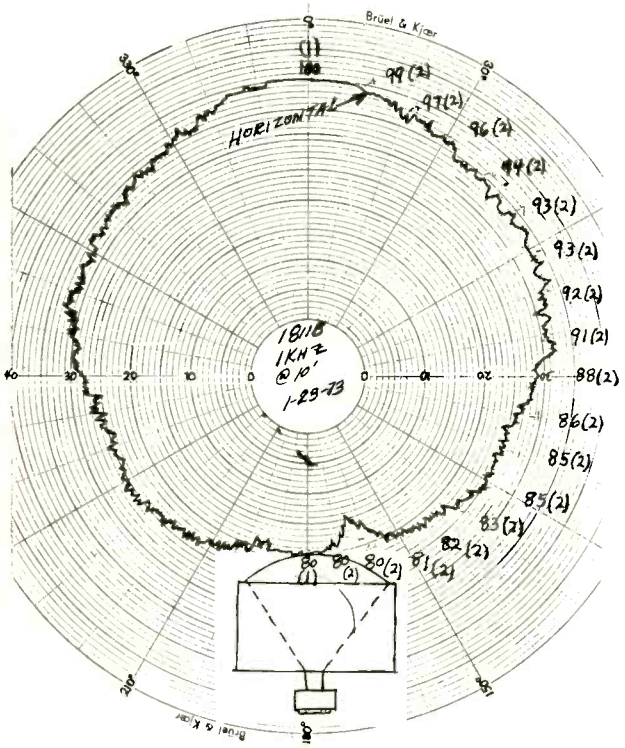


Fig. 14—An actual horozontal polar response of a horn loudspeaker.

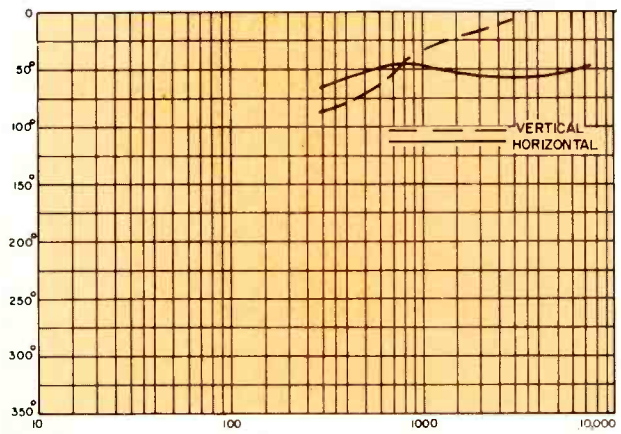


Fig. 15—Angular distribution of a horn (plotted at the –6 dB points on a series of polar responses).

Where: Q = The directivity factor
dB-SPL_D = The SPL in dB in the desired direction
$\overline{\text{dB-SPL}}$ = The averaged SPL in dB over the total horizontal and vertical coverage pattern.

These calculations should be undertaken for each of the octave bands mentioned earlier in the text.

The same polar charts can be used to assign the effective coverage angle for the loudspeaker at each of the same octave bands. The –6 dB point below the on-axis level is a normally chosen parameter for such angles. Thus, for each octave band, it would be possible for the conscientious manufacturer to assign his loudspeaker:

1. An on-axis sensitivity figure such as x dB-SPL at y feet from z watts.
2. An effective vertical and horizontal coverage angle. (See Fig. 15.)
3. The mean Q by frequency. (See Fig. 16.)

The generation of such data would immeasurably benefit the commercial sound field, especially in having an accurate knowledge of Q. By comparison with loudspeakers of known Q, various Q multipliers could be properly investigated.

Measuring Q in the Field

Once the audio engineer has in his possession a loudspeaker with a known Q for each octave band, he can measure the Q of other loudspeakers for which he does not have Q data. The basic equation for finding the critical distance (the distance at which the direct sound and the reverberant sound are equal in a reverberant space) is:

$$D_c = 0.141\sqrt{QR}$$

Where: D_c = The critical distance in feet or meters
Q = The directivity factor of the loudspeaker
R = The room constant
$R = \frac{S\bar{a}}{1-a}$

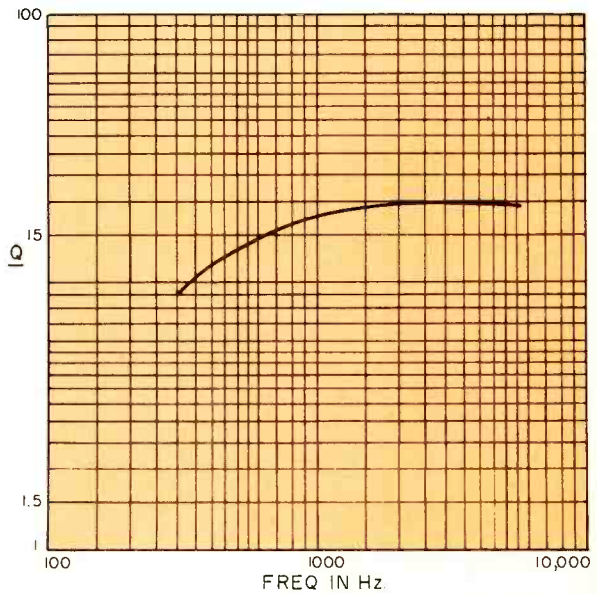
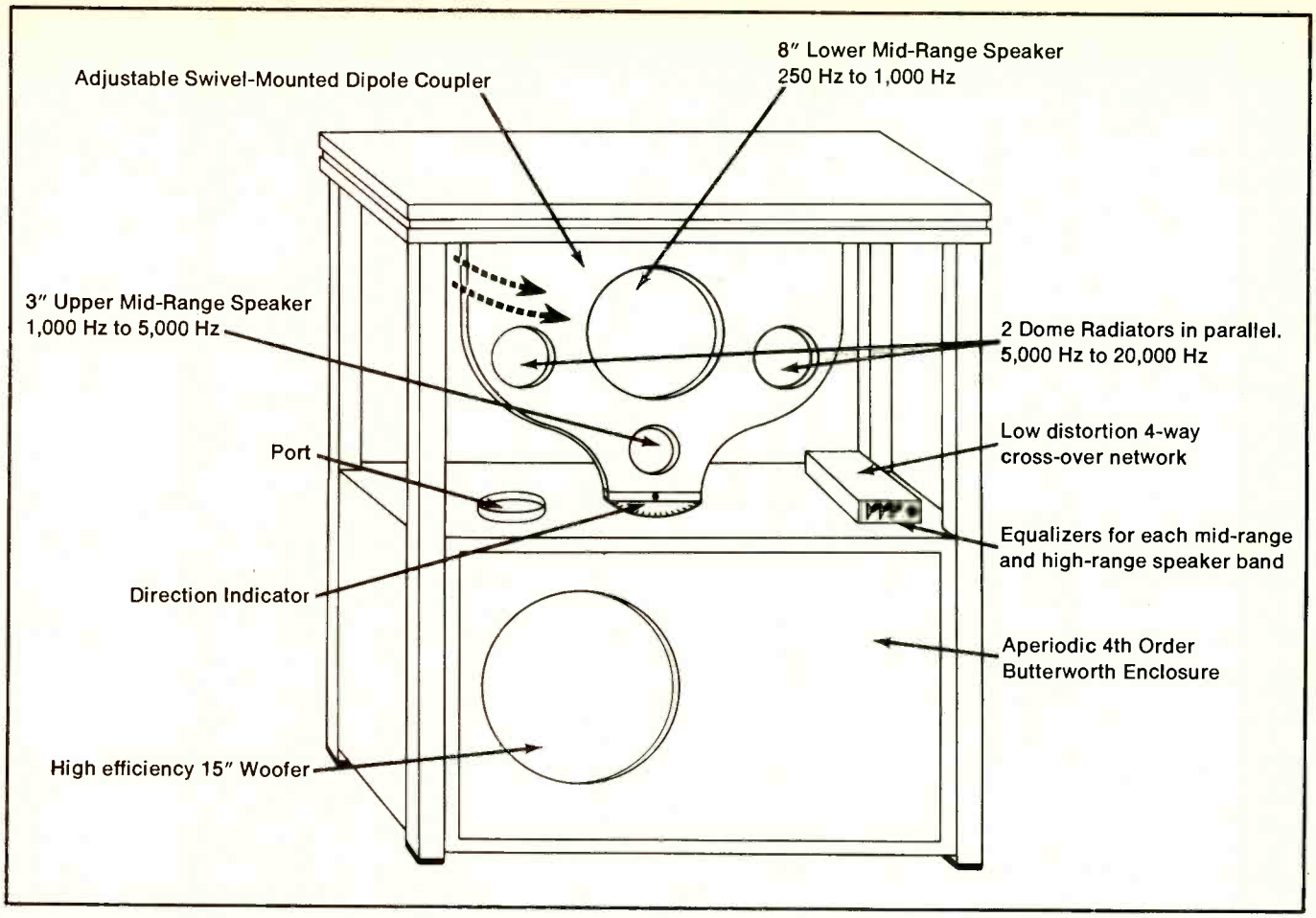


Fig. 16—A plot of the Q of the horn whose angular distribution was shown.



The new Leslie DVX Speaker: it adjusts to the geometry of your room!

CBS Laboratories and Leslie Speakers have now developed an amazing new loudspeaker system that is...quite frankly...amazing!

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DVX MODEL 570

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Where: S = the total boundary surface area in feet² or m²
$\bar{a}$ = the average absorption coefficient

This equation can be solved for: 15

$$Q = \frac{(D_c)^2}{0.01988R} \quad \text{and} \quad R = \frac{(D_c)^2}{0.01988Q}$$

Measuring D_c in a Reverberant Room

The easiest way to find D_c in a reverberant room is to put an octave band of pink noise into the loudspeaker to be tested. Using a good quality sound level meter set for its slow meter damping, take a reading at either 5 or 10 feet (after determining that this distance is in the free field of the loudspeaker by observing that inverse square law is in operation at twice and half the reference distance. Then take a second sound level reading well beyond D_c (where you would estimate 2 to 3 D_c should be.) (See Fig. 17.)

The equation for finding D_c is:

$$D_c = \text{ref. dist.} \times 10^{\left(\frac{\text{ref. dist. dB-SPL - Reverb. dB-SPL}}{20}\right)}$$

***Caution should be used to obtain levels that are at least 10 dB apart by adjusting the reference distance.**

For example, if the reference distance were 5 feet and the reference distance dB-SPL were 90.5 dB-SPL and the reverberant dB-SPL were 74 dB-SPL, then we could write:

$$D_c = 5 \times 10^{\left(\frac{90.5 - 74}{20}\right)} = 33.42'$$

Using the formulas developed above, we could then calculate for the room constant if our test loudspeaker had a Q = 5:

$$R = \frac{(33.42)^2}{0.019881 \times 5} = 11{,}235.82 \text{ ft}^2$$

If we now substituted a test loudspeaker that gave a D_c = 40 ft., we could calculate that its Q should be

$$Q = \frac{(40)^2}{0.019881 \times 11235.82} = 7.16$$

A good reverberant room with good diffusion and where the loudspeaker can be mounted away from nearby reflective surfaces can allow the audio engineer to obtain excellent field approximations of the Q for each octave band of interest.

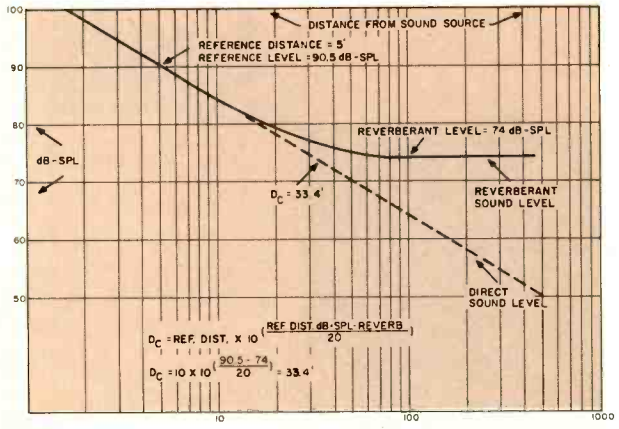

Fig. 17—Sound level with increasing distance.

What Can We Do With Q Now That We Have It?

The most exciting thing we can do is investigate the Q multipliers that exist. Cecil Cable in a splendid article first took the plunge and purposed that if a loudspeaker predominantly covered an audience area with an absorption coefficient of, say, a = 0.32 and the average absorption coefficient for the room as a whole were $\bar{a}$ = 0.16, then the Q multiplier would be $\bar{a}$

$$Q_m = \frac{\text{a of audience area}}{\bar{a} \text{ of total room}}$$

Therefore, if we had a loudspeaker with a Q = 5 in the case described above, the total apparent Q would become

$$Q \times Q_m = 5 \times \frac{.32}{.16} = 10$$

Having a loudspeaker with an accurately known Q measured in the anechoic chamber would allow field measurements to reveal the apparent Q multiplication at differing positions and the coverage angles provided by the speaker.

Once many of these positioning and coverage problems have been quantified, audio engineers could turn their attention to the effective Q of large arrays as well as the real effect of microphone Q when the microphone is normally placed in the loudspeaker's reverberant field, and the Q of the listener. (It is known that if the listener has to cup his ears to restore intelligibility at his seat, doubling the Q of the loudspeaker will free him from the necessity of holding his hands to his ears.)

The trade-off between increasing Q rather than having to increase R to achieve essentially the same ratio of direct-to-reverberant sound at the listener's ears is just becoming well known to architects, allowing better planning of spaces requiring both musical and speech usage. Future discussions of the effects of "so-called" omnidirectional loudspeakers can be brought into clearer perspective by an understanding of Q and its role in controlling the ratio of direct-to-reverberant sound. Q and coverage are both important to the sound you hear.

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Equipment Profiles

Marantz Model 4400
Stereo/4-Channel Receiver

MANUFACTURER'S SPECIFICATIONS

TUNER SECTION

R.F. Input for 30 dB Quieting: 1.8 μV. **Quieting at 50 μV (S/N):** 70 dB. **THD:** Mono, 0.2%; Stereo, 0.3%. **Selectivity:** 75 dB. **Capture Ratio:** 1.5 dB. **Spurious Rejection:** 95 dB. **Image Rejection:** 90 dB. **I.F. Rejection:** 100 dB. **AM Supression:** 60 dB. **Stereo Separation, 1kHz:** 42 dB. **AM Sensitivity:** 20 μV (external antenna).

AMPLIFIER SECTION

Continuous Power output, 8 ohm Loads, All channels Driven: 125 watts x 2; 50 watts x 4 (any frequency from 20 Hz to 20 kHz). **Rated THD:** 0.15%. **Rated IM Distortion:** 0.15%. **Power Bandwidth:** 7 Hz to 70 kHz. **Damping Factor:** 50 (at 8 ohms). **Frequency Response** (High Level Inputs): 20 Hz to 20 kHz ±0.25 dB. **Input Sensitivity:** Phono, 2.0 mV. **Equivalent noise input** (phono): 1.5 μV. **High Level Input Sensitivity:** 150 mV. **Tone Control Range:** Bass, ±10 dB at 50 Hz; Treble, ±10 dB at 15 kHz; Mid-Range, ±6 dB at 700 Hz.

GENERAL SPECIFICATIONS

Power Requirements: 120 V a.c., 50 to 60 Hz. **Power Consumption:** 650 watts at full power, 60 watts at no signal. **Dimensions:** 19-19/64 in. W x 5-3/4 in. H x 15-3/16 in. D. **Weight:** 52.8 lbs. **Price:** $1250; SQA-1, $49.95; SQA-2, $79.95; CD-400, $99.95.

To begin with, the Marantz 4400 is *big*. It has to be to incorporate all the features built into it. Examining the front panel, we see a family resemblance to other top-of-the-line Marantz receivers. Large, thumbwheel-edge tuning knob at the right, multi-purpose oscilloscope display at the left—these are all Marantz "originals." Along the bottom section of the gold and black front panel are a pair of front and rear headphone jacks, a Dolby selector switch (with positions for FM DOLBY decoding, PLAY, OFF, and RECORD I and II), program selector switch, three-position tape monitor switch, mode switch (with positions for MONO, TWO-CHANNEL, DISCRETE four-channel, VARI-MATRIX, and SQ DECODER—if the optional module is installed). An adjacent "dimension" control alters the built-in simple matrix parameters to create varying four-channel effects with stereo or matrixed four-channel recordings. There are also separate BASS, TREBLE and MID-range tone controls for front and rear channels (mounted as dual concentric controls), a master VOLUME control and a separate POWER on-off switch.

The previously referred to Dolby selector switch permits direct playback of Dolbyized FM broadcasts, playback of other Dolbyized program sources, by-passing of Dolby circuits for conventional program sources including internal FM, proper recording of non-Dolbyized signals, and, finally, proper re-recording of previously Dolbyized program sources in a non-Dolbyized fashion.

At mid-panel level, just below dial scale level, are a series of 12 push buttons—six at the left and six at the right. The first of the left-most cluster selects left or right channel calibration of the Dolby level set meter located just above this button. Next is a button which, when depressed, provides a built-in 400-Hz tone for Dolby calibration. The remaining four buttons are used in conjunction with the 'scope display, the first button turning on power to the 'scope, the remaining three determining the type of display that is to be observed, such as audio presentation (for mono, stereo, or four-channel quadrant displays), FM tuning, or FM multipath. The six symmetrically arranged buttons at the right take care of such functions as loudness control, FM muting, low and high fre-

Fig. 1— View of the rear panel.

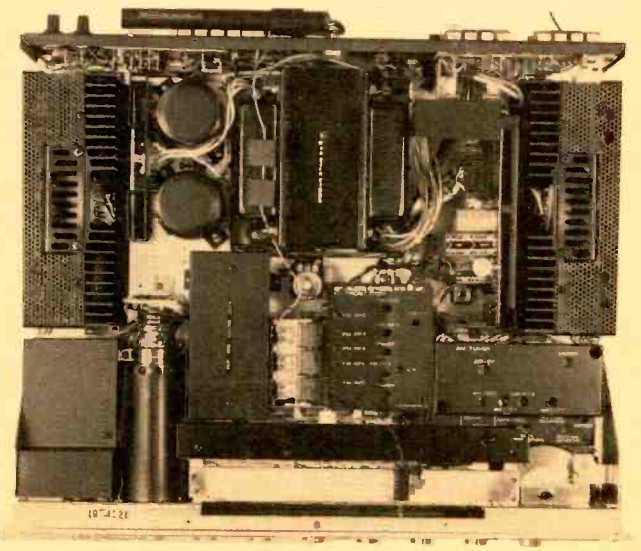


Fig. 2—View of the chassis.

quency filters, and selection of either main or remote (or both) sets of speakers.

Located at center-panel are three slide controls which control front-rear balance, front-left-right balance and rear-left-right balance. The dial scale itself is well-calibrated in both FM and AM frequencies and includes a logging scale and an illuminated dial pointer. Above the dial scale, various written designations light up to denote settings of the mode and program selector switches and there is also the usual stereo indicator light which lights up in the presence of a received stereo FM signal. Four small knobs adjacent to the 'scope display take care of record and playback calibration of the Dolby circuits, and the instructions for these calibration steps are well explained in the instruction manual.

A view of the rear panel is shown in Fig. 1. Speaker connections for both main and remote quartets of speakers are made by means of piano-key spring loaded terminals which virtually preclude the possibility of short circuits. Antenna connections are made to similar terminals. There are a pair of a.c. convenience receptacles below the speaker terminals—one switched, one unswitched—a line fuse, and a selector switch for changing operating mode from four-channel to higher-powered two-channel operation. A detector output jack, identified as "FM Quadradial Output" is provided for connection to a four-channel FM adaptor at some time in the future. Dolby FM calibration controls for left and right channels, though factory preset, may require readjustment and are therefore brought out to the rear panel for customer access. Vertical and horizontal centering controls, as well as brightness and focus controls are also available for setting up the 'scope display. A muting level control is also located on the rear panel. Jumper blocks are installed between the preamplifier outputs and the main amplifier inputs. These can be removed and the two sections may be used independently. Phono and high-level in-out jacks, tape monitor out and in jacks (two complete circuits), a chassis ground terminal, remote control socket and switch, and an FM de-emphasis switch complete the rear panel layout. This last item represents a bit of foresight on the part of Marantz's designers. Just a few days before this receiver was evaluated, the FCC authorized transmission of FM signals using the Dolby noise reduction process *plus* 25-microsecond pre-emphasis (as opposed to previously employed 75 microsecond pre-emphasis). Owners of the Marantz 4400 and a limited number of other fine tuners and receivers will be able to enjoy this new, more effective Dolby FM broadcasting from the moment it originates in their area.

An internal view of the Marantz 4400 is shown in Fig. 2. Construction is modular and the amount of circuitry contained in this well laid out unit suggests that it could not have been made much smaller in size. Yet, serviceability seems excellent and there is a minimum of point-to-point wiring for all the circuit complexity.

The front-end includes an FET r.f. amplifier, and FET mixer, and a double-tuned tank circuit between stages. The i.f. section contains six transistors and three stages of dual ceramic permanent filters. Symmetrical diode-limited circuits utilize "Hot Carrier" diodes and the i.f. limiter-amplifier is

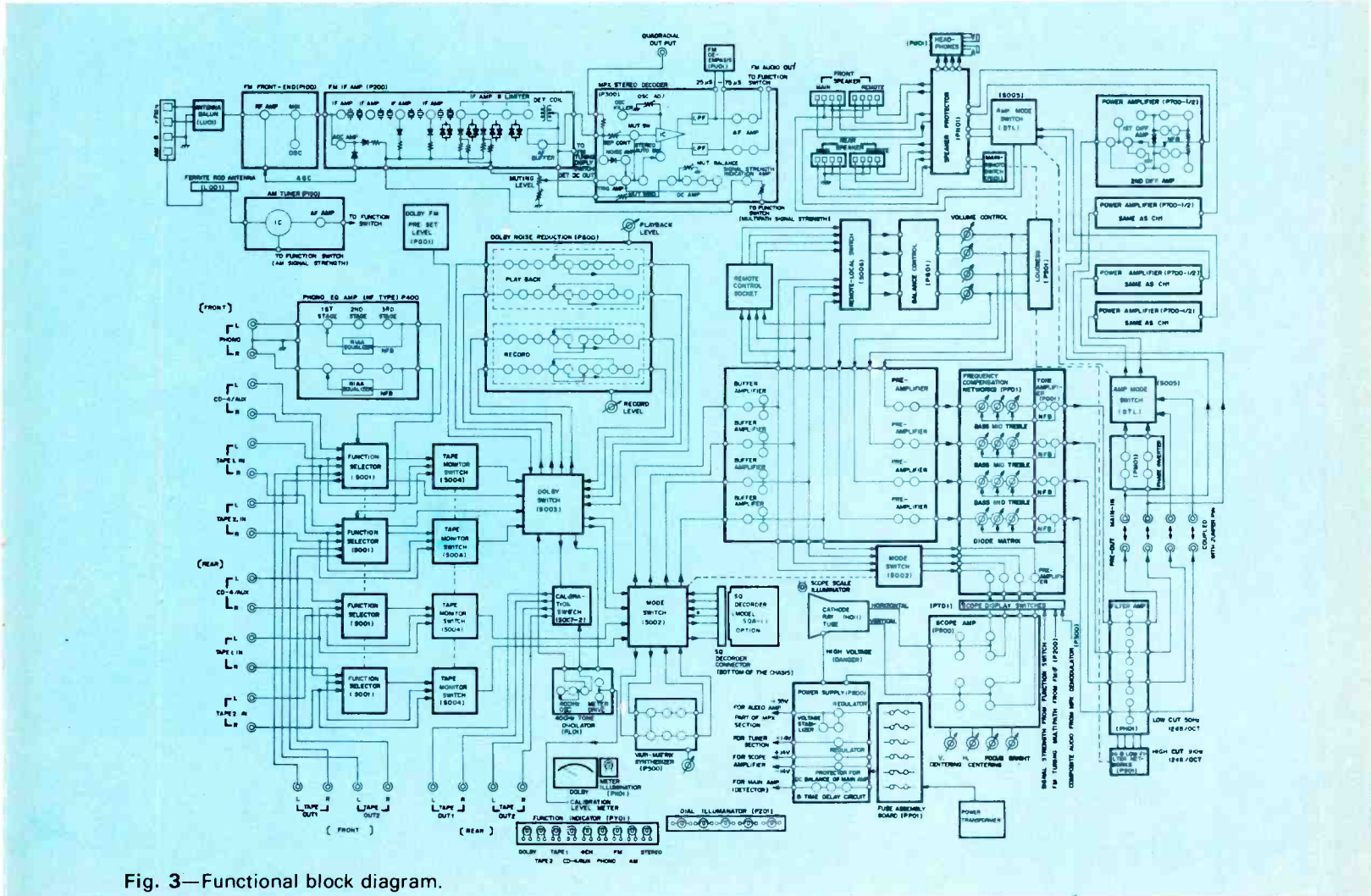
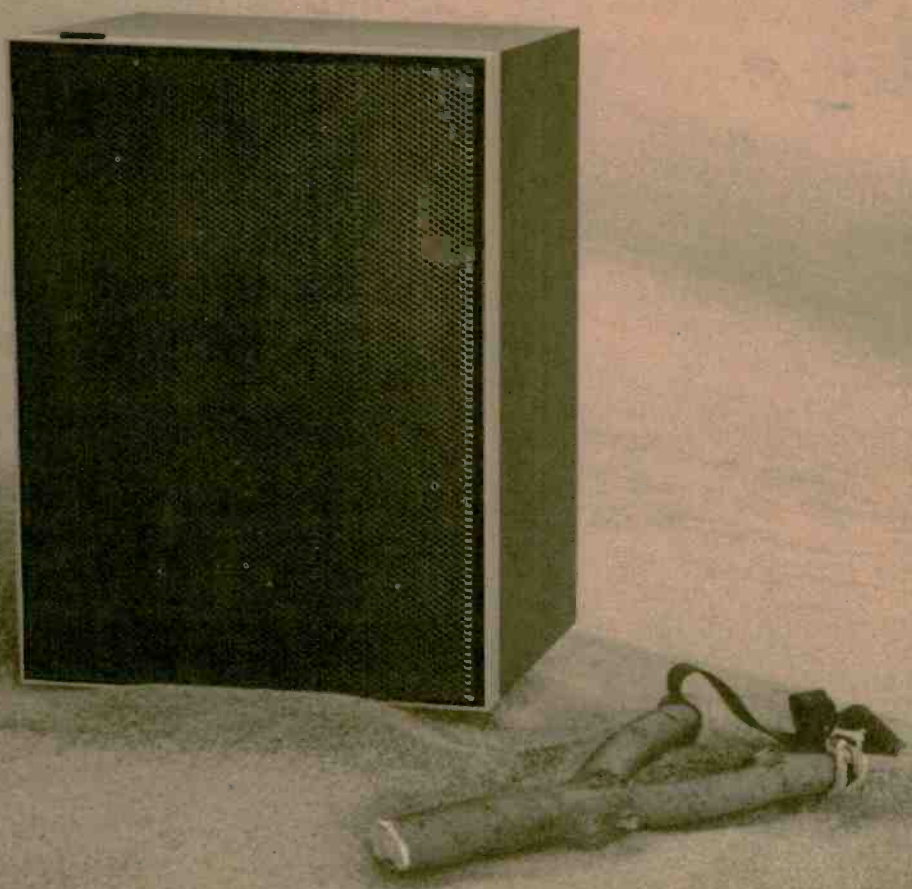


Fig. 3—Functional block diagram.

MEET DAVID



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said to have a small dynamic symmetrical aperture so that distortion-producing AGC circuitry is not required. FM stereo decoding is accomplished by means of a phase-lock-loop IC circuit. Muting circuitry includes a two-transistor noise amplifier and a three-transistor switching circuit. The AM circuitry of the 4400 consists of a multi-purpose r.f.-oscillator-mixer-i.f.-detector IC plus a transistor amplifier. A three-section variable capacitor is used in the AM section.

Tone control circuitry is of the feedback type and utilizes a two-stage direct coupled NPN-PNP configuration with an R-C feedback network. Each power amplifier includes a preamplifier stage, driver, electronic protection and output circuits. The amplifiers include direct-coupled differential stages. Silicon output stages are arranged in a full-complementary Darlington format direct-coupled output. The electronic protection circuits, consisting of three transistors and four diodes in each channel, sense peak output current and limit current fed to the driver transistors to a safe maximum value. A block diagram of the entire circuit of the Marantz 4400 is shown in Fig. 3.

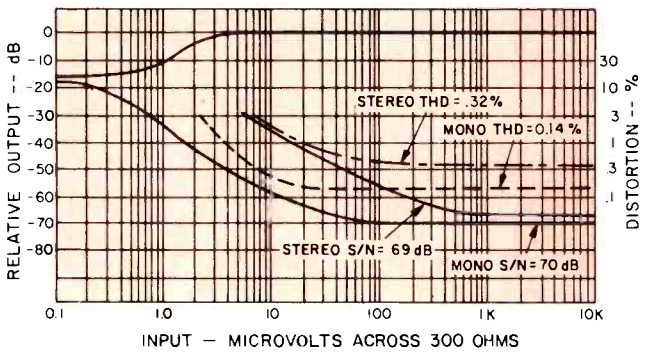

Fig. 4—FM quieting and distortion characteristics.

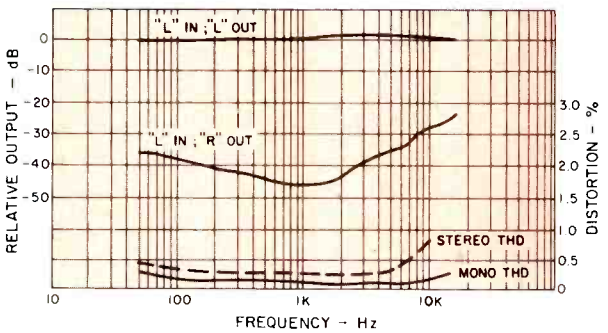

Fig. 5—Separation and distortion vs. frequency.

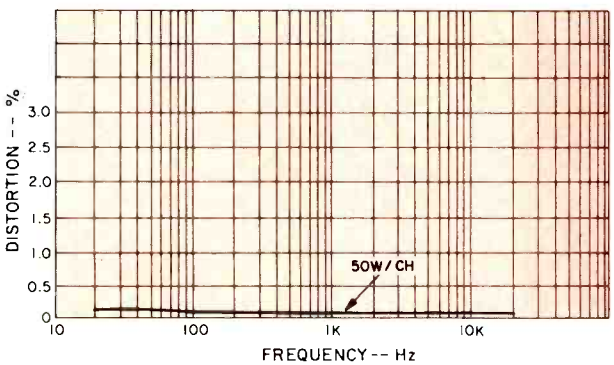

Fig. 6—Harmonic and intermodulation distortion characteristics.

FM Tuner Measurements

Referring to the published specifications at the start of this report, you will note that Marantz chooses not to mention IHF sensitivity, but prefers instead to reference the signal required to achieve a nominal 30 dB of quieting. While we do not particularly object to this format, it may be confusing to the reader who is accustomed to seeing an IHF sensitivity spec, which combines readings of both residual noise and distortion. As a matter of fact, taking Marantz's statement, they actually do better than claimed, reaching 40 dB quieting at just under 2 μV input. However, if it is IHF sensitivity you want to measure, it takes just under 3 μV to reach 3% *combined* residual noise and distortion. 70 dB of quieting was reached with an input of just under 100 microvolts and remained at that level for higher signal strengths, as shown in Fig. 4. Stereo quieting was almost as good, measuring 69 dB without inserting any low-pass filters. This means that 38-kHz and 19-kHz product rejection is excellent too. Ultimate mono THD measured 0.14%, better than claimed, while stereo THD just missed the 0.3% mark at 0.32%.

Stereo separation at mid-band frequencies actually was better than the 42 dB claimed (it measured 47 dB) decreasing to under 30 dB at 10 kHz and to 36 dB at the low frequency end of the spectrum. (See Fig. 5.) Both mono and stereo THD at frequency extremes were extremely low. Even at 10 kHz there was little evidence of intermodulation "beats" in stereo, resulting in a THD reading of well under 1.0%. Stereo sensitivity and threshold were measured at 6 μV. Muting level is adjustable from under 5 μV up to about 30 μV. Capture ratio measured 1.3 dB, a bit better than claimed, while such secondary specs as image rejection, i.f. rejection and spurious response rejection were substantially as claimed in the published specifications. Alternate channel selectivity measured 78 dB, somewhat better than the 75 dB claimed. AM sensitivity on our sample measured 25 μV and, since this was the only specification given by Marantz with respect to AM performance, the balance of our AM circuit evaluation was confined to listening tests.

Amplifier Section Measurements

The Marantz 4400 really comes into its own when considered as a four-channel amplifier. The distortion plots in Fig. 6 show that at all but maximum power output, THD and IM are at just about the level of our audio signal generator (0.015%) and as close to being "distortionless" as it's possible for us to measure. Even full power output is conservatively rated. At 50 watts output per channel, with all channels driving 8 ohm loads, THD was still a low 0.06%. Rated THD was reached at an output of 56 watts per channel under the same driving conditions, and rated IM of 0.15% was read for an output of 58 watts per channel, again with all channels driving 8 ohms. Two-chan. power was 135 w/chan. at rated distortion, 20 Hz—20 kHz.

Even more impressive is the power bandwidth of this brute amplifier (shown in Fig. 7) which extends from 6 Hz to 80 kHz! In trying to plot THD versus frequency, we ran into a problem of having to show an expanded distortion scale on our standard graph presentation, so that for all intents and purposes, it's difficult to read just how low the THD readings really are at the frequency extremes at full rated power output. In case you have trouble interpreting the "almost straight line" curve, suffice it to say that at 20 Hz, the 4400 was still producing its rated power output of 50 watts per channel with less than 0.1% THD and at 20 kHz, the THD for 50 watts output per channel was a mere 0.055%. These results are plotted in Fig. 8.

Phono overload was measured at 120 mV, better than the 100 mV claimed. Phono hum, referenced to 2 mV input and full power output was a very excellent 70 dB. Many manufacturers claim that figure, but few actually attain it, espe-

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cially when referenced to such a sensitive, high-gain phono preamplifier circuit. The omission of the RIAA curve from the manual was evidently an oversight on the part of the printer, because in fact, RIAA equalization was accurate from 30 Hz to 20 kHz within ±0.5 dB. Overall frequency response extends from 10 Hz to 25 kHz within 0.25 dB, with input applied to any of the high level input jacks. Signal-to-hum level for high level inputs measured a satisfactory 86 dB.

Tone control, filters, and loudness characteristics (for a -30 dB setting from CW position of the volume control) are all shown in Fig. 9. Filter action for both low and high filters is steep and effective in reducing rumble and hiss without seriously affecting response musically. The mid-range control (unlike some) does not provide too much presence boost—just a nice moderate amount which is easily and uniformly controlled and the center of which is at a preferred lower-mid frequency. We liked its action.

Use and Listening Tests

Considering the FM portion of the Marantz 4400, there's no doubt that a 'scope display for tuning beats any meter arrangement, as we have said in previous reports on equipment that provides this luxury. In the case of this unit, the display serves a triple purpose. When used for tuning, a vertical bar trace indicates correct center tuning as well as relative signal strength. When the FM multipath button is depressed, degree of station modulation as well as multipath distortion can be easily observed. Finally, the display is useful in observing audio signals in mono, stereo and four-channel modes. We cannot guess what percentage of the cost of the Marantz 4400 is bound up in the 'scope display feature (probably a good 25% of the parts cost), but there is no doubt about its usefulness in every one of its functions.

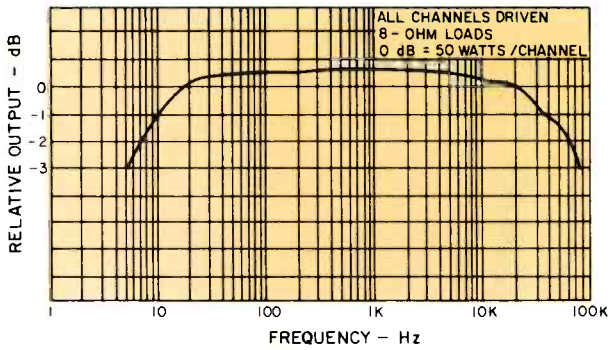

Fig. 7—Power bandwidth characteristics.

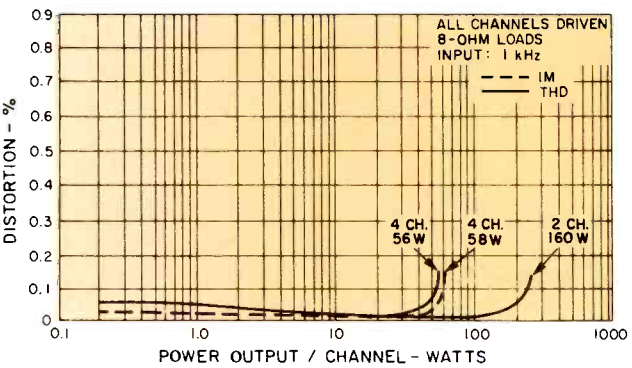

Fig. 8—Distortion vs. frequency.

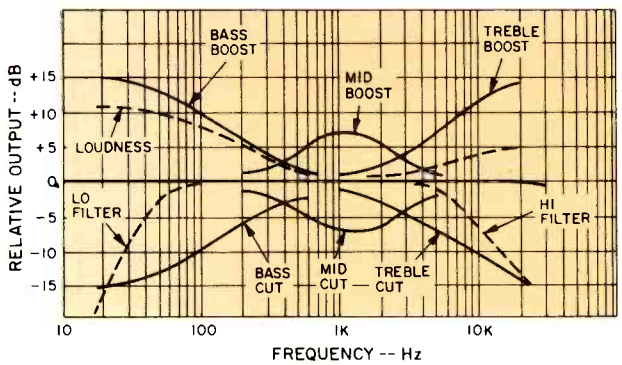

Fig. 9—Tone control range, filter and loudness characteristics.

Aside from the slight discrepancy in quieting sensitivity, the tuner section performed well, with a minimum of audible distortion on all but the very weakest signals. Stereo reception was excellent, with very positive switching occurring between mono and stereo reception. In fact, all the controls of this fine receiver have a very positive feel and transmit a sense of the ruggedness of the entire instrument.

One cannot but help be influenced by the high cost of this receiver in conducting listening tests and use tests. Certainly, the amplifier section of this unit performs flawlessly—fully as well as some of the separate integrated amplifiers and even separate power amplifiers to which we have listened. There is a tightness of bass, and an ease of power handling that is rarely found in all-in-one receivers, least of all four-channel units which often compromise amplifier power and performance in favor of quadraphonic circuit needs. Marantz has chosen the opposite approach. They have designed, first and foremost, a quality quartet of amplifiers, but chosen to leave the choice of system and sophistication up to the user by means of the "hidden pocket" system.

The built-in four-channel synthesizing circuit does do some interesting things for both stereo records and matrix encoded discs. It does not, however, decode them as their producers intended them to be reproduced, nor does it have any logic circuitry, so that separation is minimal and instrumental placement is arbitrary and does not conform to expectations. We checked this out by alternately playing several SQ records, first using the built in four-channel synthesizer and then using a separate, full-logic SQ decoder (not the one supplied as a plug-in module by Marantz). Naturally, the full-logic decoder produces superior results. That means that unless you wish to confine your four-channel listening to discrete four-channel tapes, you're going to have to spend more money for the SQ decoder of your choice. You can purchase either Marantz's SQA-1 ($49.95) which has front-to-back logic or the SQA-2 ($79.95) which has full logic. If you want CD-4 record reproduction, you will have to use an outboard demodulator such as Marantz's Model CD-400 ($99.95). In short, the Marantz 4400 is an excellent piece of electronics in its own right, though not a universal four-channel receiver unless you spend a bit more money than the initial $1250.00 required to buy the receiver. And keep in mind our arbitrary figure of 15% of the total cost for all the benefits of the triple-purpose 'scope, which amounts to nearly 300 dollars. The additional cost of $50-100, which is less than competitors' comparable units for a plug-in decoder or demodulator still keeps the price of the 4400 within the range of several other top-ot-the-line four-channel receivers. Obviously, Marantz could have easily raised the price even higher and included the extras. The fact that they did not suggests that they believe there may be further improvements in SQ decoding techniques—and they may well be correct in this surmise. In any case, with the externals added, this receiver is in no way a "compromise" design because of its four channels of audio. In fact, when the pairs of amplifiers are operated together for stereo listening, there aren't too many receivers around that can deliver its 125 watts per channel so effortlessly at any price.

Leonard Feldman

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Advertising Index

Recorded Opera Reviews

Johann Strauss: **FLEDERMAUS.** Metropolitan Opera 1950 cast. **Columbia Odyssey Y2 32666,** mono, 2 discs, $5.98.

Exactly 100 years have passed since Johann Strauss, "the Waltz King," gave *Die Fledermaus* to an unappreciative Vienna. Berlin and Paris quickly reacted differently, and since then the opera has had audiences laughing and applauding round the world. Garson Kanin, who adapted the Haffner/Genée libretto for the Metropolitan Opera's new production in 1950, suggests that the Vienna fiasco was due to a stock market crash and the prudish Viennese aristocracy. Whatever the cause, it's hard to understand the unfortunate première. This is a delicious musical bonbon from start to finish.

This re-release features the 1950 cast —Ljuba Welitsch, Lily Pons, Richard Tucker, John Brownlee, Martha Lipton and others—under the baton of Eugene Ormandy. This is an appropriately crisp performance, never pausing overlong for effect, and knowing which phrases of Strauss' engaging music should be languorous and which light as cotton candy. The overture is often so badly played, for example, that it is startling to hear what sophistication there is in the harmonies: Ormandy is very good at this kind of refurbishing. Nothing is gratuitous, everything is measured without sounding annoyingly metronomic.

Miss Welitsch's Rosalinda is perhaps a bit too classy for farce, but of course the voice was still largely radiant in 1950. In *Some Days You're Lonely,* her second act party aria, the control is there, but I have the impression that, as elsewhere, she would have been more relaxed with the original language. (So would I: Howard Dietz's rendering of what this album calls "lyrics" for the arias and ensembles are not always felicitous. A single example of his jarring strain for the English rhyme: "The judge considered him a nuisance/ And you kept putting in your two cents." Yecchhh!)

Lily Pons' Adele is a sweetly concocted piece of musical marzipan: the coloratura is offered delicately but easily, and there's real substance in her vocal character, too. In her *Look Me Over Once* aria, as in the famous *Laughing Song,* she gives me a fair idea of a now legendary voice that I never heard onstage. Pons was not at her best in heavy bel canto roles, if surviving records are to be trusted, but she was perfectly suited to those roles that stressed a lightly spun upper register. And she tosses off some remarkably pure cadenzas in a long third act aria (the famous *Spiel ich die Unschuld vom Lande* in the original).

Richard Tucker, as Alfred, is strong. Tucker was at the top of his form in 1950, with those admirable, rounded top notes. The *You Alone* duet with Welitsch is especially impressive; because of cuts, however, we don't hear too much more of Tucker. And whatever happened to Martha Lipton, a very solid Prince Orlofsky?

Fledermaus is surely Johann Strauss' masterwork, and this Met recording is as good as one could hope for (if only it were in German, or at least in a better translation!). The musical ideas are never superfluous, and the melodies, while engaging and largely hummable, are in keys and tempi that are surprisingly well tailored to each character. The opera is a good example of one in which there are no characters of depth or dimension, nor is there any real dramatic or soundly comic development: farce, after all, considers these dispensable. But the score is so consistently right, such sheer fun at every neat turn, that the Vienna of 1874 seems as desirable as it is remote. The text refers often to champagne, and this worthy recording fairly bubbles with color and a fast-paced gaiety. The cast, orchestra and chorus of the 1950 Met production captured that headiness. You could cheerily listen to this 2-disc set with a few friends . . . and lots of champagne at the ready.

Donald M. Spoto

Performance: B+ Sound: A

Gioacchino Rossini: **La Pietra del Paragone** (*The Touchstone*). Newell Jenkins conducting the Clarion Concerts Orchestra and Chorus. Soloists: Beverly Wolff, Elaine Bonazzi, Anne Elgar, John Reardon, Jose Carreras, Justino Diaz. Vanguard, Stereo, VSD 71183/4/5, $17.94; Quadraphonic, VSQ 30025/6/7, $20.94.

Right from the overture—which the composer also used later for *Tancredi*—this *opera buffa* has Mozartean elegance, humor and humanity to it. If Luigi Romanelli was not always so felicitous a librettist as Lorenzo da Ponte was for Mozart, *The Touchstone* is nevertheless delightful Rossini. It was his seventh opera (in 1812 he was just 20) and it has a generous sprinkling of good choral numbers, limpid arias, bubbly quintets and an increasing use of what has come to be known at the "Rossini crescendo."

La Pietra del Paragone might better be translated as the "criterion"—in this case, it is the stereo-typical 18th/19th century operatic ploy of disguises, ruses, feigned identities—all occurring, of course, in a lavish country villa. Count Asdrubale devises an elaborate scheme to determine which of the sycophantic ladies 'round him is sincere in her marital intentions. The working out of this plot is sufficiently incredible and more than sufficiently elaborate (especially in the latter part of the second act, when the heroine poses as her brother in order to discover if the Count is sincere in trusting *her* sincerity). But where the libretto lacks the economy and precision of, for example, *Così fan tutte,* the music has its own inner affirmations and outer fun.

There are, in fact, significant gems in this opera to warrant your attention: the finale and quintet in the first act, with its offhanded grace; the Count's aria *Se di certo,* which has a transparent loveliness in spite of its precious text; *Pubblico fa l'oltraggio,* the second act aria for the haughty Fulvia.

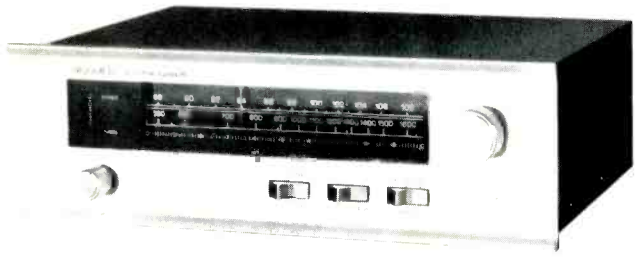
The performances are serviceable but will make no history. Justino Diaz fares best, even though he has the captious role of Pacuvio, who's a general nuisance. Anne Elgar is slightly wobbly in the middle register but has developed a direct *spinto* as Fulvia. John Reardon, as the Count, is vocally impressive but dramatically unconvincing. Newell Jenkins conducts with obvious care for the (not always consistently) reconstructed orchestral score.

This is a tuneful comic opera, surprisingly devoid of musical banality and, in its more coherent first act, has some neatly turned satirical thrusts at *preciosité.*

Donald M. Spoto

Performances: B Sound: A—

Dynaco AF-6 AM/FM Tuner



Manufacturer's Specifications

FM: **IHF Sensitivity:** 1.75 μV. **Input required for 50 dB S/N:** 5.0 μV. **Ultimate S/N:** 65 dB. **AM Suppression:** 58 dB. **Stereo Separation:** 50 Hz, 10 kHz 30 dB, 1 kHz 40 dB. **Capture Ratio:** 1.5 dB. **Frequency Response:** 20 Hz to 15 kHz ±1 dB. **THD:** 0.5%; stereo, 0.9% or less. **Output @100% Modulation:** 2 volts max.

AM: **Sensitivity:** 50 μV with ext. input. **THD:** Less than 2%. **Selectivity:** 20 dB @10 kHz, 55 dB @20 kHz. **Dimensions:** 13½ in. by 12 in. by 4¼ in. H. **Price:** $240.00, kit; $350.00, assembled.

The Dynaco AF-6 is the AM/FM version of the very popular FM-5 tuner which we reviewed back in October, 1972. It has the same simple styling with gold-finished, diecast panel—in fact, from a distance it looks very much like the FM-5! The tuning scales are different, but if you were looking for an extra AM switch you wouldn't find it. Although the same kind of rocker switches are used, they perform different functions. Thus, the one at the center is the AM/FM switch but the left-hand switch now has a dual function. When the tuner is on AM it controls the audio response in 3 steps—narrow, medium and wide. On FM, the first position is mono, the second stereo and the third brings in a filter. This not only rolls off the high frequencies (4 dB at 10 kHz) but also introduces a blend which has the effect of reducing noise on weak transmissions. The switch on the right controls the muting and Dynatune circuits —about which more later.

At the rear are two pairs of output sockets—one to feed the amplifier via the volume control (the knob on the extreme left) and the other pair are intended for use with a tape recorder as they provide a variable output. Also on the back panel is a fuse, and an a.c. outlet socket, screw terminals for AM and FM antennas and the AM loopstick itself. This is mounted on a swivel bracket so it can be adjusted—space permitting.

How It Went Together

Basically, the AF-6 consists of three pre-wired circuit boards, a complete front-end and an assortment of small components for the front and rear panels plus a power transformer. Thus, all the hard work has been done and it is really quite easy to put the pieces together. You do need a little patience and some skill with a soldering iron, but that's all. I would estimate the assembly time to be in the region of five hours although it could be done in less if you can avoid interruptions!

Although the front-end and i.f. strips are factory aligned, most engineers will realize that small variations in stray capacities and so on will affect alignment so our kit was checked as soon as it was finished and then measured again after re-alignment with a signal generator. As you will see from the figures, the differences were insignificant and the specifications were met or exceeded—all without laying a screwdriver on the trimmers!

Circuit Description

The FM circuit is very similar to that of the FM-5; the r.f. amplifier is a dual-gate MOSFET with another MOSFET as a mixer and the oscillator is a bi-polar type. The i.f. section uses two 4-pole ceramic bandpass filters with four IC amplifiers. Detector is a ratio type and it is coupled to an emitter-follower to a phase-correction network, and a 67-kHz notch SCA filter, and an FET which controls the muting circuit. The IC multiplex circuit is a cross-coupled multiplier demodulator which provides additional 67 kHz rejection. A low-pass filter with dual 19-kHz and 38-kHz filters is followed by the de-emphasis network, the volume control, and an audio amplifier stage. Output impedance is 1000 ohms, so long connecting cables can be used without undue losses. The FM meter is connected after the first ceramic filter and limiter stage and also after the third IC amplifier limiter, so ample deflection is obtained from weak signals.

The FM muting circuit is controlled by a combined logic circuit which is fed by the detector output. It senses the d.c. shift and switches off the audio signal when the variation from center exceeds 80 kHz. It is also activated by a second signal from a 150 kHz high-pass filter. Any interstation noise is amplified and will operate the muting circuit.

Now to the Dynatune circuit. This is really a kind of amplified automatic frequency control and here is how it works: The detector's d.c. output is fed back to the front-end through an amplifier limiter. This signal controls the oscillator frequency, zero d.c. being the optimum tuning point. A tuning position one side of the station would give a positive d.c. voltage and turning the tuning capacitor the other side would produce a negative d.c. voltage. The voltage feedback circuit is a servo loop and obviously it must be switched off when tuning, otherwise it would tend to lock, or hang on to one signal all the time. Thus,

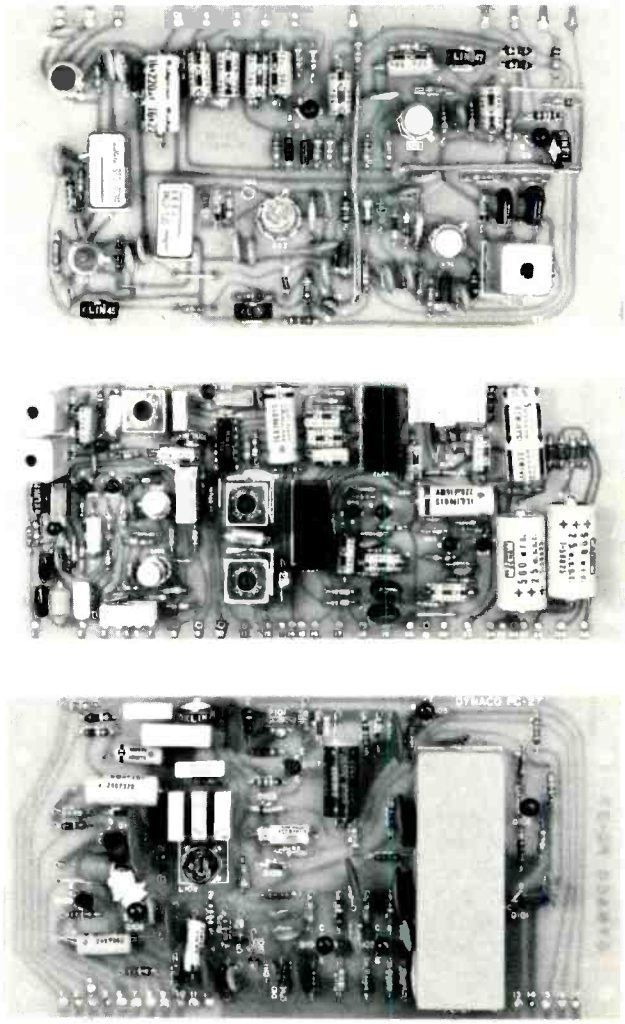


Fig. 1—Circuit boards.

when the d.c. level at the detector reaches a certain level by the action of moving the tuning knob, the muting circuit switches off the servo loop. When the logic circuit senses a lack of interstation noise, the servo loop and audio output is switched on again. Dynaco suggests that the MUTE position be used for tuning and then switching on the DYNATUNE when the station is tuned in. When the TUNE light is illuminated, you can switch over and the DYNATUNE will pull the station in to its correct tuning position. The TUNE indicator light is activated from the output of the logic circuit—which also operates the STEREO light with the addition of the 19-kHz carrier signal.

AM Section

The ferrite loopstick is tuned by the first of the three AM tuning capacitor sections, the second and third tuning the r.f. and oscillator stages. The i.f. bandpass characteristics are defined by a 12-section LC filter after the first i.f. amplifier. Then follow two more stages of amplification, the diode detector, and a transistor low-pass filter network which includes a 10-kHz notch to reduce adjacent channel interference. Signals for the AGC amplifier and meter stages are provided by a dual-diode detector. Power supply consists of a full-wave rectifier with transistor and zener regulation. Two more transistors are used in a delay circuit to avoid switching thumps.

Measurements

Figure 2 shows the FM performance characteristics. IHF sensitivity was 2.2 μV before alignment—excellent by any standards. Using a signal generator, this figure was reduced to 1.75 μV—very near the theoretical minimum. At 5 μV input, quieting was over 55 dB and this increased to over 70 dB above 30 μV. Harmonic distortion was 0.3% on mono and 0.5% for stereo. At 10 kHz these figures were 0.8% and 1.2% respectively. Stereo mute threshold was exactly 4 μV, so weak transmissions would still be heard. Stereo separation, shown in Fig. 3 was around 40 dB at mid-band and 30 dB at 8 kHz and 40 Hz. Before alignment, these figures were only 2 dB less, with a maximum of 3.4 dB less at 15 kHz! Capture ratio was 1.2 dB.

On the AM side, sensitivity came out at 41 microvolts (direct input) with THD below 2% at any input up to 100,000 μV. Bandwidth was down 6 dB at 6 kHz in the wide position, 12 dB in the medium position, and 17 dB in the narrow position. The notch filter attenuated the response at 10 kHz by 29 dB. I.f. rejection was slightly better than the specifications at 64 dB.

Listening Tests

After assembly, the tuner was connected to a Sony 2000F preamp and Phase Linear amplifier with a pair of AR-LST

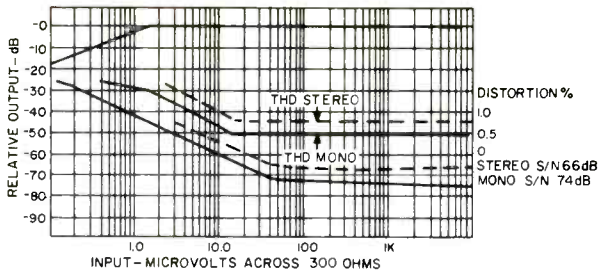


Fig. 2—FM Characteristics

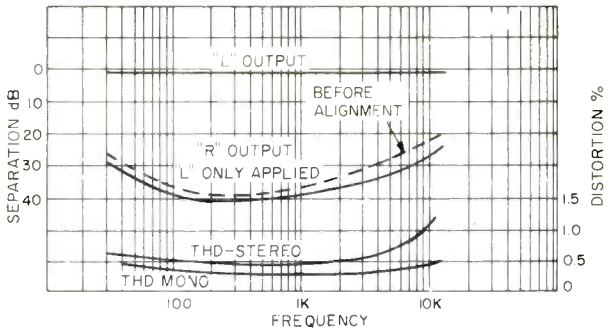


Fig. 3—THD and separation

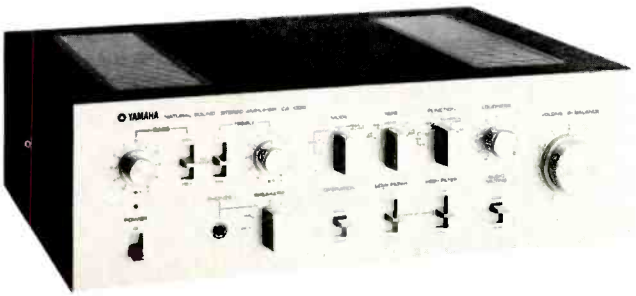
speakers. FM antenna was a simple three-element array (rotary) some 30 feet from the ground; location, about 35 miles north of Boston. More than 35 stations were received at good signal strength—and that muting circuit worked like a charm. There was no distortion or "side skirt" noises, the station was either there right on the button or not heard at all. On the AM side, all the Boston stations were received with ease using the loopstick but stations further afield—in New York, for instance—came in better with an outside antenna. Quality was variable as few AM stations put out a truly clean signal in this area. In the wide-band position, overall sound was sometimes surprisingly good—not comparable with FM, but eminently listenable for all that.

All-in-all, the AF-6 is a top quality tuner capable of giving results as good or better than tuners costing a great deal more—probably twice as much. It can be bought assembled at $350.00, but kit builders will save more money. And of course, the FM-5 is available for somewhat less, if you don't want the AM facility.

George W. Tillett

Check No. 51 on Reader Service Card

Yamaha CA-1000 Integrated Amplifier



MANUFACTURER'S SPECIFICATIONS

Power Output: 70 watts/chan., 8 ohms, 20 Hz to 20 kHz, both chan. driven, Class B operation; 15 watts/chan., similar conditions but Class A operation. **THD:** Less than 0.1 per cent, Class B; Less than 0.05 per cent, Class A. **IM:** Less than 0.1 per cent, Class A or B. **Bandwidth:** 5 Hz to 50 kHz, Class B; 5 Hz to 100 kHz, Class A. **Damping Factor:** 70 at 1 kHz. **Frequency Response:** 10 Hz to 50 kHz, +0.5 dB, -1 dB, 1 watt output. **Separation:** 50 dB. **Hum and Noise:** Phono 1 & 2, Greater than 80 dB; MIC, 70 dB; Tuner, AUX, Tape PB, 90 dB. **Input Sensitivity:** Phono 1 & 2, 3 mV; MIC, 2.5 mV; Tuner, Tape PB, 120 mV. **Tone Control Range:** Bass, ±15 dB at 50 Hz; Treble, ±10 dB at 10 kHz. **Filters:** -3 dB at 20 or 70 Hz, 12 dB per octave; -3 dB at 6 or 12 kHz, 6 dB per octave. **Dimensions:** 17¼ in. W × 12¾ in. D × 5¾ in. H. **Weight:** 34.2 lbs. **Price:** $600.00.

The Yamaha CA-1000 is an attractive, well-engineered and packaged integrated stereo preamplifier-power amplifier combination. The front panel is horizontally grained, clear anodized aluminum with all metal knobs. Construction, although complex, appears to be very solid with PC boards used throughout. Extensive use is made of shielding with critical circuits completely enclosed in metal. Heat sinking and ventilation appear to be more than adequate. All in all, a very nice looking unit.

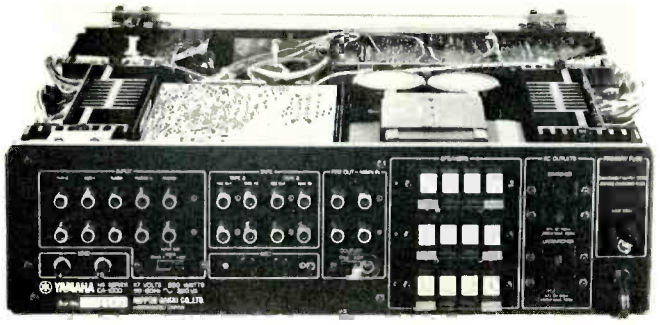


Fig. 1—Back panel of the Yamaha CA-1000.

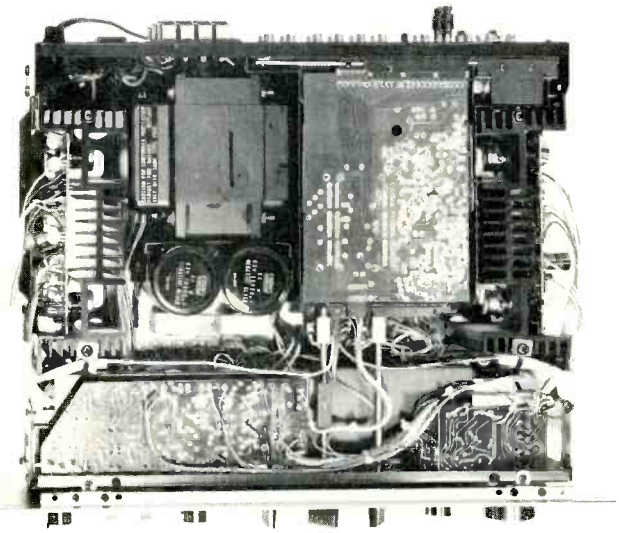


Fig. 2—Interior of the CA-1000.

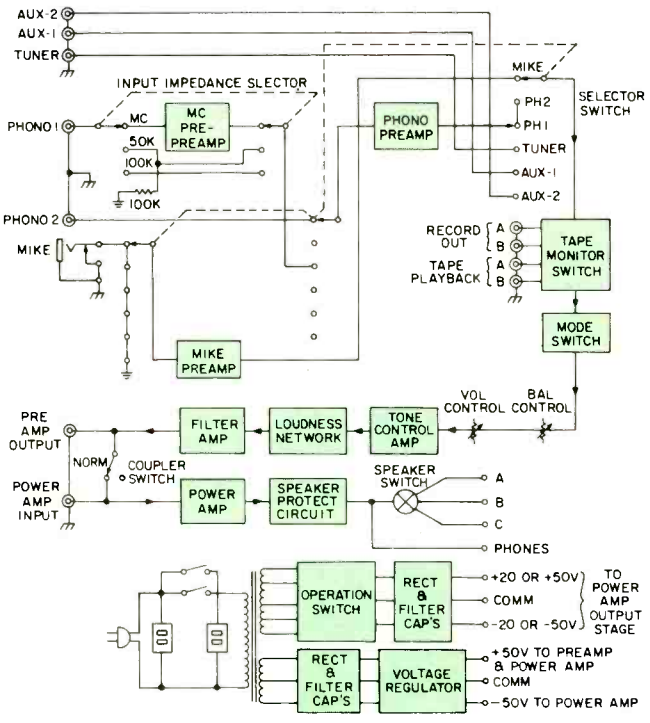


Fig. 3—Simplified block diagram.

Circuit Description

This unit has two features that are unusual and one in particular that is rare to say the least! The first is an extra low-level stage ahead of the normal phono preamp for low-output moving-coil pickups, and the other is a switch that changes the mode of operation of the power amplifier between the usual Class AB and Class A. It is a handy feature to have the built-in moving-coil pre-preamp as it appears that more high quality, low-output moving-coil pickups are coming on the market. Class-A transistor power amps are rare because of their high power dissipation relative to their power output. This class of operation, however, has the advantage of complete freedom from low-level crossover distortion as the collector currents are continuous over the full signal cycle in each of the output devices. This reviewer has had a few 20-40 watt/chan. Class-A transistor power amps to listen to in the past. Generally, this type of amplifier, when compared to Class AB units, tends to sound more neutral, less irritating, and larger and more dynamic than their power rating would indicate.

The CA-1000 has six amplifier blocks per channel; moving-coil pre-preamp, mike preamp, phono preamp, tone-control amp, filter amp, and power amp. The tone-control amp, filter amp, and power amp are always in use for any input. When using the phono mode, the phono preamp is in use with the possibility of using the moving-coil (MC) pre-preamp ahead of the phono preamp to bring the output of moving-coil pickups up to normal phono input levels. The mike preamp is used only when the mike function is selected. Since the tone-control amplifier is always in the circuit, the preamplifier output amplifier section has two cascaded amplifiers in use compared to one in the usual preamp output amplifier configuration with the tone controls switched out. See Fig. 3.

The MC pre-preamp is a two-stage circuit utilizing a common base stage followed by a common emitter stage. Overall negative feedback is applied around the circuit to set the gain to about 20/1 with the low source impedances (1-5 ohms) that moving-coil cartridges present.

The mike preamp is a conventional two common emitter stage circuit using negative feedback for controlled gain and low distortion.

Yamaha's phono preamp circuit is very different from most in that it uses a combination of field effect (FETs) and bipolar transistors. A total of six active devices are used per channel. See Fig. 4 for a simplified circuit. The FETs, Q1 and Q2, are connected in a series push-pull arrangement that Yamaha calls a SRPP (shunt-regulated push-pull) circuit. A positive-going signal at the gate of Q1 turns it on harder, causing the drain voltage to decrease toward ground. The resulting increased current, which has to flow through R1 in order to get through Q1 to ground, causes a greater bias voltage for Q2 (gate becomes relatively more negative in respect to the source) and thus turns it off, aiding the negative-going signal at the drain of Q1. A negative-going signal at the input causes the

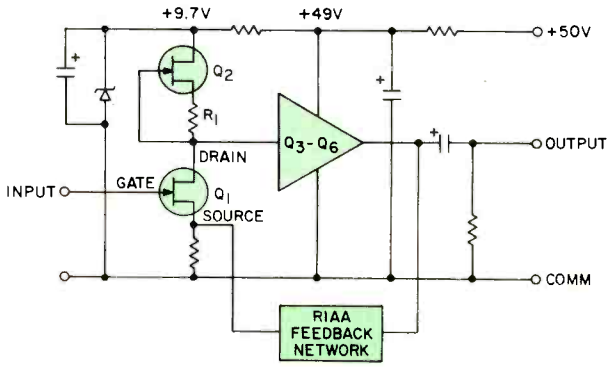


Fig. 4—Simplified circuit of CA-1000 phono preamp.

opposite circuit reaction. The net result of this stage is that it tends to cancel even order harmonic distortion and provides a large drive capability to the following stages. Input random noise of FETs for first stage use can be very good and is for this circuit. The rest of the amplifier consists of a common emitter stage, with a high value of collector load resistor for large voltage gain, followed by an emitter-follower that drives a complementary output emitter-follower. A frequency-selective feedback network from the output to Q1's source gives the necessary RIAA equalization. Input signal acceptance is very high due to the relatively low 1-kHz gain (32 dB) and high supply voltage for the output stages of the circuit.

As can be seen in Fig. 5, the tone-control amp is the first amplifier in the preamp output section. It is a three transistor circuit with two common emitter stages separated by an emitter-follower. Tone-control action is somewhat unusual in that it balances frequency-dependent output attenuation against feedback-caused boost. Changing the position of the control pot wipers changes this balance resulting in a boost or cut characteristic. With the controls switched to out, the amplifier is still in the signal chain, but the reactive elements are switched out.

The filter amp provides most of the gain in the output amplifier section and has a circuit configuration like the tone control amp. Active 12 dB/octave low-cut filtering is accomplished by a passive two section RC network connected at the input, with the first shunt resistor fed from the first stage emitter, instead of being returned to ground. The output of the filter amplifier feeds a 20-dB voltage divider. The mute switch, which is convenient for reducing volume when the telephone rings, connects the outgoing signal to the top of this divider or the attenuated output for 0 or -20 dB relative attenuation. The output impedance of this divider is about 2 Kilohms in either position of the mute switch and is used as a series resistance for the 6-dB/octave hi-cut filters. Cutoff frequencies are changed by switching two different capacitors to ground. The output of the hi-cut filter feeds the coupler switch which either connects the preamp output to the power amp input or allows a separate input to the power amp.

In the power amplifier, the input stage is a differential amp fed from a constant current source. This is followed by a second differential amp with one transistor acting as a predriver for the output stage. This transistor has a boot-strapped collector load and swings the full supply voltage. The output stage is a complementary Darlington connected emitter-follower with a voltage gain of slightly less than one. Output stage protection is of the VI type where output current and voltage are sensed and used to clamp the drive to the output stage when dissipation is excessive. The change from Class AB to A operation, in addition to reducing the supply voltage to the output stage, also increases the idling current from 50 mA to one amp by switching in a different bias-adjust pot.

This unit has a time-delay turn-on circuit that opens the speaker lines with a relay for 4-5 seconds to prevent turn-on thumps. This circuit also functions as a speaker protection device as the relay opens whenever any appreciable d.c. voltage appears at either of the power amp outputs.

The power supply consists of a large power transformer, two 18000/65 filter capacitors for the power amp out stages, and a ±50 V bipolar voltage regulator. This regulator powers all of the preamplifier section with +50 volt (suitably decoupled as required) and the input and predriver stages of the power amplifiers. Part of the Class AB-A switch changes taps on the secondary of the power transformer to lower the output stage supply voltage for Class A operation. This supply voltage is ±20 V for Class A and ±50 V for Class AB.

Listening Tests

In order to be as objective as possible, listening tests are normally conducted before the equipment is measured. The CA-1000 was first listened to as a preamplifier only. The test setup permitted the phono preamp, with signal taken at tape output and followed by a dual 25K volume control, to be compared to the sound of the overall preamp at the preamp's main output. The phono preamp was found to be clean and free of edgyness but not quite as well defined as some other solid-state circuits. With the rest of the preamp switched in, the sound was perceptibly less defined. Switching the tone controls in and out made no perceptible difference. Next, the power amplifier was compared to some other solid state amplifiers and found to be very clean and transparent. It was a surprise to find so little difference between class A and Class AB operation, and Class AB was slightly preferred. Sound of the overall integrated unit was clean and quite satisfactory. All of the controls performed their intended function with no race of clicks, pops, or noise. Pickups used for these tests were Supex SG-900 and Shure V-15 III.

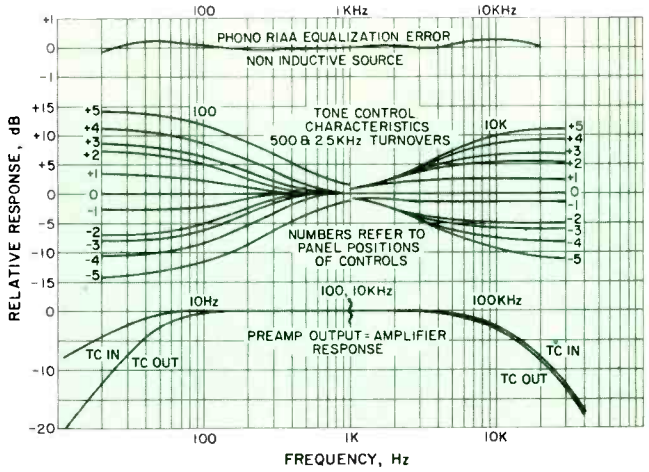


Fig. 5—Phono RIAA EQ error, tone-control characteristics, and preamp output-amplifier response. Note compression of frequency scale for preamp output-amp response.

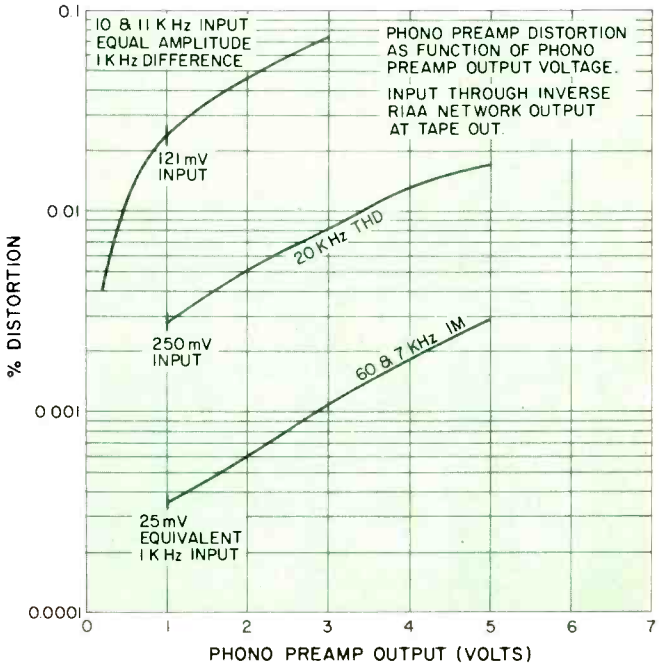


Fig. 6—Phono preamp distortion versus phono preamp output.

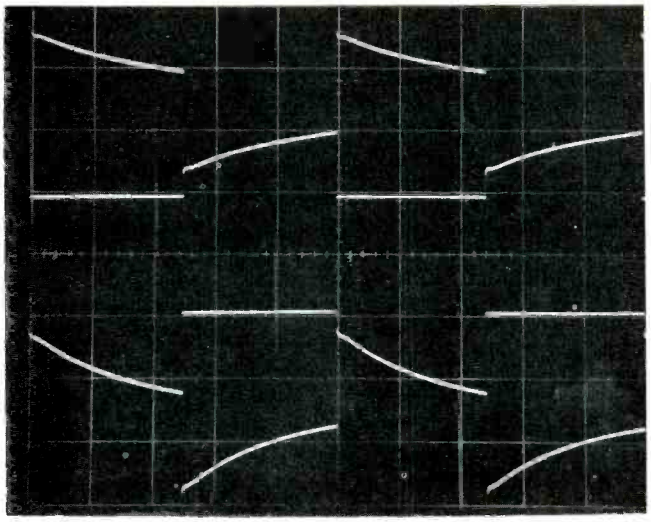


Fig. 7—Phono preamp 40-Hz square wave response, 5 mS/cm. Top is Hi-Z load, 0.5V/cm; middle, input to pre-equalizer, 1V/cm; bottom, 10K load, 0.5 V/cm.

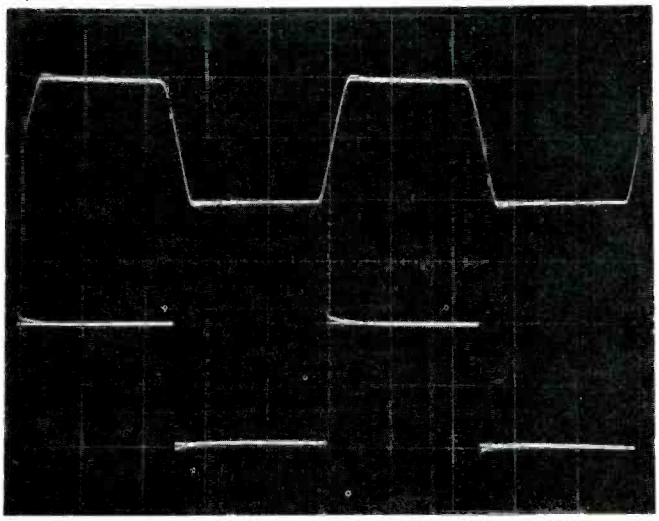


Fig. 8—Phono preamp 1- and 10-kHz square wave response, 20 μS/cm, with display adjusted for input/output amplitude coincidence. Input to pre-equalizer is 1V/cm. Top, 10 kHz input and output, 20 μS/cm; bottom, 1 kHz input and output, 200 μS/cm.

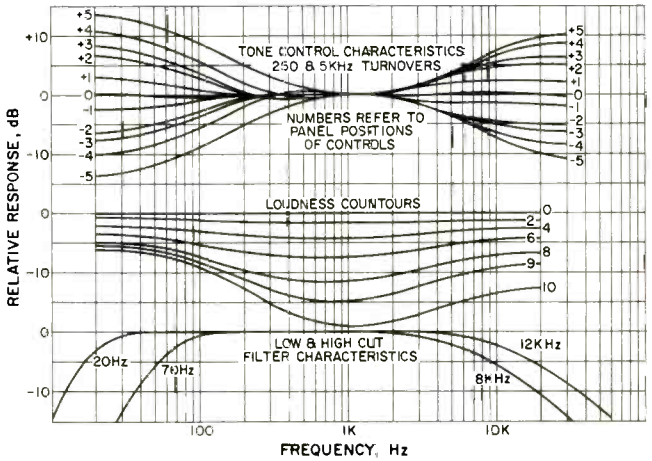


Fig. 9—Tone-control characteristics for 250- and 5-kHz turnovers; loudness contours, and low- and high-cut filter characteristics.

Measurements

Phono preamp: The gain of the phono preamp at 1 kHz measured 40X or 32 dB, which is somewhat lower than the usual 40 dB. Input noise over a 20-20 kHz bandwidth was 2.2 and 2.7 μV (-73 and -71.5 dB) in the left and right channels. These readings were dominated by 60 Hz components. With the measurement bandwidth set to 400-20 kHz, the input noise improved to 0.47 and 0.45 μV (-86.5 and -86.8 dB) The MC pre-preamp, when fed from a 1-ohm source, added an additional 26 dB of gain when switched in. Input noise of both channels of the pre-preamp measured 0.4 μV over a 20-20 kHz bandwidth and was dominated by low frequency random noise. With a measurement bandwidth of 400-20 kHz, the input noise was 0.2 μV. Taking an input signal of 200 μV, which is typical of the Supex cartridge at 3.54 cm/sec, a signal-to-noise ratio of 60 dB would result. This noise level is felt to be quiet enough so that it would be buried by record surface noise and thus be inaudible.

RIAA equalization error for a non-inductive source is shown in Fig. 5. Further work has been done to determine the effects of different cartridge inductances on the RIAA equalization of phono preamps. A new test has been devised that lumps the effect of possible non-resistive input impedance and interaction of cartridge inductance on the feedback loop of the preamp under test. A representative example of low and high inductance pickups are used for the test which compares the response of the preamp under test to an ideal circuit that is free of the above effects. The CA-1000 phono preamp was found to have negligible deviation from ideal with the low inductance cartridge and a mild high frequency rolloff with a high inductance type of about -0.7 dB at 15 kHz and -2 dB at 20 kHz. If this preamp when using a high inductance pickup were compared to one that was flat or up in the high end on this new test, an audible difference would probably occur due to this effect alone.

This reviewer measures distortion and square-wave response of phono preamps by feeding the test signal through an inverse RIAA network or pre-equalizer and then into the phono input. Distortion data is shown in Fig. 6 for standard 60 and 7 kHz IM, 20 kHz THD, and 1 kHz difference tone distortion for equal amplitude 10 and 11 kHz input signals. All of these distortions are exceptionally low for this circuit.

Square-wave response for input frequencies of 40, 1 kHz, and 10 kHz are shown in Figs. 7 and 8. Figure 7 shows the effect on low-frequency phase shift, as evidenced by square-wave tilt, of loading the phono preamp output with a 10 K load. A few tape recorders have an input impedance this low and could cause what this reviewer feels is excessive low frequency phase shift. High frequency bandwidth for the 10 kHz square wave is limited to about 50 kHz by limiting the rise time of the transition to 7 μS. Figure 8 has the output waveforms overlayed with the inputs for ease of comparison.

Phono-preamp crosstalk was measured on a pre-equalized basis and was found to be down more than 70 dB from 20 to 3 kHz, and rose to -54 dB at 20 kHz. This is very good for this test. Phono overload with frequency and output, along with equivalent input, were:

Frequency	Output	Input
20	13.5 V rms	34 mV rms
100	14.0	77.5
1 kHz	14.0	350
10 K	14.0	1700
20 K	11.0	2800

Preamp Output-Amplifier: The voltage gain of the output amplifier section with volume control at maximum and loudness control at position zero (no compensation) was 6.8X or 16.7 dB. This, when combined with the phono gain of 32 dB, gives

a total preamp gain at 1 kHz of 49.7 dB, compared to 60 for most preamps, to accept the wide dynamic range of this preamp. Tone-control and frequency response curves are shown in Fig. 5. Tone-control curves for other turnovers, loudness contours, and high- and low-filter responses are shown in Fig. 9. The tone-control curves are for front panel markings of -5 through +5. The controls click like switches but are continuously variable pots with detent mechanisms. Distribution of amounts of boost or cut for each position is not uniform and, particularly for positions 2 and 3, are rather close together. This may be different for various samples of the CA-1000. Loudness control curves are given for panel positions of 0, 2, 4, 6, 8, 9, and 10. Frequency response doesn't change much until positions 3 and 4 are reached. Filter cutoff slopes are 12 dB/octave for the low-cut filters and 6 dB/octave for the high cut.

Square-wave responses are shown in Figs. 12 and 13 for frequencies of 20 and 20 kHz. For some reason that remains obscure, the very low end response is better with the bass control switched in.

IM distortion of the output section was less than 0.03 per cent for an output of 2.5 V or below with a 10K load. Harmonic distortion for the same conditions was less than 0.02 per cent from 20-20 kHz.

Crosstalk between channels was measured by feeding one channel of AUX 1 and shorting the other channel input. Volume control was at maximum, and all filters and tone controls were switched to the OUT positions. Crosstalk was down more than 80 dB between 50 and 500 Hz rising to -75 dB at 20 Hz and -55 dB at 20 kHz.

Output amplifier noise was measured over a 20-20 kHz band and with the volume control at the worse case position (generally about 6 dB down from maximum). This noise was slightly more with the tone controls switched in and was 22 μV for the left and 24 μV for the right which is satisfactorily low.

Power Amplifier: The voltage gain of the power amp was 31.6X or 30 dB which is 4 dB over the usual 26 dB. IM distortion and 1 kHz THD are shown in Fig. 14. Distortion was plotted for the left channel in every case as this channel was the higher of the two. Right-channel distortion was about 50-70 per cent of the left. It can be seen that the distortion in general is lower with Class A operation. The dashed curves in Fig. 14 are the sum of the 5th and 7th harmonics in the IM residue and

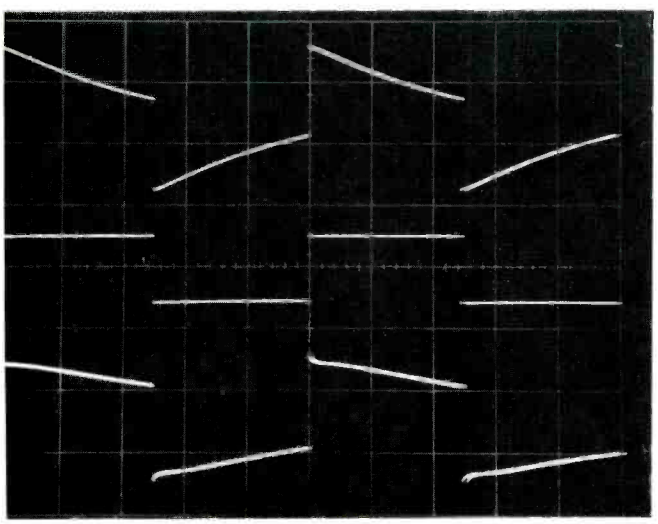


Fig. 10—Preamplifier output-amplifier 20-Hz square-wave response, 10 mS/cm. Top is tone control out, 1V/cm; middle input, 0.2 V/cm; and bottom tone control in, 1V/cm.

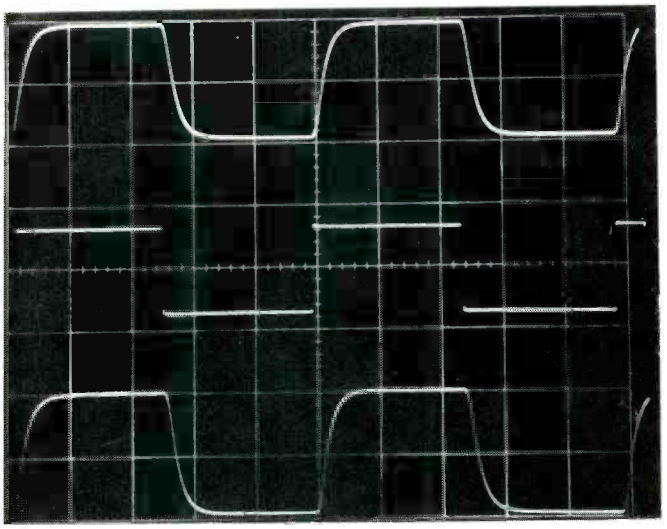


Fig. 11—Preamplifier output-amplifier 20-kHz square-wave response, 10 μS/cm. Top is tone control out, 1V/cm; middle input, 0.2 V/cm; and bottom tone control in, 1V/cm.

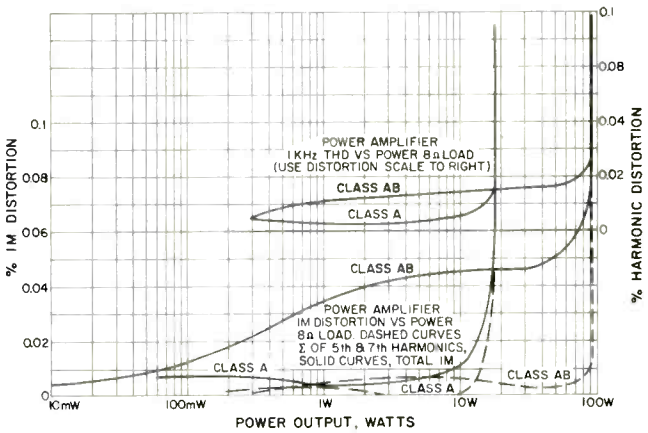


Fig. 12—THD and IM distortion versus power input.

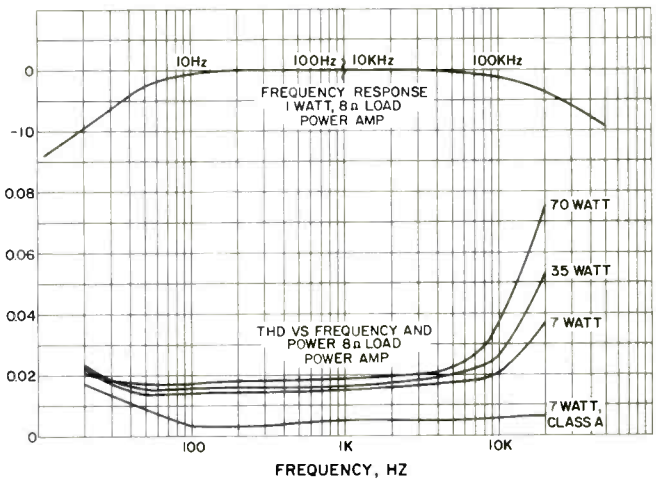


Fig. 13—Frequency response (1 watt) and THD versus frequency and power, both for the power amp.

are measured using a special comb filter that allows the sum or any combination of harmonics to be measured up the 7th. The amount of 5th and 7th are felt to have some correlation to irritation and graininess in power amplifiers. This circuit is remarkably free of higher order odd harmonics even in the Class AB mode of operation where one would expect to see more of this kind of distortion, especially at low levels. Harmonic distortion vs. frequency for three power levels along with wide band frequency response at one watt are shown in Fig. 15. Square wave performance at 50 and 10 kHz is shown in Fig. 16. The middle trace shows the effect of a 2 μF capacitor across the 8-ohm load. The aberation is dominated by the output buffing RL network used in this and most amplifiers with no VI limiting taking place at this 10-V peak-to-peak output level.

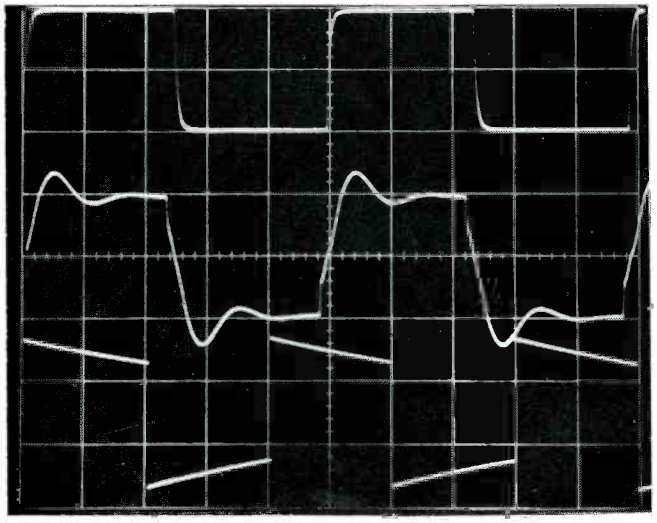


Fig. 14—Power amplifier 50-Hz and 10-kHz square-wave response. Top is 10 kHz, 8 ohm load, 5 V/cm, 20 μS/cm; middle is same as top with addition of 2 μF across 8 ohms; bottom, 50 Hz, 8 ohms, 5 V/cm, 5 mS/cm.

Damping factor was measured by injecting a known current into the output terminals of the amplifier and measuring the resultant voltage drop. Output impedance is calculated as this voltage divided by the known current. The damping factor was 80 from 20-1 kHz and decreased to 15 at 20 kHz, still satisfactorily high.

Output hum and noise at idle in a 20-20 kHk bandwidth for the Class AB mode was 77 and 94 μV in the left channels which is 109.7 and 108 dB below 70 W, 8 ohms. Hum and noise in the Class A mode was 278 and 325 μV in left and right channels and was mostly line harmonics.

Clipping power into 4 and 16 ohms was 123 W and 58.1 W for Class AB and 27.6 W and 9.9 W for Class A. Power at 8 ohms was 92 watts, Class AB; 18 watts, Class A.

In conclusion, the CA-1000 is a well-made, excellent performing unit that is a pleasure to look at and use and should appeal to many who are interested in an integrated amplifier of this type. *Bascom H. King*

Check No. 52 on Reader Service Card

Canby's Capsules

Edward Tatnall Canby

Henri Dutilleux: Sonata (1947). Hindemith: Sonata No. 3 (1936). Jeffrey Siegel, piano. **Orion ORS 7299,** stereo, $5.98.

—And add this one: a fine big Hindemith piano sonata, expansively played and recorded, plus an interesting post WWII French sonata, neo-Poulenc mixed with Brahms, large, serious but with wry humor and Poulencian acid. Good piece. Excellent playing of both works.

Karl Weigl Songs. Judith Raskin, Betty Allen, George Shirley, Wm. Warfield; David Garvey, pf. **Vox Turnabout TV-S 34522,** stereo, $2.98.

Curious composer—a late-Romantic Viennese who carried right on into the '40s unchanged, as of maybe 1902, even writing *Lieder* in NYC to English words! But they are good, much respected by music pros—as witness this quartet of soloists, no doubt organized by Vally Weigl, his indefatigible window and composer herself—she phoned me to promote the disc! Glad to oblige.

Fritz Busch. *(Beethoven 9th Symphony.)* Cho., Orch. Danish Radio, Soloists, (rec. 1950). **First Editions FER-4,** mono.

A great conductor but not really for big works like this—his best was opera by Mozart, smaller German classics. Fled Germany (with brothers Adolf, vl., Hermann, cello) in 1933, led celebrated pre-war British Glyndebourne opera, ended up in Denmark, died 1951—just barely made it into tape. Curious Beethoven, dynamic but fast and non-grandiose, almost chamber style. Last movement (so often chaotic!) is the best—his opera experience? Excellent disciplined singing even at high speed. Late close-up mono recording, studio-like, with audience.

Canby's Capsules

Jennie Tourel, Leonard Bernstein at Carnegie Hall (1969). Columbia M 32231, stereo, $5.98.

She was a great vocal dramatist in the French and Russian song areas, complementing such Germanic Lied singers as Lotte Lehmann. (The Schumann here is only so-so.) He—the moody Romantic!—is here a masterfully authoritative pianist, an uncanny accompanist. At end of her career, Tourel still has drama, pure, relaxed tone, only occasional strain. Some earful—and beautifully recorded! High points: Tchaikowsky and an inebriated Offenbach.

Robert Casadesus. Columbia M3 32135, mono and stereo, $17.96.

This memorial (d. 1972) has only a performer's unity—it assembles material old and new, mono, stereo, harsh and smooth, solo and orchestral, for a lot of bumpy listening—which will not bother C. fans. The choice is arbitrary—enough left for a dozen more albums. I was never a C. fan; my ear says cold, pianistic, not always musical. But this is a minority opinion—so suit yourself. He was France's elder-statesman pianist, world famous.

Legendary Pianists of the Romantic Era, Concert 2. (Hofmann, Grainger, Bauer). **Klavier KS 121**, stereo, $5.98.

Klavier has optimized the transfer of piano-roll recordings by now and these are easily convincing. And yet—somehow, the lack of ear-feedback still tells; the pianists bang the loud notes as they never would have in the flesh. Even so, the music is maybe 90 percent authentic and it's in stereo too. But such bland and juicy encore stuff! Incredible technique, vapid content; one longs for a dissonance now and then. Our ears *have* changed, even untrained.

British Band Classics (Walton, Holst, Byrd-Jacob). Eastman Wind Ensemble, Fennell. **Mercury SRI 75028**, stereo, $6.98. (Imported)

Always a pleasure to hear Frederick Fennell's superb Eastman band in its famed Mercury domestic recordings—now reissued out of Holland and Philips. But this isn't exactly light listening; Holst and Walton are ponderously cheerful, gloppy, Jacob's Wm. Byrd is à la Stokowski.

Beethoven: Serenade in D Op. 8; Quartet in E Flat, Op. 16. Cantelena Chamber Players. **Mus. Heritage MHS 1795**, stereo, (mail order only).

Top performances of two major early Beethoven works, for three strings, strings and piano (Op. 16 is an arrangement by the composer)—how potent this music is beginning to sound, these days! (It was once downgraded.) MHS has hundreds like these, out of Europe, via mail order only. Recording a bit scratchy, metallic. (Most MHS aren't.)

Alexander Goehr: Piano Trio; String Quartet No. 2. Orion Trio; Allegri String Quartet. **Argo ZRG 748**, stereo, $5.95.

A youngish modern here, very easy to listen to and beautifully played and recorded—he is atonal and minus "beat" but even so. . . . The old pioneers, Schoenberg, Ives etc., wrote inevitably prickly music; now their innovations are smoothly absorbed and second-nature, which shows in the listening. Goehr rates basically as conservative, i.e. no abnormal noises or strains in the playing—just good piano and good string writing.

World Popular Song Festival in Tokyo 1973. Yamaha Music Foundation (1 disc, stereo).

Ha! Had to get this in. Yamaha's huge super-TV-style festival of song—with vast orchestras, enormous audience, spotlights, slinky costumes in the Hollywood extravaganza style the Japanese now love, an incredible international hodge-podge of over-arranged, overblown show stuff. But the 17-year-old Akiko Kosaka's *I Wish You Were Here* (last cut) is memorable—it sold millions and you hear it 1000 times a day over there. She sounds about 10½, but very, *very* pro. You can get this when you get there—anywhere. You can't avoid it.

Pierre Cochereau at St. Mary's Cathedral, San Francisco. Frescobaldi, Gabrieli, Zipoli, Cochereau). **Klavier KS 529**, stereo, $5.98.

Professional obtuseness! This leading French organist plays a huge new organ in S.F. in mod cathedral—and murders his older composers unbelievably, blows them up 1000 in high 19th c. style. Musically unbelievable in this day of restored modesty for "ancient" music! On Side 2, his own ear-shattering five-movement improvised "symphony" on the same music goes even further. Super hi fi, the whole disc, and it'll blow your Phase Linear fuses. Arrgh.

Courtly Pastimes of 16th century England. St. George's Canzona. **L'Oiseau-Lyre SOL 329**, stereo, $5.98.

The "Pro Musica" formula for old-music programs, authentic, is now predictable: five or six performers each playing numerous old instruments—crumhorn, rebec, recorder, cornetto—and usually also singing (one thing at a time of course . . .); a soloistic vocal ensemble, with counter-tenor added to usual voice ranges; a variety of solo songs, vocal ensembles, instrumental dances, etc. This disc starts noisily but gets better and better; much from the Henry VIII period (including H. VIII), pre-Elizabethan.

Boxed Sets

Schubert: Piano Sonatas, Vols. I, II, III. Walter Klien. **Vox SVBX 5465, 5466, 5467** (3 discs each), $9.95 each.

Debussy—His Works for Orchestra, Vols. I, II. Orch. Radio Luxembourg, Ens. Vocal "Psallette de Lorraine", etc. de Froment. **Vox SVBX 5127, 5128** (3 discs each), $9.95 each.

Baroque Program Music, Toccatas, and Dances for Harpsichord. Silvia Kind. **Univ. of Washington Press UWP 2002**, stereo, (2 discs), $9.95.

Walter Klien's Schubert is superb. There are few other pianists who can match his utter understanding of this sometimes difficult and extended music, in particular the big late Sonatas. If anybody can get their ineffable qualities over to you (and change your musical life for good, very likely!), it is this man. Vox's recording is beautifully done, with one *caveat*. Mr. Klien (what a name) has a gorgeously delicate pianissimo and a triphammer fortissimo; you will have to adjust yourself and your equipment, which may take awhile in the listening. After that—no problems.

The Debussy boxes from Vox are fascinating—they include not only the familiar works but a series of seldom heard items that will throw a new light for you on this French composer. The occasional chorus, *Psallette de Lorraine*, is startlingly good when it appears, and Lous de Froment's interpretations are strong and original though his orchestra is not entirely first rate. Good sound, too, if not quite remarkable. Listen especially to the Martyrdom of Saint Sebastien (Vol. I) in a version that includes both chorus and spoken narration in French, by far the best interpretation I know.

The University of Washington has a prize in Silvia Kind, and its production of her album is a first rate job in every respect. She is a grand lady of the instrument, a newer Wanda Landowska, out of Europe (born Swiss) and the essence of European musical greatness. She plays vigorously with forthright rhythm and enormous drama and color, never a pallid moment—she even announces each work from her harpsichord (which aids the stereo placement remarkably!). Absolutely lovely recording of the Neuport instruments, fine pressings (my copy) and a beautiful album production. Big companies, please take note. The "program music" is not much in respect to story telling in this Baroque period but the music itself is enough to please and Mme. Kind's succinct and colorful spoken bits keep us on the story line whenever there is one. (Univ. of Wash. Press, Seattle, Wash. 98105)

The Column

Fred DeVan

THE NEW QUARTET. Gary Burton. **ECM 1030 ST**, $6.98.

Shades of Bill Evans, Scott LaFaro, Paul Motian with hair on their chests! (Reference—Riverside's June '61 Village Vanguard Set) This also is a great grouping of totally complimentary musical tastes and talents. Gary Burton blends conceptually with the new quartet rather than standing off and out, being the fine musician that he is. Abraham Laboriel on bass is amazingly full of flourishes and thrills. Harry Blazer on drums does everything just right without being predictable or redundant. Laboriel and Blazer are so inventive they almost steal the show, but they are playing with Gary Burton and his energy and touch make it near total unity. Michael Goodrick's guitar is the final binder. I feel him to be the weakest soloist in the group, but his thoughtful playing really completes the solid sound of the quartet.

They are a lay-back balanced group that never really is either dull or overwhelming as a unit. They do not assault you with how good they are, and each of them stands out on his own. They all get their licks in with perfect support and framing from the other three. You can really listen to them all day without getting tired or bored. They take Chic Corea's *Open Your Eyes, You Can Fly* and soar around enough to make Jonathan Livingston Seagull seasick. But they are so tasty in approach that you could use it as background music.

The rhythm work between Goodrick and Laboriel is fascinating, exciting counterpoint in itself, and it's wrapped around and within a separate rhythmic structure between Burton and Blazer, or Blazer alone, like a spiral within a musical spiral. At moments, they go their own ways, and it all holds together beautifully. This is *Jazz*. This is the area of the idiom that's alive and not writhing within its form. The harmonic basics are simple. The construction and execution is a visceral, complicated envelope of rhythms using many harmonics. The ease of musical awareness and competence belies the intricacies.

But, boy, there is display after display of brilliance. Gary Burton is a very inspired musician, and Laboriel, Goodrick, and Blazer are the same. Very inspired musicians. Listen to Laboriel through side one and you know jazz is not standing still at all!

FOREIGNER. Cat Stevens. **A&M 4391**, stereo, $5.98.

Once upon a time there were these three dudes. Right! Bernie Purdie, Phil Upchurch, and Paul Martinez. And then there was this other dude, Cat Stevens. Bernard, Phil, and Paul played drums, bass, and guitar. Cat Stevens had a head full of things like love, the pain of loves past and gone, love that was still to come. He had his head, all at once, in total focus, on selected facets of loving a woman, those that are like searing hot irons thrust in the guts of all of us that live and breathe. . . . Got that now? Passion-filled words bounced around his head like clear sweet *Ohio Hill* honey fractured by bites from a fresh cool lemon. Like spending that ominous cool spring night we all spend buffering our own realities and reflections with some Chivas or Remy Martin. AAAHH YES!! 'TAINT IT SO!! Stevens had one up on us, he refused to have a downer about it. (Overdose of Tim Hardin style "love's shittin' on you" songs.) Or as he puts it, "But it's in my heart that's where it's taking place, and I couldn't stand to let it go to waste."

This is where Bernie, Phil, and Paul begin to emerge, almost . . . stay with me now. . . . Cat Stevens is an excellent, creative, versatile, unrestricted musician who has not been burned out by the music business or any other smothering force. He faces a delicious relationship with what he calls sweet blue love. And man, if you are over twelve you can begin to know what that's all about. Blues are what it's all about. However, Mr. Stevens is into an alternative. (AH-HA, he has Van Morrison records too—probably along with what little Kenny Rankin you can find.) Stevens found these dudes, Bernard, Phil and Paul and told them about his sweet blue love and how full of light and air and future it was. They looked at each other, played eight bars, and nodded at each other! Stevens sat down at some keyboards, scintillated his words sparsely and delicately, and they all knew, they knew! And so they made this album. They called it **Foreigner.** One thing that could be drawn from this is that if you are a foreigner to the feeling of the music therein contained, there are few messages for you to get. Just to keep things interesting, they

added more people and strings and took words that could inspire a new generation of quotable statements about human relationships. They could inspire anything from notes passed in high school to octogenarians gone wild. Bernie and those guys, not to leave out Steven's keyboards and synthesizers, just lay down together with the words and "make it" with each other. Cat Stevens has not offered so much of himself before and has definitely not been so straightforward, yet mature.

I suggest everyone could sit down with the liner notes, pick a few lines, and write a warm note to somebody, even themselves.

MATINEE WEEPERS. Martha Valez. **Sire SAS-7409**, $5.98.

Sire's First Shot With An American Sound! Martha Valez may or may not be a great singer. You won't be sure from this first album effort! She certainly can become a pop star singer. She has a big, gutsy, articulate, open voice quality. It is not polished but never rough. It's a gruff, gutsy song that she does best. But she can deliver with delicacy and power both. The arrangements sometimes defeat her best efforts but at other times give her room to stretch out. In general, the overall choice of songs is not consistent. It's as if nobody could decide exactly what Martha's style was, so they did a bit of everything. That's not all bad, it's just confusing if you want to type class the album. On the whole, it is so well done that you can initially enjoy it without reservations. Its flaws just don't stand out very much. You could be listening to radio programming of a group of odd songs by various good female artists. Martha always sounds the same but the subject matter, backgrounds and general tenor vary from Reggie to Ike & Tina with stops along the way near Bette Mitler and others. Yet Martha holds her own even with all this! Even as the production swings from lush to lively, the backgrounds, band, and general sound are near perfect. Maybe the whole thing is a sales problem. This record has a lot of cuts that can go top forty and enough substance to become the new underground replacement for Maria Muldaur.

Anyway in summation, it sounds like a lot of conscientious people set out to make a good album, but they lacked a point of focus. And that is what they made. A good album without a point of focus. Could be, that is to their credit. Listen well and you will really get impatient trying to figure out what the second Martha Valez album will be. You will know it will be a blockbuster of one kind or another.

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MONIUM. Jeremy Steig. **Columbia KC 32579,** stereo, $4.98.

Jeremy has come a long way since his first Columbia album, **Flute Fever,** of 11 years ago. I was blown over by all the energy and speed contained in his playing then. I ran to the store to buy that disc, and I would run to buy this album. In these long 11 years, he has mellowed and matured, yet the vitality is all there, but, oh-so-much-more control and finesse! He has stretched out as a musician, yet, unlike Hubert Laws and Thijs Van Leer, is displaying his scope in a much smaller framework, that of a basic quartet. With an added plus, by playing music written by himself, bassist Eddie Gomez and drummer Marty Morell. The fourth member is Ray Mantilla, on congas and timbales.

They reached inside themselves for themes and created sparse, well-planed lines for musical excursion with delicate bass and flute duets, darting-flashing-quicksilver lines and flourishes amid soft, gentle, pensive basics. The rhythm section is everybody and they really work great together. Marty Morell does not need to take a back seat to most any drummer. So, I guess, just to prove it, he, on the title cut, out Billy Cobhams Billy Cobham.

The total effort is an exercise in thoughtful understatement. Jeremy is not out to overwhelm you, just to wrap you up in his music with a subtlety that is both refreshing and effective. He and Gomez come off as not playing at you with their instruments, but instead playing *for* you. The whole record is lovely in its controlled freedom.

CHICAGO VII
Columbia C2-32810, $4.98.

As much as I would like to dismiss a new *Chicago* album as an event that happens as predictably as the evening television news or Muzak in elevators, they have denied me that ability. The logo band keeps on truckin'. This time with long, slow, melodic lines; delicate, thoughtful phrases that build to a logical musical package that is as solid as their bank account. *Sure,* the horns blare when horns should blare. The guitar riffs occur when the riffs should, but when put together with the nuances of good production and creative musicianship it all works into a fresh spring breeze of music. Top it off with The Beach Boys as back-up vocalists and tasty keyboard work by logomen numbers two & five (do they have names?) and you get a winner. Valid, sensitive music from a very valid, agile band that has more depth then most give them credit for.

Jazz & Blues

Gary Bartz: NTU Troop—I've Known Rivers

Musicians: Gary Bartz, soprano and alto sax, vocals; Hubert Eaves, piano, electric piano; Stafford James, bass, electric bass; Howard King, drums.

Songs: *Nommo—The Majick Song; Sifa Zote; Jujuman; Bertha Baptist; Don't Fight That Feeling; Mama's Soul; I've Known Rivers; Warrior's Song; Uhuru Sassa; Dr. Follow's Dance; Peace and Love.*

Prestige P-66001, 2 discs, stereo, $9.96.

The Montreaux Jazz Festival is a once a year jazz extravaganza for Europeans who anxiously await event-type performances by top artists from the States. With the season being summertime—an easygoing time of year—and the place being Switzerland—a breath-taking area of the globe—the performers have the optimum conditions for blowing their best. The audience, as overseas jazz audiences go, is artistically appreciative. No wonder Milestone-Prestige opted for preserving these inspired musical interludes through recording.

This Bartz two-record set is a notable production, attributable in part to stimulation from a very receptive audience. The two discs supply enough musical variety to satisfy a plethora of divergent interests. Bartz opens the concert by singing *Nommo,* a modern progressive melody, quoting Trane's *A Love Supreme.* This vocal, as with his others, will satisfy those who enjoy Bartz' acceptable voice and mixture of poetic lyrics. Bartz' blowing on saxes, though, is so good that his occasional attempts at profound lyrics should be left to other vocalists such as Andy Bey. Bartz' vocals would not be considered bad on albums of lesser merit. It's just that on this album, where his compositions and instrumental solos are so good, vocals are a relative low point.

Nommo segues into *The Majick Song,* a fiery piece demonstrating the group's cohesiveness and Bartz' explosive alto. Bartz plays masterfully on another up-tempo number, *Bertha Baptist.* This piece is his *tour de force* on which he demonstrates his buxom tone and fierce fingers. The rhythm section is also a standout on this piece.

Pianist Hubert Eaves is on electric piano on *Bertha Baptist,* although the majority of his work on the album is on acoustic. His chords, often down the deep end of the audible spectrum, prove his allegiance to monster McCoy Tyner.

These ears are partial to the mellow and rich sounds of an acoustic bass, and Stafford James' performance is rather rewarding. His agility up and down the instrument manifests itself in his excellent time, and his rhythmic elasticity in and out of the time bond the rhythm section tightly. James' transition onto electric bass on the funky cuts like *I've Known Rivers* and *Peace and Love* is a welcome change of pace, done in good taste, and add a different and colorful shade to the group's sound.

Howard is a mean drummer for 17 years of age. His time is happening. He has a light touch on the swinging cuts, and he intersperses the funkier cuts with a multitude of different rhythms—never getting hung up on playing any one favorite rock beat. I particularly enjoyed his Latin and African tinged backbeats. His playing on some of the freer things (*Bertha Baptist*) is done in good taste. He juxtaposes the sounds of the drums and cymbals in a way that Tony Williams used to be heard doing.

The Warrior Song was the one piece which got a bit long. It is in two parts—one devoted to Malcolm X and the other to John Coltrane—but interest waned with the second part. It sounded like one part of the song was bloody enough to cover the memory of both fallen giants.

Uhuru Sassa is the one vocal of Bartz' which had some punch to it.

He does it all the time, but this light, pleasant latinesque piece never tires.

Bartz' virile playing and composing are the dominating force and guiding light in this two-LP package. He tours all avenues of playing, and we get ample time to hear his ability to play in or out of the changes as only a few can do.

Live concerts like this are a pleasure to be a part of—as part of an audience and more so as part of the group. Prestige has captured both halves of this combination on a superb recording—one that will make you green with envy that you weren't at the festival in Montreaux last summer.

Eric Henry

Steeleye Span: **Below the Salt**
Chrysalis CHR1008, $5.98.

Steeleye Span's brand of electronic folk music is likely to win you over. The group's highly original approach combines the dynamism of contemporary rock with the lyricism of traditional folk music, producing a well-seasoned blend that evokes images of the Tom Jones era.

The group draws from Child's famous *English and Scottish Popular Ballads* as well as from the Journals of the Folk-Song Society, material that is none the worse for wear for its longevity. According to Tim Hart, a member of the fivesome, "It is very difficult to write songs in the same calibre as something that has gone through so much."

Steeleye is excellent instrumentally, playing all manner of stringed instruments which range from a fiddle and a tenor banjo to a mandolin and of course an electronic bass. They play two utterly charming jigs which literally make one want to get right up and dance, and lift *King Henry* up into the realms of bluegrass, building it to quite a peak. Their arrangements are so fine that the words are secondary and one finds oneself listening to the instrumentation and how they handle their material musically.

Sheep-Crook and Black Dog is rendered a stirring performance by Maddy Prior who does most of the singing throughout in a melancholy forceful voice. Tim Hart's acoustic guitar in the company of Bob Johnson's electronic counterpart together comprise a pleasing timbral mixture in *Saucy Sailor,* demonstrating the best of taste.

This group from merry ole England provides a unique and refreshing listening experience which you shouldn't miss.

THE STORY OF HOWDY DOODY

Before I began the review of this album, I decided to contact Mike Nise, one of its producers, to find out just exactly why anyone would want to put out an album on a TV show that has been off the air for 14 years. Mike told me he first met Bob Smith (Buffalo Bob) at the Electric Factory in Philadephia while he was touring, and later saw him perform before crowds at shopping centers and schools. Struck with the way children, even today, responded to the antics of Howdy Doody, and no doubt coupled with his own nostalgic memories of the late afternoon TV show, Mike finally persuaded Bob Smith and company in 1973 to make a recording at Sigma Sound Studios in Philadelphia.

The Story of Howdy Doody
Take Two TT-101, stereo, $4.98.
(Order from Take Two, Box 5132, Philadelphia, Pa. 19141.)

Naturally, most of us around 30 can remember well the program that ran for 12 years, but what about the children of today who have no memories to draw upon—how could they be introduced to it effectively? Appropriately enough, in addition to using the original cast, the producers sought out the original writers and created a skit to do the job.

Buffalo Bob introduces the characters by telling the Howdy Doody Story to a television camera, and gives humorous descriptions of each accompanied by the old songs, the lyrics of which appear on the jacket of the album. The sound reproduction is so well done that most of the characters' names pop back from the twilight world of trivia as soon as you hear them speak. The only missing characters are Princess Summer-Fall-Winter-Spring who perished in an auto mishap, and Chief Thunder-Thud, omitted because the buffoon role he originally played would be of questionable taste today.

While hardly serious listening music, the album will nevertheless be appreciated by children for its clear and entertaining treatment of the cast (not to mention the included coloring book and punch-out characters and stage!).

In closing, I should like to mention that while a famous man once said, "You can never go home," he made no mention of Doodyville.

Walter K. Young

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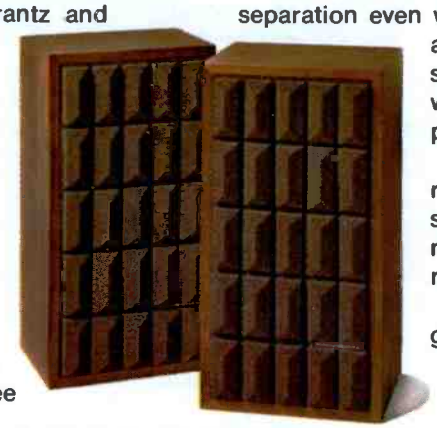

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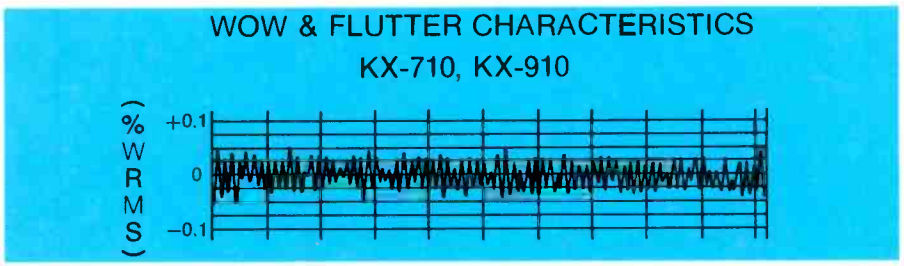

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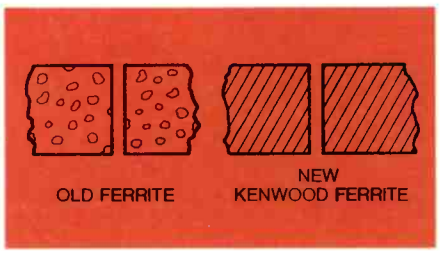

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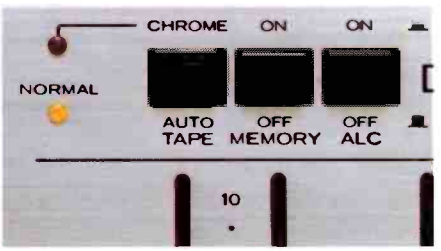

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