Seven Equipment Reviews

Audio

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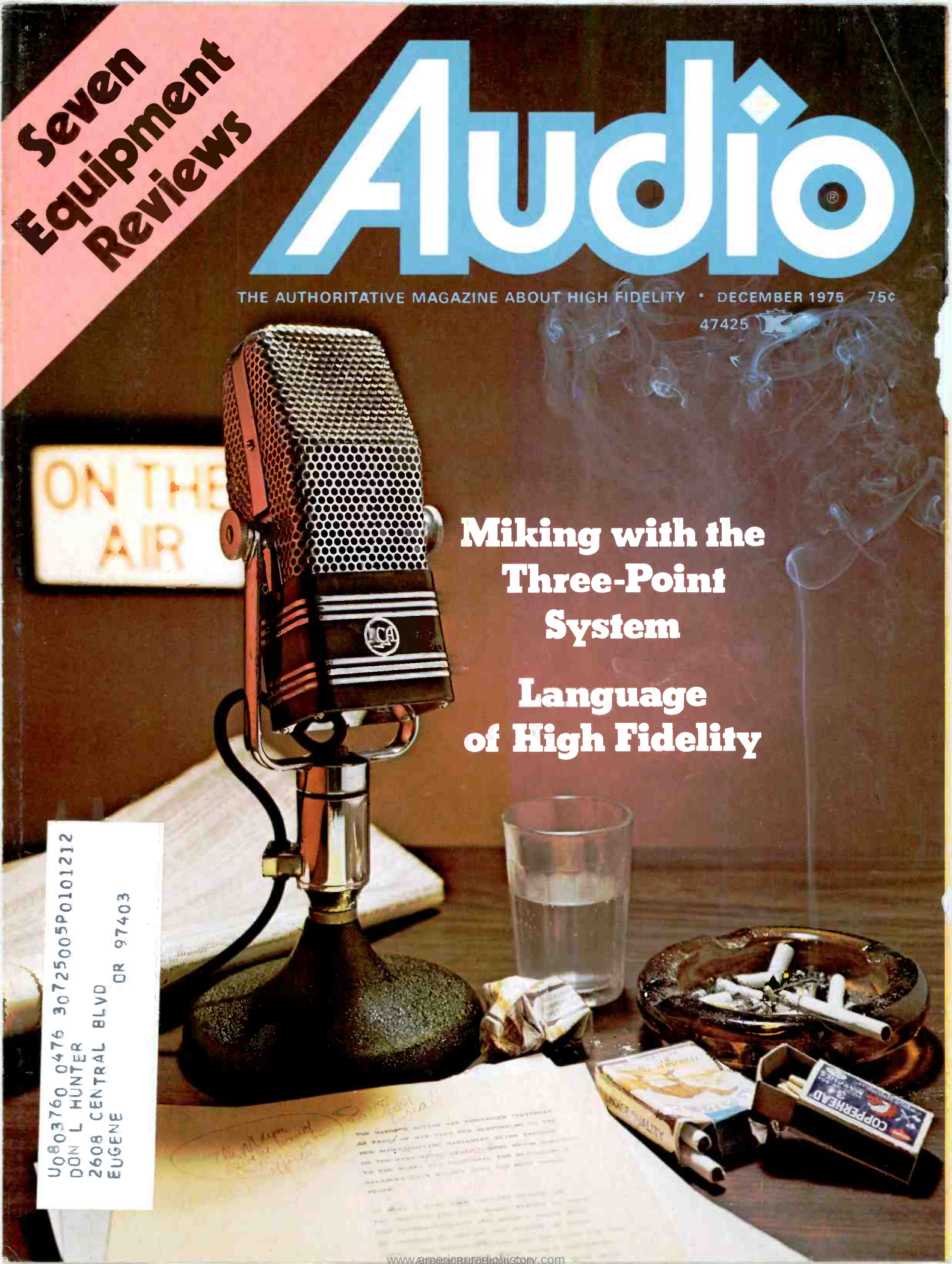

Miking with the Three-Point System

Language of High Fidelity

PL-A45D

PL-55X

e best
e, get a Pioneer.

Both units are even equipped with a strobe light directed at the strobe marks for easy viewing.

Combine the best automatic features with manual operation

While many hi-fi enthusiasts demand completely manual turntable operation, there are many purists who prefer semi-automatic operation. Pioneer provides this extra convenience in the PL-55X and PL-15D/II. Both models incorporate automatic tonearm return and shutoff. When the record has finished playing, the tonearm automatically returns to the arm rest and the power is turned off.

Automatic tonearm return and shutoff

The PL-A45D is completely automatic. You don't ever have to touch the tonearm when you play your records. This 2-motor model has a special precision gear motor to exclusively handle automatic tonearm lead-in, automatic return, automatic shutoff and repeat play. And when you prefer, you can switch to fully manual operation.

Fully automatic operation in single-play

The PL-71 and PL-12D/II, at both ends of Pioneer's turntable lineup, offer the total involvement that can only be attained by completely manual operation.

Superb S-shaped tonearms for better tracking

The tonearm of every Pioneer turntable system is the S-shape design, for optimum groove tracking. All are statically balanced and all use adjustable counterweights with direct reading of tracking force. All have adjustable anti-skate control and oil-damped cueing for the gentlest application of stylus tip to record groove. Lightweight plug-in cartridge shells insure positive electrical contact and optimum stylus position and angle for lower distortion and reduced record wear.

S-shaped tonearm for better tracking

Unexcelled performance

Still, all of these features and refinements do not guarantee the performance specifications of Pioneer's new turntables. Each tonearm and turntable platter combination is shock mounted in its specially designed natural grain base (with hinged dust cover). Precision machining of all rotational parts plus continuous quality control insure that each will meet or exceed its published specifications — a time honored tradition with all Pioneer components.

Choice of the professionals

Engineers, experts and enthusiasts agree: to get the best performance, select a manual turntable. And to get the best manual turntable, you need a Pioneer. Every Pioneer manual turntable offers a level of precision and performance unparalleled in its price range. And every one is a total system — with dust cover and base — designed for years of professional, trouble-free sound reproduction.

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.

PL-12D/II

PL-15D/II

For the manual turntabl

The manual turntable is rapidly becoming the first choice of hi-fi enthusiasts everywhere. The reason why is quite simple. Today's enthusiasts are more knowledgeable, more sophisticated and more involved with their music. And only the manual turntable can provide the involvement and performance they demand.

At Pioneer, this trend comes as no surprise. We have long recognized the superiority of the manual turntable. And long recognized a simple fact: a record changer in no way improves performance. It can detract from it.

As a result, we now offer the finest and most complete line of manual turntables available. Manual turntables that are designed with the needs of today's hi-fi enthusiast in mind. Turntables that are engineered for precision response.

When you get right down to it, good record playing equipment really has only two requirements: uniform rotation of a turntable, and accurate tracing of a record groove by a tonearm and its cartridge.

Pioneer's engineers have long recognized that these requirements are best met by single-play turntables and precision engineered tonearms. Our five new belt-drive and direct-drive turntable systems mean you needn't settle for the higher wow and flutter and the poorer signal-to-noise ratios (rumble) of record changers. Whether you've budgeted $100 or $300 for this vital element of your high fidelity system, there's a Pioneer turntable that outperforms any record changer in its price class.

Consider the performance advantages

Belt-drive, featured in Pioneer's PL-12D/II, PL-15D/II and PL-A45D, means smoother, more uniform platter rotation than can be achieved with typical idler-wheel/pulley arrangements normally found in record changers. Even changers

Belt-drive for rumble-free rotation

Direct-drive motor reduces friction

equipped with synchronous motors transmit vibration to the turntable platter. This is picked up as low-frequency rumble by the tonearm and cartridge. By driving the platter with a precision-finished belt, vibration is effectively absorbed before it can be translated to audible rumble.

Pioneer's direct-drive models, PL-55X and PL-71 go even a step further in achieving noise-free, precision platter rotation. The DC electronically controlled servo-motors used in these models rotate at exactly the required 33⅓ and 45 rpm platter speeds. Their shafts are directly connected to the center of the turntable, with no intermediate pulleys or other speed reduction devices. This means no extra friction-producing bearing surfaces.

Because of the unique technology embodied in these new, direct-drive motors, it's possible to control their speed electronically. This is more precise than any mechanical drive system. Both our PL-55X and PL-71 offer individual pitch control for both 33⅓ and 45 rpm speeds. Their turntable platters are edge-fitted with stroboscopic marks, so you can adjust precise speed while a record is playing.

Electronic speed adjustment for each speed

For the best performance, get a manual turntable.

PL-71

There's a Pioneer turntable that's just right for your needs

Model	PL-12D/II	PL-15D/II	PL-A45D	PL-55X	PL-71
Type	Manual	Semi-Auto.	Fully Auto.	Semi-Auto.	Manual
Drive System	Belt	Belt	Belt	Direct	Direct
Drive Motor	4-pole synch.	4-pole synch.	4-pole synch.	DC servo	DC servo
Speed Control	—	—	—	±2%	±2%
S/N (RUMBLE)	Over 48dB	Over 48dB	Over 47dB	Over 53dB	Over 60dB
Wow & Flutter (WRMS)	0.08%	0.08%	0.07%	0.05%	0.05%
Tonearm Type	Static Bal. "S"	Static Bal. "S"	Static Bal. "S"	Static Bal. "S"	Static Bal. "S"
Tonearm Length	8 11/16"	8 11/16"	8 11/16"	8 11/16"	8¾"
Turntable Dia.	12"	12"	12"	12¼"	12¼"
Priced Under*:	$100	$125	$175	$250	$300

*The values shown are for informational purposes only.
The actual resale prices will be set by the individual Pioneer dealer at his option.
The PL-71 includes a walnut veneered base; all other models include a base of walnut grained vinyl.

PIONEER®

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Audio

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Equipment Profiles

Record Reviews

Audio In General

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a brilliant new achievement in Heil air-motion transformer technology

Since introduction of the ESS amt 1 three years ago, to world-wide acclaim as the first really new development in loudspeaker technology in over 50 years, the Heil air-motion transformer has guided knowledgeable audiophiles to new horizons of sound clarity. Now after two year's research this extraordinary loudspeaker classic has been further perfected to achieve virtually flawless accuracy over a substantially increased range with:

A NEW Heil air-motion transformer configuration that achieves greater vertical sound dispersion and permits penetrating unified magnetization of each transformer with special equipment designed and built by ESS expressly for this purpose.

A NEW 12 inch high acceleration woofer manufactured by ESS under the strictest quality control, incorporates a 7.4 pound magnet assembly mounted on a rigid, open backed, cast aluminum frame. Its cone is made of a newly developed rubber impregnated pulp and is contoured to provide extreme definition and clarity through the critical midrange crossover point with dynamic, overhang-free bass. Its high temperature voice coil assembly allows massive power handling.

A NEW aluminum frame 12 inch passive radiator with a diaphragm of laminated styrofoam and neoprene suspended by a compliant half-roll foam surround, operates in conjunction with the woofer to provide useful output in the typical listening environment, extending as low as 25 Hz.

The new ESS amt 1a reaches a level of performance impossible to achieve without full manufacturing control over all system elements so you can recreate the excitement, immediacy and grandeur of a live performance with a clarity and dynamic power never before experienced. Hear this new ESS standard of excellence, yourself at a franchised ESS dealer—a dealer who understands the loudspeaker of tomorrow, the ESS Heil air-motion transformer amt 1a. You'll experience sound as clear as light.

ESS. inc. 9613 oates drive · sacramento, california 95827
ESS products available in Canada through ESS CANADA

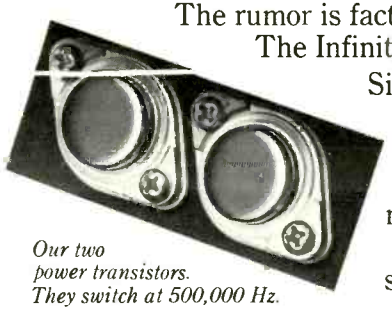
the new ESS amt 1a

Heil air-motion transformer system

The Infinity DSP Switching Amplifier.™
It makes all previous amplifier technologies obsolete.

For some years now, the audio world has heard rumors of the advanced work in Class D amplification going on at Infinity, a young, and, if we do say so ourselves, rather imaginative group in Canoga Park, California. These rumors told of a major new audio technology based upon mathematic and electronic principles in use only in exotic aerospace applications.

The rumor is fact.



Our two power transistors. They switch at 500,000 Hz.

The Infinity DSP (Digital Signal Processing) Switching Amplifier™ has nothing in common with existing amplifiers. The sophistication of its computer technology and the unprecedented, lifelike purity of its sound are totally new. In performance, it eclipses anything ever seen—or heard—in the audio world. Including vacuum tubes and the Vertical FET which have produced the finest sound available—until now.

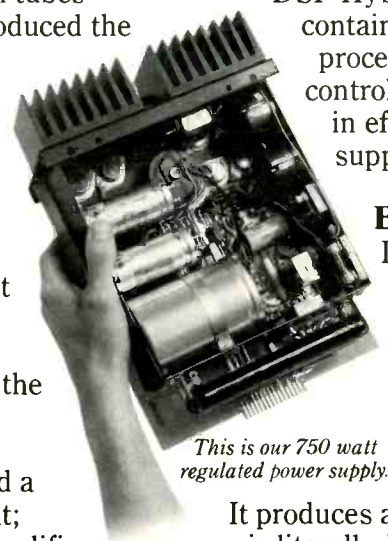
All amplifiers to date, whether vacuum tube or transistor (including the evolutionary V-FET), have used their device for amplification. The DSP Switching Amplifier however, employs a truly revolutionary mode of operation; it uses the transistor not for amplification, but as a *switch*. It simply switches the signal on and off 500,000 times per second—or, at the rate of two millionths of a second.

We know that the concept of Class D switching sounds offbeat and a little opaque. But take our word for it; mathematically, it calculates as an amplifier.

Essentially, the DSP Switching Amplifier performs as a digital computer.

How it works: a not-so-simple explanation

Considerably understated, the Infinity DSP switching circuitry works like this: The power supply delivers 750 watts of regulated power by converting the 60 cycle line to DC, then to a regulated voltage level DC, and then square-wave-modulating that voltage, by switching at 25kHz. (These are the first switching elements in our circuitry.) The amp section converts the audio analogue signal to a computer-coded pulse-width modulation and a filtering network then decodes the modulation from the switched audio signal. The entire function is controlled by an exotic 2½" by 2½" digital chip "brain center"—the Ulrick-Henderson DSP Hybrid™—a plug-in module containing the logic which processes the signal and controls performance functions; in effect, connecting the power supply directly to the speakers.

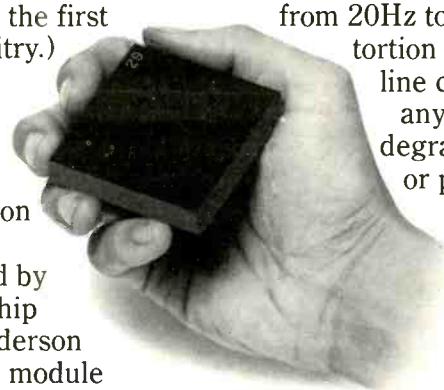


This is our 750 watt regulated power supply.

Nifty. But what does it do?

It does what all previous types of amplification have tried to do and failed. It brings you the ambient, warm, life-quality of live music in a way that makes it virtually indistinguishable from the original sound. It produces a transient-perfect signal that is literally incapable of overshooting or undershooting. It lifts the veils and bypasses the edgy colorations and transient intermodulation distortions that are inherent limitations in all conventional amplifiers.

It totally eliminates the thermal degradation that plagues all transistors, vacuum tubes and V-FETs; therefore it can run virtually forever at full music power and still remain cool. It delivers a rock-steady 250 RMS watts continuous per channel, with power bandwidth from 20Hz to 20kHz, and harmonic distortion of less than 0.1%; under *any* line conditions from 96 to 240 volts, anywhere in the world. With no degradation power in output, quality or performance.



Our digital chip brain-center: the Ulrick-Henderson DSP Hybrid.

Yet it measures only 18¼ by 4½ by 12 inches and weighs less than 40 pounds!

There has never been an amplifier even remotely resembling the Infinity DSP Switching Amplifier—whether in breadth of tonal quality, or in depth of technological advances. It's a stunning scientific achievement.

It cost us six exciting, exhilarating years; it will cost you $1850.(Our FET Preamplifier, soon, will be $1000.)

The DSP Switching Amplifier is ready for you at selected Infinity dealers.

Are you ready for the Third Era?

Infinity

We get you back to what it's all about. Music.

Audioclinic

Joseph Giovanelli

50- and 75-μS Pre- and De-emphasis

Q. Please explain 50-microsecond and 75-microsecond pre-emphasis at the FM transmitter and 50-microsecond and 75-microsecond de-emphasis at the FM receiver. I have noticed that some receivers and tuners have a switch for selecting either one. Does the 50-microsecond de-emphasis circuit produce a brighter sound? /Larry Cook, Albany, Ga.

A. In FM broadcasting, as with tape and disc, we boost treble during production or broadcast and reduce it during reproduction to compensate for the boost. This results in less noise, but the amount of initial boost must equal the amount of later frequency cut or the frequency response will be altered. This is accomplished with a combination of a resistor and a capacitor. Any network of this kind will have a specific frequency boost or cut, starting at a given point and continuing at the given rate to the desired frequency. Beyond the designed-in frequencies, however, the network may not remain effective.

Simply, when a capacitor and resistor are connected in series and a voltage is impressed across it, it takes time for the capacitor to charge. If the capacitor is already charged and then connected in parallel with the resister, it will take time for the capacitor to discharge into the resistor. These charge and discharge periods are said to be the "time constant" of the combination. Since several combinations of resistor/capacitor elements will produce this same time constant, the amount of boost or cut can be stated by using the time constant of the components which make up the circuit, rather than the amount of boost or cut involved and at what frequency.

Most FM stations use a 75-microsecond boost requiring 75/1,000,000 of a second to charge or discharge a network. (Actually, the formula is based on a charge of 68 percent of the maximum possible charge that the capacitor can hold, and a discharge to 32 percent of the full original charge.)

Using a 50-microsecond cut while listening to a station broadcasting with a 75-microsecond boost, the treble will be a bit brighter than otherwise. FM stations which broadcast in the Dolby system use a 25-microsecond frequency boost at their transmitters for increased listener compatibility between Dolby and non-Dolby equipped receivers.

About The Cover: For this impressionistic cover depicting microphone use during WW II, we borrowed an RCA Model 44B mike from Bob Paquette. Introduced about 1937, most radio stations used the 44B throughout the 40s, and it was standard for network radio.

Loudspeaker Flux

Q. Please explain what the word "flux" means, as applied to loudspeakers. Does more flux make a speaker sound better?—Richard McHale, Upper Darby, PA.

A. Flux describes the amount of magnetism, in this case, in the voice-coil gap of a loudspeaker. It is measured in oersteds (the old term was gauss). Generally, the more gauss present, the better. The amount of flux will affect the efficiency of a speaker and the amount of control which amplifier damping can exert on the motion of the speaker cone.

Direct-coupled Amplifiers

Q. What is a "direct-coupled" amplifier and how is it different from other amplifiers?

Ronald L. Ambrogi
Brooklyn, N.Y.

A. A direct-coupled amplifier is one in which the signal is transferred from one stage to the next without coupling capacitors. Because capaci-

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.

The Dual cassette deck.

The first high-performance precision deck with automatic reverse.

Automatic reverse has not been generally associated with high quality in tape recording. But as Dual has long proven with automatic turntables, convenience can accompany precision performance.

Since the primary reason for selecting a cassette deck is its performance quality, let's consider this first. With standard tapes, the frequency response of the Dual cassette deck extends from 20 to 14,000 Hz at ±1.5 dB and to 17,000 Hz at ±3 dB. Wow and flutter (DIN weighted) is 0.07%. Harmonic distortion is less than 1.5%, and signal-to-noise is greater than 50 dB; 59 dB when the Dolby system is switched in.

The motor is Dual's well-known Continuous-Pole/synchronous motor which has long proven its reliability in our finest automatic turntables. A precision-ground flat belt transmits power to the capstans. A separate drive belt powers tape take-up. The VU meters are ballistically damped to provide precisely the rise time and overshoot characteristics specified for broadcast quality meters.

Now for convenience. Automatic reverse lets you double the playback time of any cassette. Continuous-play lets you hear both sides over and over until you shut the machine off. Recording is bi-directional, eliminating the need to turn the cassette over at the end of side one. Rewind time for a C-60 cassette is 60 seconds flat.

You can see the rest for yourself in the photograph. This cassette deck is also typically Dual in appearance: clean, functional, uncluttered. If you own a Dual turntable, you've come to appreciate these qualities. And if you're about to own a cassette, you'll appreciate some additional niceties of the Dual. The meters tilt up for viewing from across the room. The viscous-damped cassette holder rises smoothly and silently when the eject button is pressed. The built-in Dolby test oscillator precisely adjusts for any tapes, today's or those of the future.

In short, this cassette deck was designed with the same philosophy that Dual has espoused for years: the most serious audio equipment can also be the easiest and most convenient to use. Price: $450.

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Dual®

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tors introduce phase shift, their elimination removes this problem. Their elimination also saves parts and therefore lowers cost a bit.

The disadvantage is that the voltage of the early stages affects the operating point of the later stages. A failure in any of the early stages may bring about failure of the later stages. This can prove costly. Fortunately small-signal transistors and ICs used in these early stages are not highly prone to failure.

Direct-coupling is widespread in transistor amp circuitry. It was used only very occasionally in tube amp circuitry.

Equalizers

Q. Please explain the use of an equalizer in a four-channel component system. Are two equalizers necessary? Where is the equalizer connected within the system? Some manufacturers claim their equalizer enables the user to increase the volume of certain instrumental sections and enhance the performance of a given soloist. If this claim is true, how does an equalizer accomplish this?/Roy Clark, Chicago, Ill.

A. Amplifiers have bass and treble tone controls. They enhance the sound quality of the system by enabling the listener to add or remove bass or treble from specific program sources. Such controls are a form of equalizer. Today's "full" equalizers are more sophisticated. Rather than dividing the audio spectrum into just two segments, these devices take narrower segments of the response and boost or cut them. A segment usually is one octave wide, but can be narrower depending on the design of the equalizer and the desired uses.

Considering we can hear over a frequency range of perhaps 10 octaves, we might have 10 separate tone controls for each channel. If we divide the spectrum into even smaller segments, we would have even more controls and, in so doing, can correct peaks or dips in room or speaker response. But this flexibility brings with it the complications involved in trying to use all these controls effectively.

If an equalizer can correct for problems in a stereo or mono system, it can also be used successfully for four-channel sound systems. It would probably be easiest to install the equalizer after the matrix decoder on a matrix four-channel system. For discrete channels, it would be placed between the discrete source (decoder, tape machine, etc.) and the individual channel inputs.

Most equalizers sold are stereo units. Such a unit can be used to control the equalizations for two channels, requiring two such units for a four-channel unit. Some equalizers have a set of controls which affect both channels at one time. But if each channel has its own set of controls to adjust for room acoustics, more flexibility is available. Some equalizers are sold as single-channel units. You would then need four of them, one for each channel.

Equalizers can occasionally be used to increase the volume of certain instrumental and vocal timbres, though this is not always successful. If an instrument has most of its acoustical energy concentrated in a certain portion of the frequency spectrum, the equalizer can be adjusted to bring up only the portion containing that instrument. Conversely, an instrument can be subdued by turning down its portion of the spectrum. But if more than one instrument or vocalist shares a portion of the spectrum, everything will be affected when that portion is adjusted.

Equalizers can totally destroy the sound of a system when used improperly. The highest quality sound system can be made to sound like a table radio if the equalizer is not adjusted properly.

"The Sony TC-756 set new records for performance of home tape decks."

(Stereo Review, February, 1975)

Hirsch-Houck Laboratories further noted, "The dynamic range, distortion, flutter and frequency-response performance are so far beyond the limitations of conventional program material that its virtues can hardly be appreciated."

The Sony TC-756-2 features a **closed loop dual capstan tape drive system** that reduces wow and flutter to a minimum of 0.03%, **logic controlled transport functions** that permit the feather-touch control buttons to be operated in any sequence, at any time without spilling or damaging tape; an **AC servo control capstan motor** and an eight-pole induction motor for each of the two reels; a record equalization selector switch for maximum record and playback characteristics with either normal or special tapes; mic attenuators that eliminate distortion caused by overdriving the microphone pre-amplifier stage when using sensitive condenser mics; tape/source monitoring switches that allow instantaneous comparison of program source to the actual recording; a mechanical memory capability that allows the machine to turn itself on and off automatically for unattended recording.

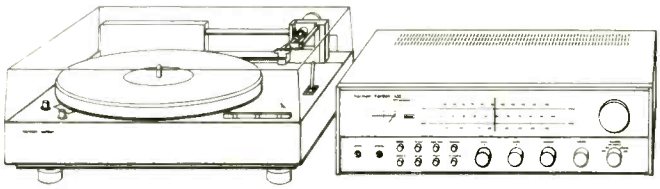
In addition, the TC-756-2 offers 15 and 7½ ips tape speeds; Ferrite & Ferrite 2-track/2-channel stereo three-head configuration; and symphase recording that allows you to record FM matrix or SQ* 4-channel sources for playback through a decoder-equipped 4-channel amplifier with virtually nonexistent phase differences between channels.

The Sony TC-756-2 is representative of the prestigious Sony 700 Series—the five best three-motor 10½-inch reel home tape decks that Sony has ever engineered. See the entire Sony 700 Series now at your nearest Superscope dealer starting at $699.99.

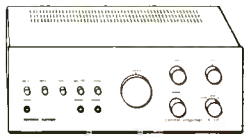
SONY. Brought to you by **SUPERSCOPE.**

*SQ is a trademark of CBS, Inc. © 1975 Superscope, Inc., 8150 Vineland Ave., Sun Valley, CA 91352. Prices and models subject to change without notice. Consult the Yellow Pages for your nearest Superscope dealer.

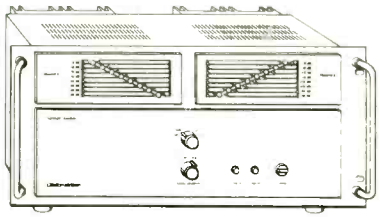
You're looking at our attitudes



Rabco ST-7



430



A401

Citation 16

We've been at the business of high fidelity for a long time. And still, every so often we ask ourselves, "What's it all about?"

For us, it's certainly *not* about mass production, nor about squeezing products into traditional "price points". What we *are* about is to find, without qualification, the best way to reproduce music in the home.

Of course we've had our disappointments. We remember a "shelf" unit that couldn't fit on any shelf known to mankind.

But then there have been our triumphs.

We believe the products in this advertisement are the finest expressions of the attitudes that motivate us. They are *diverse,* but *consistent* with our commitment to bring the highest quality to every function of music reproduction.

The new Harman/Kardon Rabco ST-7 turntable is an excellent example. It plays a disc in precisely the way the cutting head made the master record. The arm, carried by the remarkable "rolamite" bearing, moves across the disc in a straight line. The result is a cascade of zeroes. Tracking error? Zero. Skating force? Zero. Stylus overhang? Zero. Horizontal friction? Zero. Vertical friction? Zero.

Simply stated, the new ST-7 provides a way of playing music in the home that obsoletes conventional pivoted arm turntables.

Diverse and *consistent*. The Citation 16 amplifier is a remarkable synthesis of brute force, technological precision and sonic sensitivity: awesome power with flawless performance. When measured by the criteria that *together* most accurately predict musical results–square wave response, slew rate and rise time–Citation 16 is without peer. The excitement we feel at Harman/Kardon these days is in part due to the reaction from audiophiles who have experienced Citation 16.

Diverse and *consistent*. The ST-7 and Citation 16 expand the boundaries of state-of-the-art. The resulting new technology is soon incorporated in other products. The new A401 integrated pre-amplifier and power amplifier does not produce the absolute power levels of Citation 16. But its square wave response, slew rate and rise time reveal its genealogy. We can conceive of no better recommendation for the first time "investor" in high fidelity.

Diverse and *consistent*. As the 430 receiver vies for visual attention on your dealer's shelf, it may seem almost diffident. Don't believe it! For within its graceful contour lies such power as to meet truly demanding dynamic conditions–without compromise of sound quality.

The source of the 430's energy is not the conventional single power supply. It has *two* discretely separate power supplies–one for each channel. Consequently, no matter how much energy is called for by dynamic music passages, performance of one channel is not affected by the other. The features of the amplifier section (twin power, square wave response, phase linearity, instantaneous transient response) and many elements of the tuner and preamplifier sections are inherited from our Citation series of components.

There is simply no comparison between the 430 and other modestly priced receivers. Its performance can be appreciated most by direct comparison with expensive individual components. The 430 demonstrates, upon the very first hearing, that quality need not be sacrificed to achieve the economy of size, convenience and price.

Of course you're looking at new high fidelity instruments. But the attitudes with which they were conceived and built are their very essence. We'd like to tell you much more about them–directly–without circled numbers or coupons. Write to us. We'll respond promptly. Harman/Kardon, 55 Ames Court, Plainview, N.Y. 11803

Harman/Kardon Canada Ltd., Montreal

harman/kardon

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Tape Guide

Herman Burstein

Tape Recording Problem

Q. The quality and volume of the sound from tapes I record on my TEAC 6010 are much lower and poorer than the program material, even though the VU meter shows proper deflection. When I play tapes on other machines the sound is OK. What can the trouble be?—P. Y. Kosol, Winnipeg, Canada.

A. Your VU meter may be miscalibrated, causing it to give too high a reading, thus leading you to record at too low a level. Or you may have insufficient bias current feeding to the head, due to a defect in the bias oscillator and the record head, or to a misadjustment of the control which sets the bias current. If your recordings also include excessive high frequencies, you probably have insufficient bias. Another possibility is that there is a defect in the record electronics following the point where the signal is tapped off for the VU meter. This could cause insufficient record signal at the record head.

Tape Recorder Care and Operation

Q. Where can I get a book telling me how to get the best results from my tape recorder? The instructions which came with my Radio Shack 909 are very brief. I also need to know what is correct routine maintenance.—A. L. Hall, Portsmouth, N.H.

A. Every tape recorder maker I know of produces a service manual for his machines, either available free or for a dollar or two (although service manuals for very new models sometimes are not available for some months after they are first on the market). For books dealing with tape recorder use and maintenance, go to the largest parts distributor near you. If none are within your area, write to: (1) Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, Ind. 46206, (2) TAB Books, Blue Ridge Summit, PA. 17214, (3) Audio Book Club, 134 N. 13th St., Phila. Pa., 19107. Sams may be best for specific service information on a particular machine.

Adding Dolby to O-R Tape Deck

Q. I am considering adding a Crown SX824 tape deck to my system. This machine has excellent specifications, but since money is no object I am considering adding the Advent Dolby B unit to it. Will I be helping or hurting the sound otherwise obtainable with the Crown?—Lee A. Swoboda, Long Beach, California.

A. The Advent should not degrade the quality of the recordings you make with the Crown, but it's not likely to improve them audibly at the higher speeds. If you use the Crown at low speeds, there should be some improvement. The rule is, the better the tape machine to begin with and the higher the tape speed, the less improvement Dolby will make.

Cassette machines, running at 1-7/8 ips, and with very narrow tracks, four across a 1/7-in. wide tape (!), get much more help from Dolby noise reduction than do open-reel machines using 1/4-in. tapes, at higher speeds.

Which Tape to Use?

Q. I own a Sony TC630 machine. I'm getting into some serious recording using Sony FCM-22 mikes. I understand that Sony adjusts bias to its own tapes. Until now I have preferred to use Audiotape. Do you think I should either use Sony tapes, which are more expensive, or readjust the bias to Audiotape?—Neil Davidson, Stamford, Conn.

A. Are you sure that you must have bias adjusted in order to use Audiotape? If bias does indeed have to be changed, consider the following. Unless you have the instruments and technical knowledge, the adjustment must be made by a competent technician. His charge will be between $15.00 and $25.00, perhaps more, and this could pay for the price differential of quite a number of reels of tape.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.

60% of BOSE Owners Changed Our Mind

While we enjoy talking about the technology that distinguishes the BOSE 901®, and about the unprecedented series of rave reviews by leading critics, the purpose of an advertisement is to increase sales by introducing more people to the product.

A surprising result of a customer survey changed our mind as to the most effective use of advertising funds. It revealed that 60% of the people who select the BOSE 901 do so at the recommendation of a 901 owner! This told us that the best advertisement is the product, and the best salesman is the enthusiastic owner.

We concluded that an excellent use of advertising funds would be to help set up an absolutely phenomenal music system in as many owners' homes as possible. Known as the SUPER BOSE SYSTEM, it consists of the 1801™ power amplifier and **two** pairs of 901 speakers. One pair of 901s is placed to reflect sound off a front wall, and the second pair reflects off side walls, producing sound with spatial realism and presence that is simply astounding.

Our program in setting up these systems in owners' homes is to provide the **SECOND PAIR OF 901s FREE** to all those serious enough to purchase a component system consisting of the 1801 amplifier and a pair of 901s. We have allocated sufficient advertising funds to cover all purchases made from October 15, 1975 to January 15, 1976.

We believe that the SUPER BOSE SYSTEM is the best music system available today.

And we believe that its owners will be the best BOSE salesmen tomorrow.

One equalizer is required for the Super Bose system, and accordingly the second pair is supplied without equalizer.

This offer is good in continental U.S.A., Alaska and Hawaii only.

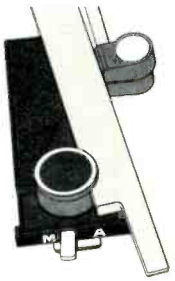
901 cabinet is walnut veneer.

BOSE®

The Mountain, Framingham, MA 01701

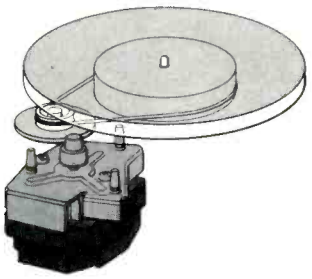
Four questions you multiple-play

1. Does it perform as well as any single-play turntable?



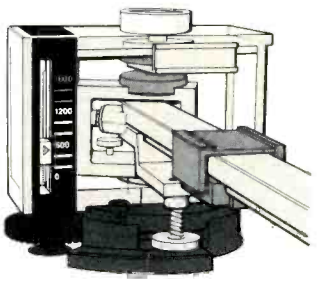
There are some who believe that a single-play turntable is somehow inherently better than a multiple-play unit. All right—the Z2000B *is* a single-play turntable. Its capacity to function as a multiple-play unit offers convenience with no compromise of performance. The *automatic* mechanism which gently indexes the arm, lifts it at the end of play, returns it to the arm rest and shuts off the motor—is completely disengaged during record play. A 2-position control sets the proper vertical tracking angle for single or multiple play. The Z2000B can truly be called the automated, single-play turntable with multiple-play capability.

2. Does it have belt-drive and variable speed?



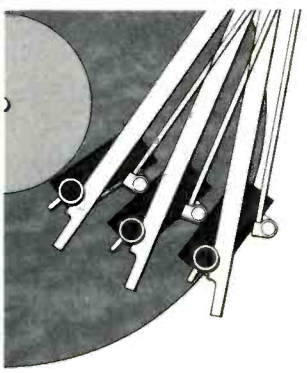
Garrard engineers have attained remarkable results by combining the world famous Synchro-Lab motor and an inventive belt/idler drive combination. A 5 lb., die-cast, dynamically balanced platter is rotated via a flexible belt. Not only are the tiniest fluctuations of speed smoothed out, but an extraordinary -64dB rumble is only one example of the impressive specifications achieved. A variable speed control corrects out-of-pitch recordings and an illuminated stroboscope provides optical confirmation. The Z2000B combines all of these elements to achieve the main goal of Garrard engineering: superior performance at reasonable cost.

3. Does it handle records gently?



All responsible turntable manufacturers are concerned with protecting your records. With Garrard, it's an obsession. The Z2000B boasts an array of features designed solely to prolong the life of your records. In addition to the exclusive, articulated tonearm, it incorporates an exceptionally accurate magnetic anti-skating device. Cueing is viscous damped in *both* directions. The ingenious built-in automatic record counter keeps track of how many LP sides the stylus has played. And unlike some of the highest priced changers that support records only at the center hole, the Z2000B supports them at the hole *and* edge, and the release mechanism operates at *both* points. Protection for your records indeed!

4. Does it eliminate tracking error?



The grooves of a record are cut by a stylus that travels in a straight line. Conventional playback tonearms move in an arc. The difference between these two paths is called "tracking error." Simply stated, tracking error launches a cycle of distortion and record wear. In good design, the error is averaged over the record so that distortion is minimal. But such compromise was unacceptable in the Z2000B. What Garrard engineers did about it was summed up by High Fidelity Magazine which described the Zero Tracking Error Tonearm as "...the best arm yet offered as an integral part of an automatic player." The Z2000B is the *only* automatic turntable in the world without tracking error.

For your free copy of the New Garrard Guide, write to Garrard, Division of Plessey Consumer Products, Dept A, Plainview, New York 11803.

Check No. 16 on Reader Service Card

must ask about any turntable.

The Garrard Z2000B. Yes. Yes. Yes. Yes.

$229.95

Garrard
The Automatic Choice

Behind The Scenes

Bert Whyte

I SEE BY my calendar that December has arrived for its appointed round, and the end of the year is nigh, and it is time for the rotund little chap in the red suit and "Ho, Ho, Ho" and all that jazz.

How did the hi-fi industry fare in 1975? It certainly wasn't "the best of all years," but it was a great deal better than most people expected. That the industry weathered this recession year as well as it has is continuing proof of its basic strength. Yet there were warning flags flying in 1975, and the industry will jeopardize this strength if these signals are ignored.

In 1974, the FTC ruling on power amplifier rating, with its controversial "burn-in" provision, became law. That it caused consternation within the hi-fi industry is to put it mildly. Audio engineers *en masse*, led by colleague Len Feldman, Chairman of the IHF technical committee, denounced the "burn-in" period as "harmful" and not "relevant to the normal mode of amplifier usage in the home." In spite of documenting to the FTC that compliance to the "conditioning" provision would in most cases require technical modifications to the amplifiers that would ultimately mean higher costs to the consumer, the FTC has barely budged from its position. It appears the FTC knows that they made a bad ruling and in fact have been looking for a way to retreat from their position without causing themselves too much embarrassment. What we must remember is that part of their intransigence is due to the fact that they consider that they gave ample time for the hi-fi industry to study the power amplifier ruling and suggest possible changes or amendments. It must be admitted that by and large the industry ignored this matter, and when they finally did become aware of the perils of this ruling, it was already too late.

The latest word is—and this is only at the "opinion" level, not the full "promulgated ruling" level—is that the FTC will allow an amp's thermal cutout to operate during the preconditioning until the required one-hour burn-in time has been accumulated.

I have a feeling that the power amplifier ruling of the FTC is just the tip of the iceberg. Government agencies are always trying to perpetuate themselves and justify their existence. Inevitably, other aspects of the advertising and promotional activities of the hi-fi industry will come under FTC scrutiny. Now please don't misunderstand me . . . I'm not saying the hi-fi industry has anything to hide or is in any way engaged in any chicanerous practices. In fact, as I have said many times before, the industry is virtually unique as one of the last bastions of the "good value for the money" philosophy. Nonetheless, it is conceivable that the wording and even the validity of product specifications and performance parameters might be questioned. Let us not delude ourselves that manufacturers do not interpret specifications to their competitive advantage in their advertising. This is, of course, entirely due to a lack of hi-fi industry standards for the various aspects of product performance. One cannot blame the manufacturer for taking the "leeway" this affords in quoting specifications.

For some time now, there has been a groundswell of opinion in favor of the establishment of performance standards for all audio equipment. In view of the unfortunate experience with the FTC power amplifier ruling, the industry should act now to establish these standards. The IHF could be the regulatory body for such standards and, as noted previously, has already in existence a technical committee which could initiate this program. It is realized that there are many types of audio components, with many different performance parameters and formulating standards for them will be technically difficult and a most arduous task. However the need is obvious, and the time for action is now, if further brouhahas with the FTC are to be avoided.

Writing in the September, 1975 edition of *Radio-Electronics*, Len Feldman points out some of the "inconsistencies" in the quoting of signal-to-noise ratio figures for phono preamps and turntables. For example, if a phono pre-amp stage has a true input sensitivity of 2 millivolts at 1 kHz with the usual test procedure, the S/N ratio may turn out to be -55 dB, and be accurately quoted as "-55 dB below 2 mV." However, for some years now, in this country and abroad there seems to be a "tacit agreement or acceptance" among manufacturers to the use of a "reference" phono input sensitivity of 10 mV. Thus, while the manufacturer states the *true* input sensitivity (i.e. 2 mV), they quote the S/N ratio at the "reference" input of 10 mV, which magically improves the S/N ratio by 14 dB and enables them to state the specification as "-69 dB below 10 mV." While this may seem a deplorable practice, most of the manufacturers do it in self-defense, much in the same fashion of using the term "rms" in rating power amplifiers, in which the use of rms is not really relevant. Len also relates a similar situation in the manufacturers specifications for the rumble content of turntables. There are four different methods of measuring rumble . . . the NAB, CBS/ARLL, and the German DIN A (unweighted), and DIN B (weighted). (And don't forget the CCIR standard, Bert.—Ed.) In all of these methods, the turnover frequencies are different, the rate of attenuation for the filters is different, and they do not employ the same "reference" frequency or amplitude in establishing the "0 dB" point, below which the rumble is measured. Thus, depending on the actual distribution and amplitude of the rumble frequencies in a turntable, the manufacturer can choose from among the four methods, that which gives the highest "number" and therefore the most favorable rumble specification.

Another provocative and informative article on the use and abuse of test procedures and the interpretation

TWICE AGAIN, HISTORY REPEATS ITSELF.

Carrying on the innovative tradition of our almost ninety year involvement in music, Yamaha announces a double breakthrough in all-FET technology.

Yamaha's C-1.

At $1800, you've never seen a preamplifier like this before.

It's so different we call it the Master Control Center. You'll call it well worth waiting for.

From input to output, it's the first to use advanced FET's exclusively throughout the signal path.

Yamaha's C-1 is made for perfectionists who appreciate the superb clear tonality and exceedingly low distortion that only FET's can bring.

For advanced audiophiles who want the complete control over literally thousands of audio variables that only the most advanced circuits and features can offer.

A built-in oscillator.

Consider the C-1's unique built-in oscillator with level control, a professional test instrument that's usually found only in sophisticated audio labs.

By generating both random "pink" noise as well as the four most useful test tones (70 Hz, 333 Hz, 1 kHz and 10 kHz), the C-1's oscillator can be put to a variety of tasks:

Determining the precise phono impedance loading, checking the frequency response of speakers, A-B speaker comparisons, setting up a tape deck, balancing the output level of an entire system, and balancing room acoustics. You'll discover more and more uses as you go along.

(A word of caution: because the C-1's oscillator can be used externally, all your audiophile friends will want to use it to test their own components.)

Where most other manufacturers use a negative feedback design in their phono equalizer amplifiers, Yamaha specified the more sophisticated passive interstage equalizer (CR-type). The results were worth it:

Greater stability, lower distortion, superior tonality.

In our all-out effort to reduce noise at all preamp output levels (not just at maximum output), the C-1 features a unique four-gang volume control that simultaneously adjusts inputs and outputs.

You're totally in control.

With the C-1's selectable equalization controls for presence and acoustic balance, you enjoy the equivalent of a separate equalizer. For those occasions when you don't want to use equalization controls, the C-1's special circuitry lets you bypass them completely.

Another unique feature that sets the Yamaha C-1 Master Control Center apart from other so-called state-of-the-art preamplifiers:

Six-position selectable phono impedance that allows your cartridge to be precisely loaded for optimum high frequency performance.

The Yamaha C-1's absolute control over sound also includes a pair of extra wide-range (−50 db to +6 db) peak reading meters. Electronic damping provides both faster peak readings and slower decay, assuring precise monitoring. You can also use the C-1's meters to monitor any external component that doesn't have meters.

Writing in *Audio* about our unique metering system, Bascom H. King stated:

"...by far the most accurate and meaningful of any meter set-up seen thus far."

Individual level controls let you balance the input from all signal sources, except the tuner. (Yamaha's companion tuner, the CT-7000, has its own variable output level adjustment.) So the volume level stays the same when you switch, for example, from tape to phono, tuner to aux, etc.

And there's more.

Enough that once you hear the Yamaha C-1, you'll never be satisfied with another preamplifier again.

Yamaha's B-1.

At $1600, it's already redefined state-of-the-art amplifier performance in a lot of people's minds. Yours might be next.

Revolutionary Vertical-FET design produces a completely different kind of sound. Clean, open and transparent. With a richness that goes beyond the best vacuum tube amplifiers.

And, up to now, unavailable.

Worth the wait.

As late as a few years ago, there existed only two types of transistors: bipolar and horizontal FET. Each operated in a completely different manner.

The bipolar device uses input current to control output current. On the other hand, the horizontal FET uses input *voltage* to control output current—a more suitable audio technique that's quite similar to vacuum triode tube design. (Both use input voltage to control output current; both have sharp cut-off characteristics which eliminate high-order harmonics and notch distortion.)

Only there was a small problem.

Because current passage was restricted to a single path, the horizontal FET didn't produce enough power to be used in the output stages of a power amplifier.

Then, in 1971, Prof. Nishizawa of Tohoku University drastically changed the FET's internal structure. The shape of the voltage-controlled constriction was altered to let the current take an almost infinite number of paths.

And so, the Vertical-FET was born.

During the past three years, working exclusively with Prof. Nishizawa, Yamaha's engineers have brought the Vertical-FET to the forefront of audio technology, where it serves as both driving and output devices in our new B-1 amplifier.

The B-1's rated 150 watts per channel (20 Hz to 20 kHz, less than 0.1% THD) are produced by only two Vertical-FET output devices per channel.

Compare that with the minimum of six to eight output devices per channel found on most other amps!

Yamaha knows that fewer output devices minimize the distortion caused by out-of-balance output devices during transistor switching cycles. And maximize tonality.

People are talking.

Here's what Julian Hirsch of *Stereo Review* had to say about the power-handling capacity of Yamaha's new Vertical-FET:

"Each of the FET's is about the size of an ordinary power transistor, but it can dissipate 300 watts!"

Audio's Bascom H. King observed that the B-1's power output at visual onset of clipping for an 8-ohm load was 220 watts—46% over spec!

So you can see that our 8-ohm rating of 150 watts is quite conservative indeed!

Because the B-1 is used as a reference amp by many of our dealers, we supply an optional control unit that can A-B up to five pair of speakers and balance them for efficiency at the head amp. Without the insertion of T-pads that degrade low-end response by decreasing damping characteristics.

It's called the UC-1. It costs $250. And you don't have to be a Yamaha audio dealer to own one.

Besides speaker switching, the UC-1's extra wide-range peak delay meters, with faster peak and slower decay like those on the C-1 (but calibrated in both dB's and watts of power output), offer an extremely precise monitoring capability to your system.

Yamaha's C-1 and B-1, $3650 the pair, with the UC-1 control unit.

After you hear them together, you'll never be satisfied with anything less.

YAMAHA

International Corp., P.O. Box 6600, Buena Park, Calif. 90620

Check No. 53 on Reader Service Card

of manufacturers specifications appears under the title of "The Specification Says . . ." by Hugh Ford, writing in the September, 1975 issue of that most estimable British journal, *Studio Sound*. Mr. Ford examines in depth, measurement techniques for frequency response, S/N ratio, input and output sensitivities, total harmonic distortion, and intermodulation distortion, as applied to various audio equipment and warns us about interpretive pitfalls. Speaking of *Studio Sound,* if you are into professional audio or if you are a very advanced audiophile, this is a "must" publication providing comprehensive coverage on audio subjects simply not available elsewhere. Recent issues on quadraphonic sound and ambisonic recording were real gems. If you want to subscribe to *Studio Sound,* which is published monthly, it will cost you the dollar equivalent of 4 pounds, 20 pence; write to the magazine at Link House, Dingwall Avenue, Croydon CR9 2TA, England.

The authors of the aforementioned articles have given us very cogent arguments on the need for the establishment of internationally accepted standards of audio measurement and performance. Needless to say, this has been true for many years . . . let us hope that we will have an end to procrastination and assorted excuses, the "backing and filling," and finally get some action.

As mentioned at the beginning of this article, it seems that Christmas is upon us. Although I may be stretching the term a little, herewith some "super stocking stuffers" that should gladden the Christmas spirits of any audiophile. . . .

With the winter months ahead of us, the heat will be turned on in homes and apartments (Allah willing) and the humidity will drop, and all that dry air will bedevil our vinyl records with static. The use of a humidifier helps some (supposed to be better for your health, too) but I have been testing a Jim Dandy gadget that positively eliminates the static charge on your precious discs. It is called a Zerostat, and looks at first glance to be similar to a white plastic toy water pistol, with a large, elongated metal trigger. The action is quite mysterious, and the construction of the unit does not encourage explorations into its innards. However, as far as I can determine, it seems to be some sort of "strain gauge" affair. In any case, it takes a fair amount of pressure to squeeze the trigger. The instructions state that you must exert a slow constant pressure on the trigger. If you are too fast you will hear a "click" and the desired reaction will not happen. What is happening is that when you fully depress the trigger in the proper manner, a stream of positive ions is flowing from the tip of the gun. By then releasing the trigger in the same slow controlled motion, negative ions are produced. To test the Zerostat, I briskly rubbed a record with a dry cloth, and created enough static that when I passed the disc just above my arm, the hair on my arm was attracted to it. Then, holding the Zerostat about 4 in. above the center of the record (as per instructions), I went through the squeezing operation. When I passed the now "treated" disc over my arm, I could neither observe nor feel any attraction . . . the static charge had been completely removed. The Zerostat is a British product and is imported by the Discwasher Company. It retails for $29.95. In my view, when you use Dr. Bruce Meier's Discwasher system, which really does a superlative job of cleaning a record, followed by a treatment with the Zerostat, your record will be in pristine condition.

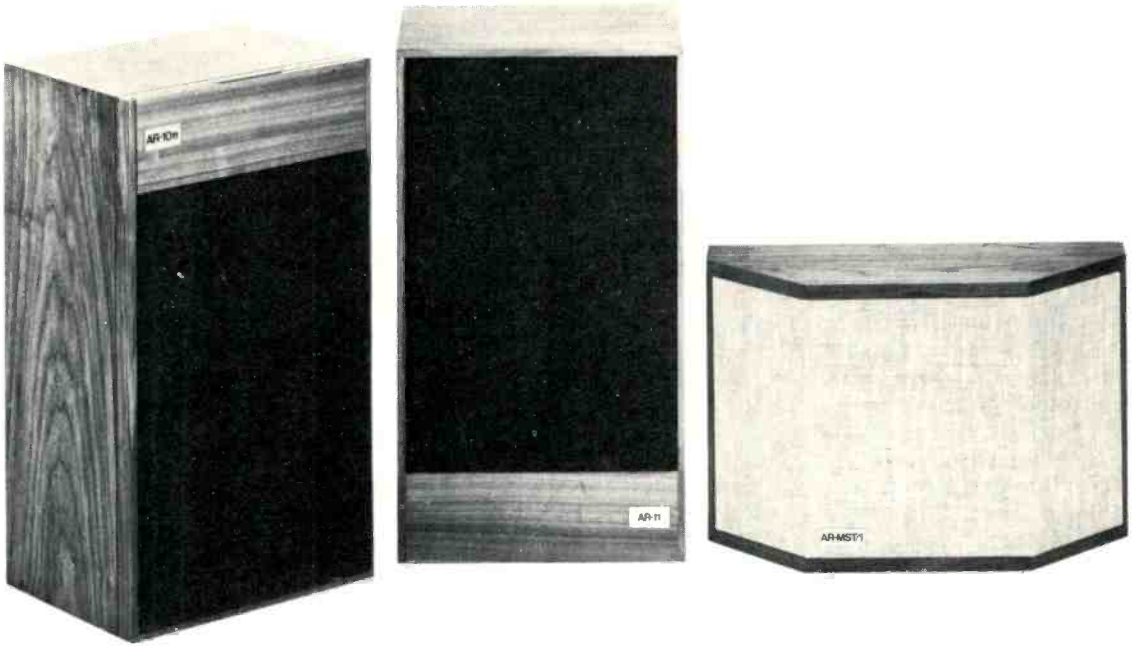
For those fortunate audiophiles who own professional tape machines, they will appreciate the AKG K-140 headphones, whose 600-ohm impedance allows you to hear a signal at a good level from the headphone jacks of the tape machine amplifier. Add an ingenious headband that easily adjusts to different shaped "noggins," a light weight of 6 oz., and an extremely smooth and extended frequency response, all for around $34.00, and you have a worthwhile gift. There are other phones in the 600-ohm category, but I happen to like the combination of features on the K-140.

Another stocking stuffer that would be a welcome gift for the tape recording enthusiast is a professional quality alignment tape, such as those made by Magnetic Reference Laboratory, on which I reported some months ago. Price, around $30.00.

Lastly, the well-known CBS Labs Technical series test records have recently been updated and remastered. There are nine of them covering such areas as square wave, tracking and intermodulation tests, wide range pickup test, RIAA pink noise acoustical test, RIAA frequency response, stereo frequency test, etc. For the serious audiophile, they are an inexpensive, but most thoughtful gift. See the ad elsewhere in this issue for details on how to order.

New from Acoustic Research

Introducing
A new family of loudspeakers from Acoustic Research



AR-10π
The AR-10π is the most accurate musical reproducer that Acoustic Research has ever made. It shares the characteristics of AR's previous speaker systems, smoothness of response, uniform dispersion, and low distortion. A significant additional feature of the AR-10π is its ability to deliver uniform flat energy response in most listening rooms.

Further, the designed-in performance of the AR-10π is preserved, whether the speaker is positioned against a wall, in a corner, or even in the middle of a room. Setting a single switch, called the 'Woofer Environmental Control', will ensure the correct level of bass energy for any of these positions. It is not possible to do this accurately with conventional loudspeaker designs or equalization techniques.

AR-11
The performance, drivers, and crossover of the AR-11 are identical to those of the AR-10π, except that the AR-11 does not incorporate a Woofer Environmental Control and the associated crossover components.

The AR-11 is designed for optimum performance when placed against a wall, as in the conventional bookshelf position, or slightly away from two adjoining room surfaces.

Both the AR-10π and the AR-11 use a 12 inch acoustic suspension woofer, a 1½ inch dome midrange, and a newly designed ¾ inch dome highrange.

AR-MST/1
The AR Miniature Studio Transducer offers at moderate cost the flat energy response of AR's other new speaker systems, together with the high power-handling capability required in many professional applications. Along with the AR-MST/1's small size, light weight, and shallow depth, these characteristics make the speaker especially appropriate for the monitoring of remote-location recordings as well as the accurate reproduction of music in the home, even at relatively high sound levels.

Guarantee
The workmanship and performance of all AR speaker systems are guaranteed for five years.

A complete description of the new family of AR speakers is available free. Mail us the coupon today.

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Norwood
Massachusetts 02062
Telephone 617 769 4200

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A TELEDYNE COMPANY

☐ Please send me a complete description of the AR-10π, AR-11, and AR-MST/1 speaker systems.

☐ Please send me the AR demonstration record 'The Sound of Musical Instruments' (check for $5 enclosed)

Name

Address

AU12

Audio ETC

Edward Tatnall Canby

AT FIRST glance, it might have been no more than a technical shift in merchandizing, that casual announcement a few months ago from EMI, Electrical & Musical Industries of England. Far from it! Profound implications for quadraphonic. A major record company on the move. And look! There's light at the end of the tunnel.

Interesting that it should come from EMI, the sobersided giant of British conservatism, the same outfit that took a leisurely five years or so to make up its mind about the LP record after 1948. Inertia! Big companies have it. They can afford it. But also—momentum, once they get going. Being conservative in England, after all, generally means being absolutely unflappable. That's EMI. EMI's momentum can shake the record world. The new EMI decision: *no more quadraphonic records.*

Don't jump. —That is, no *separate* quadraphonic records sold parallel to stereo in a dual inventory. Instead, once again we have a single basic EMI classical disc, and history is timelessly reversed, back to where we were before we had ever heard of four channels. And as things were before we had stereo. And as they were before the LP. Each of these technical innovations brought with it, for awhile, an uncomfortable dual inventory, two types of disc and a sort of workable compatibility, more or less. But within years, in each case, the industry returned to the traditional single release—just as soon as conditions permitted. So it is happening again. How very much in the old tradition, then, is EMI's present move! Positively classical. Here's how it works.

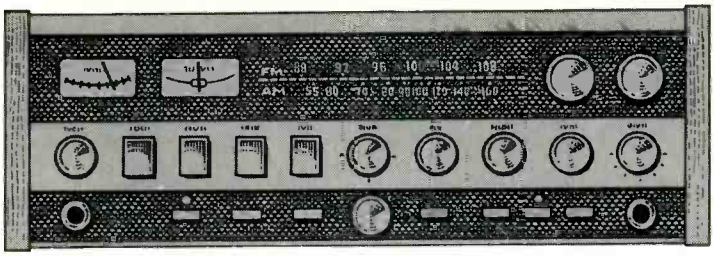
EMI's classical discs (the pop field evidently is left open) will no longer carry any special quadraphonic label or number or price. However, almost all classical releases—across the board, the whole production—will bear a new standard designation, "stereo/quadraphonic." Every one of those records will be encoded for SQ quadraphonic and there will be no stereo equivalent at all. Does *that*, in a casual British way, go far beyond Columbia itself, the SQ mother hen! Rather. Quite breathtaking.

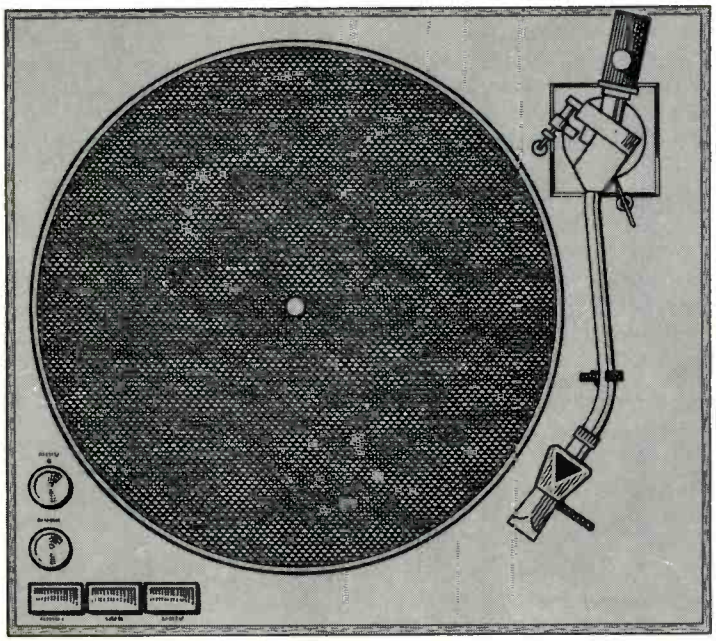
Depending on circumstance, some EMI releases will be marked "stereo." No encoding. Solo instruments and the like, where it is felt to be unnecessary. No implications of better or worse, just a matter of aesthetic judgment. All the EMI classicals are in there together now, whether they happen to be stereo or quadraphonic. *Single inventory.* That is the key phrase. The quadraphonic aspect, you see, is both played up and played down. On the one hand it is now taken for granted, as though there were no further argument, and is routinely applied to the entire production—that plays it up, all right. On the other hand, quadraphonic is pointedly integrated into the larger aspects of record production, just another useful tool among many that bring us good music and hi fi on discs. That correctly plays it down.

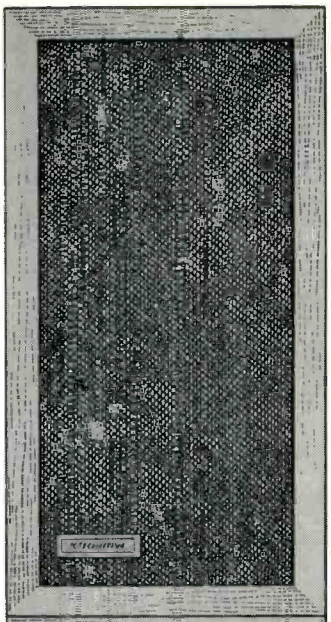
So infinitely reasonable! I'll bet the mother hen is in a flap, over here. We've had no such clear thinking (and action) from anybody on this side of the water, either from SQ or CD-4. In fact, for all our quadraphonic trumpetings hereabouts, we are still floundering all over the place, or sitting on uncomfortable fences with sharp points that keep getting sharper. An agony of noisy indecision and dangerous for all concerned. Imperturbable EMI! Cooler heads over there. EMI has stepped right in where, er, Angel fears to tread. Not to mention Columbia and RCA.

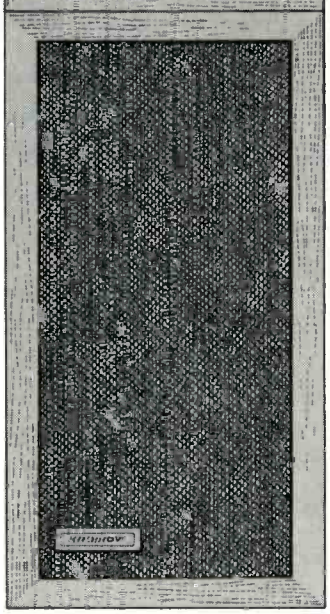
Curious, for instance that, though the EMI story appeared in the trade papers, CBS itself flashed out the news in an "SQ Newsletter" to dealers and hi-fi writers. Curious that in that letter there wasn't a word about CBS's own thoughts and intentions—and would we all like to know them. Curiouser still that the word "Columbia" did not appear. The Newsletter came from the CBS Records Division. From which segment of CBS, in all its complexity, did we actually receive this interesting communication? And where was Columbia Records, the old mother hen herself? Odd. Could we read a veiled mini-hint here of some internal distress within the CBS empire? Could be. Because, as you know, from the very beginning of SQ the Columbia policy has been precisely the opposite of that now promulgated from EMI. A dual inventory, separate stereo and quadraphonic releases, side by side at a dollar's difference, the SQ product conspicuously promoted as deluxe, even to those gaudy gold labels.

Could it even be, I thought to myself, that the big British SQ tail was beginning to wag at least a part of the U.S. (Columbia) dog? *(Here now, enough of those mixed metaphors, Canby. What would Nipper think? —Editor.)* Hmmmm. An interesting thought. EMI is plenty big enough. EMI is by far the largest of Columbia's SQ licensees and worth a hundred of the others. *Something* must be going on there back behind the scenes.









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With that SQ Newsletter there was enclosed a Columbia ad offprint showing a model who is buying up dual-inventory SQ discs, conspicuously marked quadraphonic. Was this sent along just to contradict EMI? I wouldn't know.

Compatibility

In all the quadraphonic camps since the beginning of four-channel disc the loudest tune has been COMPATIBILITY. Every quadraphonic disc always plays on any sort of equipment. True, true. But oversimplified. Trouble is, the sales people have found themselves somewhat limited as to what they can say on this subject. Limited to superlatives. The fact is that total compatibility is a very rare bird, unless, let's say, you mean one stereo disc and its twin, hot from the press. "Compatible," as everyone knows who plays discs and tapes, means a technical *marriage de convenance*, a convenient marriage (with divorce more or less taken for granted)—we can get along together as long as we have to. A working arrangement, for the time being, and don't tell me otherwise. So we have assorted compatible quadraphonic discs, but there's nothing permanent about the relationship. Indeed, compatibility has an important silver lining—it is dynamic, it changes as the scene changes. The emphasis is shiftable, right across from one side to the other as necessity requires. That applies to stereo/quadraphonic compatibility.

It is true, then, that EMI's new combined stereo and quadraphonic disc involves a give and take, call it a compromise, between the ideal stereo sound and the ideal quadraphonic. They aren't the same, and it is here that Columbia, I think, gets very hot under the collar at the thought of a single inventory. Columbia has developed an experienced and dedicated SQ team over the years; it keeps its quadraphonic operations remarkably apart from stereo, right down the line from master tapes through separate mixdown and pressing (and often in the recording, where it all begins). This is a valid idea and can be applied to any quadraphonic production, as opposed to stereo. So we have, logically enough, the separate stereo record which, at least in theory, sounds better as stereo than the quadraphonic disc, even though both will produce stereo on stereo equipment—compatability. That's the argument. And it can get to seem very important to the engineers and producers involved.

Yet, as EMI understands, time is on the side of the quadraphonic engineer. If quadraphony remains viable, then the emphasis is bound to shift. A stereo disc with quadraphonic encoding becomes, slowly but surely, a quadraphonic disc that will play as stereo. Stereo mixdown becomes the secondary factor, as mono once did when stereo took over. Moreover, "compromise" recording techniques, for both types at once, most certainly will develop—EMI has already satisfied itself on this score. So the quadraphonic boys will come back into their own. Seems to me, this is a worthwhile compromise to make, *if it will keep the quadraphonic art alive.*

Single inventory is the way out.
It can be applied to any compatible system.

"If" is the word! Can the four-channel disc, any type, survive at all as things now stand? I am beginning to doubt it. So does EMI.

We have worked ourselves into such an unyielding impasse over quadraphonic that the corporate batteries are running dangerously low. If the big fellows pull out, we are in deathly trouble. There is an explosively exact limit to big-corporation patience in such impasses, as we know all too well. The major record producers are but the slaves of bigger entities whose bosses are not interested in aesthetics that do not pay. The danger limit has now been reached. It *is* an emergency. No question about it. Something has to be done very soon, or else. EMI has done it already.

The proposition is, can we swallow a mild loss of technical flexibility, can we endure a major upheaval in production and distribution, in order to avoid a tragically greater loss—the whole shebang? It has come to that. Not for SQ alone but for all quadraphonic disc production—the whole bit. The EMI single inventory is the way out. It can be applied to any system, to all present systems that are "compatible." It could rescue all of them from collective extinction. It seems to be that the question of single versus dual inventory is now far more vital than the whole time honored argument as to which system is best. *All* systems are threatened! This we have got to understand.

So if quadraphonic's time has come, it must either die or cease being a hepped-up special-order extra at extra cost. At all costs, in order to live, it must somehow blend itself into the great existing body of the art of recording, just as every other technical innovation in records always has. There, it seems to me, is the EMI message. Back to normalcy.

And so we are shaken. One of the Big Companies has moved. If the other world record companies (including our own) will now please get right on this bandwagon, in whatever fashion they may choose (and via their own chosen euphemisms and slogans), if all will universally adopt the basic idea of one classical inventory and no duplication—then, I think, we will have reason to hope that quadraphony on disc will survive and grow. Without disc, you understand, there will be no quadraphonic.

I know—the pop field is bigger. But pop is also more flexible, as well as more demanding, and requires more leeway. If the classical disc is firmly established in the single inventory pattern, one disc per release, whatever type it may be, then pop music and all the rest will find an easy relationship within the same framework. After all, EMI isn't exactly an all-classic company. EMI recorded the Beatles, don't you remember. They still own a few little properties of that sort. They have pop plans too. But first—get classical on the rails. Done.

The beauty of the single classical release is that it takes you off the hook, gives you flexibility. Cheaper, and so much easier to merchandize! Once again you sell records, period. You promote the most important thing you have to sell, the artistic product. Throw in as much or as little quadraphonic as you want, or none at all, without shaking any foundations. And are your dealers happy! Not to mention the customers. The whole systems is fluid again, things move, sales tracks are re-greased, there's confidence (no more of that painful confusion of choice), the aisles are clear (more room), the cash registers noisier. So much simpler, the whole deal. And the pay-off: merely a *workable* compromise in the sound, and not a bad one at all. I'm for it.

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Dear Editor:

One + One = Four

Dear Sir:

We favor the technique described in the article on bi-amplification by Lovda and Muchow in the September issue of *Audio*. We recently designed a 1-kilowatt system for a stadium using bi-amplification and Shure SR105 amplifiers with two low-frequency and six high-frequency horns.

By connecting our speakers individually to the amplifiers, we missed the advantages of the "bridged-pair series connection" scheme that the authors mention will double the power output of each amplifier. With this technique, we could have halved the number of amplifiers and saved our client substantial cost.

We congratulate the authors' honesty in bringing this cost- and energy-saving technique to the public's attention. Unfortunately, the a.c. input power is rated at more than twice the audio output, so this method cannot be used to generate electricity. However, by a slight increase in efficiency, an important solution to the energy crisis would result.

Jon R. Sank
Cross Country Engineering
Haddonfield, N.J.

The authors reply

We believe that Mr. Sank is referring to the comments in the "Summary" and, in particular, to Fig. 8A, the "Typical Biamplified Sound Reinforcement System for High SPL Operation."

The intent of this portion of the article is to illustrate in general terms how to most efficiently utilize the components of a biamplified sound system. In the example described, the four 16-ohm, wide-range loudspeaker systems are two-way systems with biamplification capability. Both the 16-ohm, high-frequency section and the 16-ohm, low-frequency section of each system are made available for external connection. The Shure SR105 amplifiers used in this example, if operated at the mentioned maximum output-voltage capability of 28 volts rms, will deliver approximately 200 watts continuous to a 4-ohm load or 100 watts to an 8-ohm load. In addition, two SR105 amplifiers may be "bridged" to provide approximately 57 V rms output resulting in a total power of 400 watts to an 8-ohm load. The question, then, is what circuit configuration of amplifiers and speakers will most efficiently drive the speakers for highest SPL operation? Analysis reveals that the optimum combination consists of four SR105 amplifiers split into two bridged pairs, with each pair driving two parallel-connected, low-frquency speakers. (Please note that due to a typographical error, the two low frequency speakers are shown series-connected instead of parallel-connected in Fig. 8A.) In this way, each pair of speakers constitutes an 8-ohm load. A bridged amplifier pair will deliver 400 watts to this 8-ohm load, while a single amplifier will deliver 100 watts to this 8-ohm speaker combination.

In the article, we elected not to explain in great detail the subject of amplifier bridging. Rather, it was included to inform readers that his technique was available with amplifiers offering this feature. We certainly hope that this explanation will clear up any confusion that may have resulted.

John M. Lovda
Stephen Muchow
Senior Development Engineers
Shure Bros., Inc.
Evanston, Ill.

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As for the specifications themselves, here are some examples. The Luxman M-4000 power amplifier has less than 0.05% harmonic and intermodulation distortion at any frequency from 20 to 20,000 Hz, even with both channels driven simultaneously to its rated output of 180 watts per channel into 8 ohms. Another M-4000 specification: signal-to-noise ratio beyond 100 dB.

Another example is the C-1000 preamplifier. Its phono-input circuits are virtually overload proof, accepting almost half a volt of audio signal at 1000 Hz. The distortion of its phono-preamplifier circuits is an astonishingly low 0.006%, and the rest of the preamplifier circuits add only 0.001% more.

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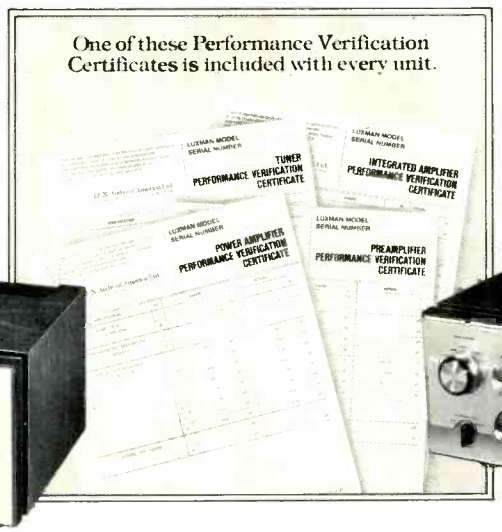

Luxman M-4000 Power Amplifier—180 watts per channel minimum continous power, both channels driven simultaneously into 8 ohms. Total harmonic and intermodulation distortion less than 0.05%. Frequency response: 5-50,000 Hz, ±1 dB. Signal-to-noise ratio: 108 dB. Features include: separate power supplies for each channel, including output and drive stages. Two-meter power-output display in combination with LED peak-output indicators reveal dynamic range of program material. Output level set by precision potentiometer with 1-dB click stops. $1,495.00.

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Miking With The 3-Point System

IN ORDER to understand the advantages of the three point pick-up system, it is necessary to be aware of the distinction between binaural and stereo. A good binaural recording makes a poor stereo recording and vice versa. The fact is that situations in which acceptable stereo recordings can be made with two microphones are severely limited in number.

The seemingly simple case of a solo instrumental performer on stage serves to illustrate this point. A recording made with two cardioid (uni-directional) microphones, when played back over monitoring loudspeakers, will in most cases approach one of two extremes depending on microphone placement: if the microphones were fairly close to the performer, the instrument will seem 10 feet wide; if they were placed farther away, there will be a left and a right but a hollow middle, creating the illusion that the performer is in two places at one time. A proper three point pick-up would produce a recording not only with correct left-right perspective but with depth as well. The performer will be heard occupying the correct amount of space at the correct point on the stage.

The effect becomes easier to understand when one realizes that the success of binaural reproduction is largely dependent on certain psycoacoustic phenomena. Stated simply, the human brain, when isolated from external factors as in binaural reproduction, is amazingly capable of filling in details. Stereo reproduction cannot take advantage of these psycoacoustic effects. It becomes necessary, therefore, to take special steps in the recording process to insure that the sound, when reproduced over monitor loudspeakers, will be an accurate rendition of the performance.

Many amateur recordists will use multiple microphones (more than 3) in an attempt to produce a "professional" recording. While it must be acknowledged that certain situations call for multiple microphone techniques, it must also be pointed out that such situations are rare and that such techniques are quite difficult to master. Phase interference between microphones (resulting in peaks and cancellation of certain frequencies)

EDITOR'S NOTE: *The Nakamichi folks have recently released a small booklet on the three-point recording system, entitled "The Nakamichi Live Recording System," several parts of which are reprinted here. This technique makes use of a third or blend mic in addition to the more usual stereo pair to produce a greater sense of depth or space in the recording. The system also allows a wider latitude in placing the basic mic pair to achieve the correct stereo or left-right image. While the basic technique calls for the use of a recorder with a third or blend mic input, tape decks with only a pair of inputs can be adopted to the technique if a mixer with a blend feature is used. The Nakamichi booklet also gives many valuable tips on relative levels and placement of mics for various instruments. It is available through the firm's dealers.*

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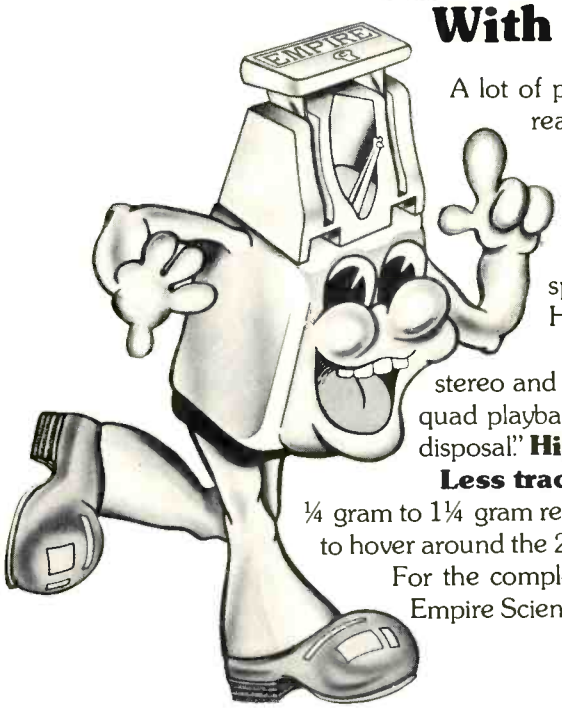

A lot of people have started "trackin'" with Empire cartridges for more or less the same reasons.

More separation: "Separation, measured between right and left channels at a frequency of 1 kHz, did indeed measure 35 dB (rather remarkable for any cartridge)." **FM Guide, The Feldman Lab Report.**

Less distortion: "...the Empire 4000D/III produced the flattest overall response yet measured from a CD-4 cartridge—within ±2 dB from 1,000 to 50,000 Hz." **Stereo Review.**

More versatile: "Not only does the 4000D/III provide excellent sound in both stereo and quadriphonic reproduction, but we had no difficulty whatever getting satisfactory quad playback through *any* demodulator or with *any* turntable of appropriate quality at our disposal." **High Fidelity.**

Less tracking force: "The Empire 4000D/III has a surprisingly low tracking force in the ¼ gram to 1¼ gram region. This is surprising because other cartridges, and I mean 4 channel types, seem to hover around the 2 gram class." **Modern Hi Fi & Stereo Guide.**

For the complete test reviews from these major audio magazines and a free catalogue, write: Empire Scientific Corp., Garden City, N.Y. 11530. Mfd. U.S.A.

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Output Voltage per Channel at 3.54 cm/sec groove velocity:	3.0	3.0	3.0	5.0	5.0	5.0	5.0	5.0
Channel Separation	more than 35dB	more than 35dB	35dB	35dB	35dB	35dB	30dB	30dB
Tracking Force in Grams:	¼ to 1¼	½ to 1½	¾ to 1½	½ to 1½	½ to 1½	¾ to 1½	1 to 3	1 to 3
Stylus Tip:	miniature nude diamond with .1 mil tracing radius ™4 Dimensional	miniature nude diamond with .1 mil tracing radius ™4 Dimensional	miniature nude diamond with .1 mil tracing radius ™4 Dimensional	nude elliptical diamond .2 x .7 mil	nude elliptical diamond .2 x .7 mil	nude elliptical diamond .2 x .7 mil	elliptical diamond .3 x .7 mil	spherical diamond .7 mil
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	 (White)	 (Yellow)	 (Black)	 (Clear)	 (Blue)	 (Green)	 (Red)	 (Smoke)

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becomes more of a problem as the number of pick-ups is increased. Many professional live multi-mike recordings, in fact, suffer from this phenomenon and end up bearing little resemblance to the actual performance. With practice and experimentation the recordist will soon discover that the three point pick-up system is ideal for the large majority of live recording situations.

Microphone Choice

While perhaps it need not be said that a successful live recording invariably depends on the use of high quality microphones, a few general guidelines on the use of uni-directional (cardioid) versus omni-directional (non-directional) microphones in the three point system should be helpful to the amateur recordist. Cardioid is usually the choice for the two stereo microphones. In general, however, unless there is good reason to use cardioid microphones, omni-directional microphones are preferable as they will yield superior results. If wide separation is physically impossible, for example, directional microphones may be desirable to establish stereo left and right. Cardioid microphones will also help to suppress audience noise, very often a problem in live recording.

The blend microphone can be either uni-directional or omni-directional depending on the recording situation. An omni-directional microphone circumvents the proximity effect (boosting of lower frequencies) which one encounters when close-miking with a uni-directional unit. An omni-directional microphone also solves the problem of uneven sound caused by slight movements by an instrumental or vocal performer. It is occasionally necessary to suppress information behind the microphone. In such cases a uni-directional device must be employed. Most high quality uni-directional microphones, fortunately, are equipped with a switchable low-frequency attenuating network to minimize proximity effect. There are a few select cases where proximity effect may actually be desirable. Here again, the uni-directional microphone is the solution (the attenuating network, if provided, should be bypassed, of course). If time permits, it is best to try both types and choose the one that yields the most natural sound.

The advanced recordist will most probably want to experiment with more sophisticated microphones, such as the super-directional (shotgun type) or the super-nondirectional (pinpoint pick-up type) microphone. Super-directional microphones are not only useful for picking up sounds from a distant source but also for stereo pickup in halls or churches with excessive and prolonged reverberation, which tends to make recordings sound muddled and cavernous. Super-nondirectional microphones are highly refined omni-directional microphones. The expert recordist will often use a pinpoint microphone in place of a standard omni-directional unit, even though the former requires much more critical placement. The pinpoint microphone has the advantage of smoother high frequency response (almost no diffraction effects because of reduced pick-up element size) and truer omni-directional response at higher frequencies.

It is usually the case, unfortunately, that monitoring during a live recording session must be performed with headphones. This causes no difficulties for the binaural recordist, but the stereo recordist is confronted with the rather complex problem of creating a tape which will faithfully reproduce the performance over stereo loudspeakers while monitoring on-location with headphones. Clearly there is no substitute for experience in this matter. The seasoned recordist is able to extrapolate the binaural information and thereby position the microphones and set levels to produce a perfect stereo recording.

It should be pointed out, nevertheless, that choice of headphones can have a profound effect on the end result. Certain headphones are not suited to the purpose of on-location stereo monitoring because of their physical and/or acoustical characteristics. Open-air type headphone provides no isolation from external sound making it relatively difficult to monitor live recordings unless the recordist situates himself in a rather soundproof room. Generally poor results in terms of balance can be expected when one monitors with headphones which have boosted low and high frequency responses (in other words a suppressed midrange). It is much more preferable to use headphones which have slightly attenuated responses at the lower and higher ends of the audio spectrum.

Finding the optimum positions and setting the levels for proper balance among the microphones are the most important and the most difficult tasks in live recording. There are numerous factors to be taken into account. Type of instrument, type of ensemble, type of microphone, and acoustical characteristics of the room or hall (which are affected by factors such as size, shape, material, size of audience, etc.) are but a few of the details which must be considered in positioning the microphones. Once the microphones are optimally located, the levels must be set so as to achieve the most natural balance between the stereo and blend microphones. It would be impossible to postulate exact microphone locations and level settings for any given recording situation. If it were possible to do so, live recording would not be quite so enjoyable. There is regrettably little time, however, for one to experiment with microphone placement and level setting at an actual performance. The successful live recordist, therefore, relies heavily on experience gained from past recordings and on knowledge gained from those sessions in which there was ample time to experiment.

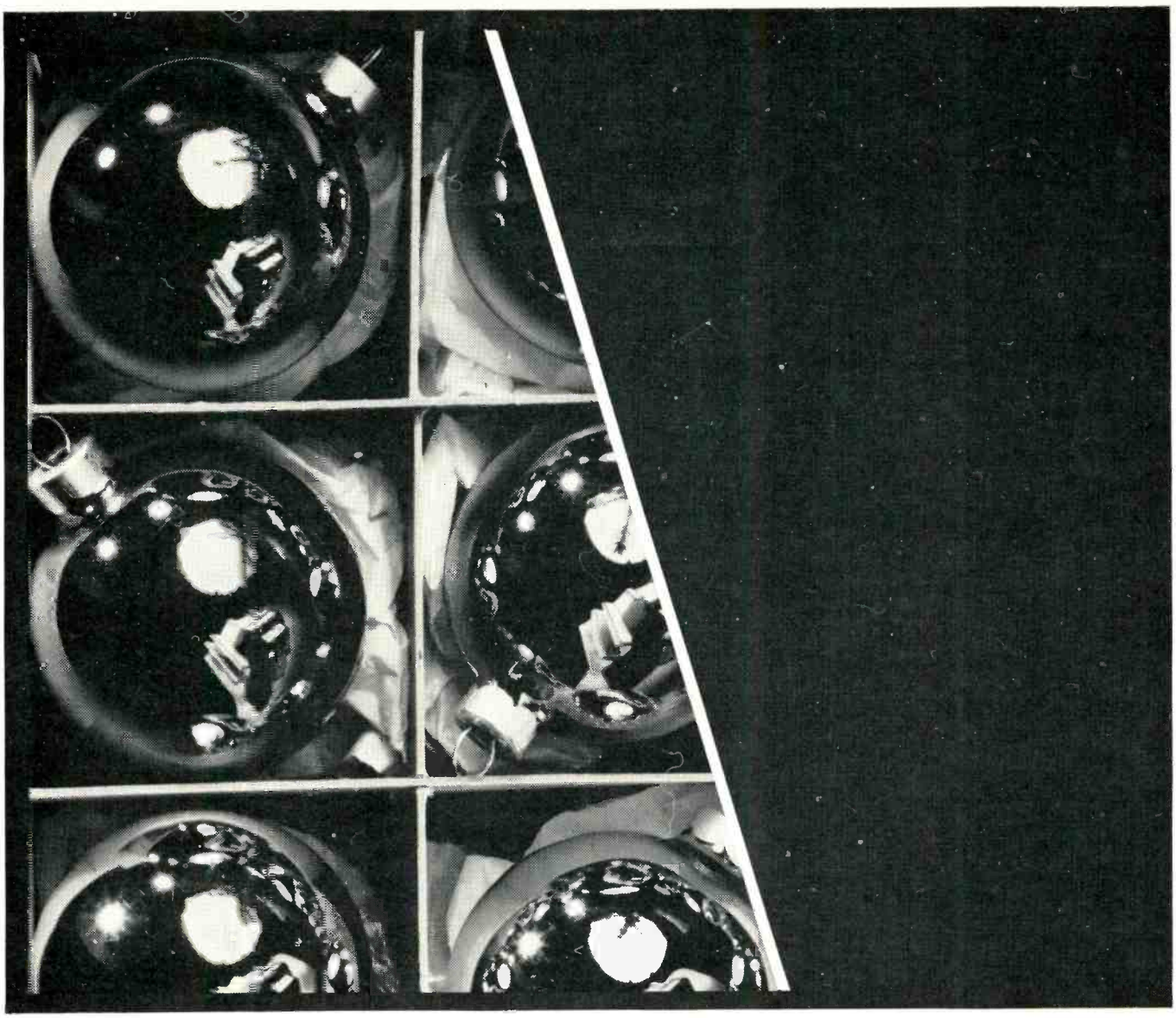
The following examples of specific recording situations are intended as a guide. Combined with the availability and proper use of top-performing equipment and some time to experiment with the variables, these diagrams and suggestions should enable the serious amateur to produce highly successful live recordings.

Piano Solo

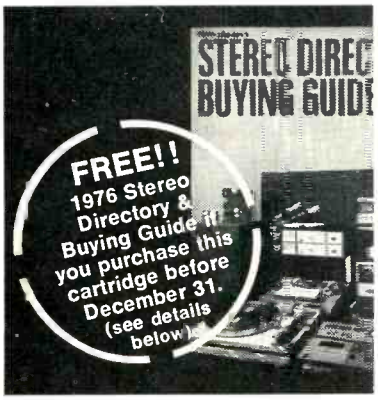
In recording a solo performance the blend microphone is used to pick up the primary sounds emanating from the instrument while the stereo microphones are used to pick up the piano's natural ambience and room reverberations.

Blend mic: Place the microphone to pick up direct sounds from the piano as shown in the diagram. This microphone must be placed rather close in order to capture the percussive qualities which lend clarity to the piano. If the microphone is placed too close to the strings, however, single notes will stand out and the resulting recording will sound uneven. Correct placement can actually depend on the composition being performed! If the piece limits playing to the lower half of the keyboard, for example, the microphone should be placed farther away from the keyboard than usual.

Stereo mics: Placement of these microphones depends largely on room acoustics. As a general rule of thumb, they should be at least 6 ft. high and 3 ft. apart. The axis formed by the two microphones, however, should always



A cartridge in a pear tree.



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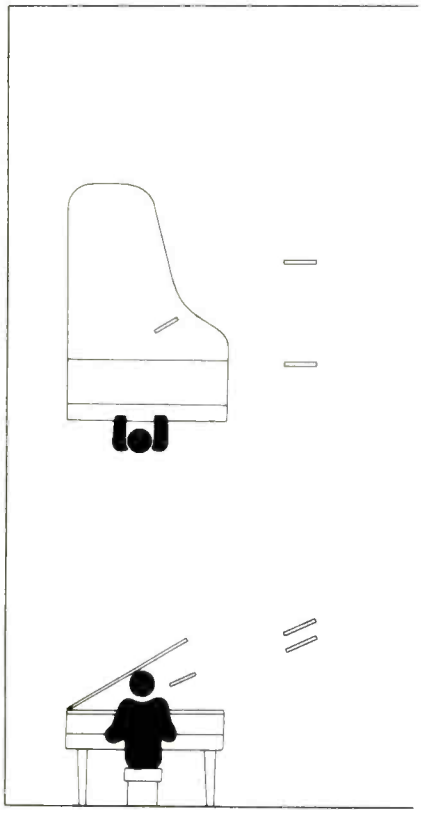
be parallel to the strings (perpendicular to the keyboard). To give an example of how room acoustics affect placement, it can be stated that a large hall would call for the stereo mi-



crophones being positioned farther away and more toward the keyboard than they would be for a smaller hall or room.

Levels: The blend microphone is the main source. The stereo microphones, therefore, should not be allowed to overpower the blend mic.

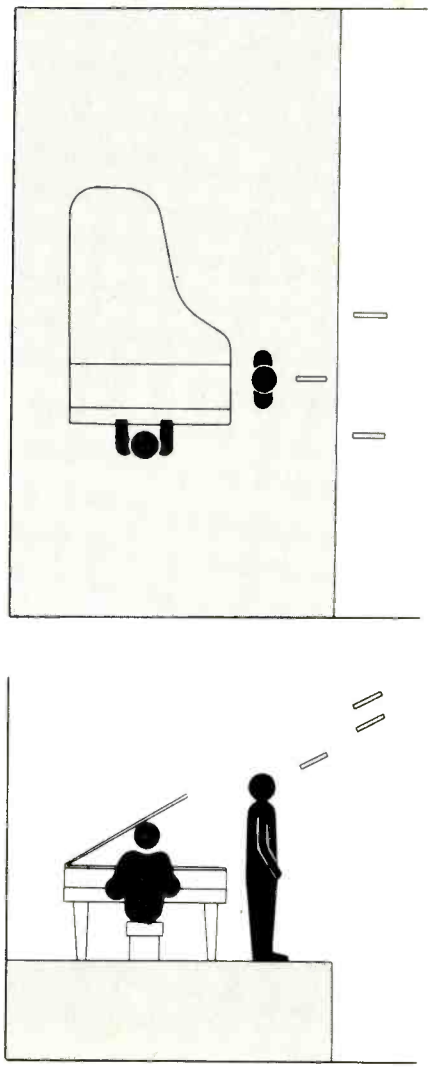
Vocals with Piano Accompaniment

The main source is the vocalist and the blend mic is once again the primary pick-up.

Blend mic: Place the mic at a level just above the vocalist's head. Be careful not to place it too close. It is highly recommended that a windscreen be used to minimize pops and blasts. A dynamic microphone is generally preferable to a condenser type for vocal recording.

Stereo mics: These must be positioned to pick up the piano accompaniment in addition to the reverberant sounds. Placement will once again largely depend on the room or hall acoustics.

Levels: The balance between the vocals and the accompaniment can be controlled quite well by adjusting the level of the blend mic with respect to

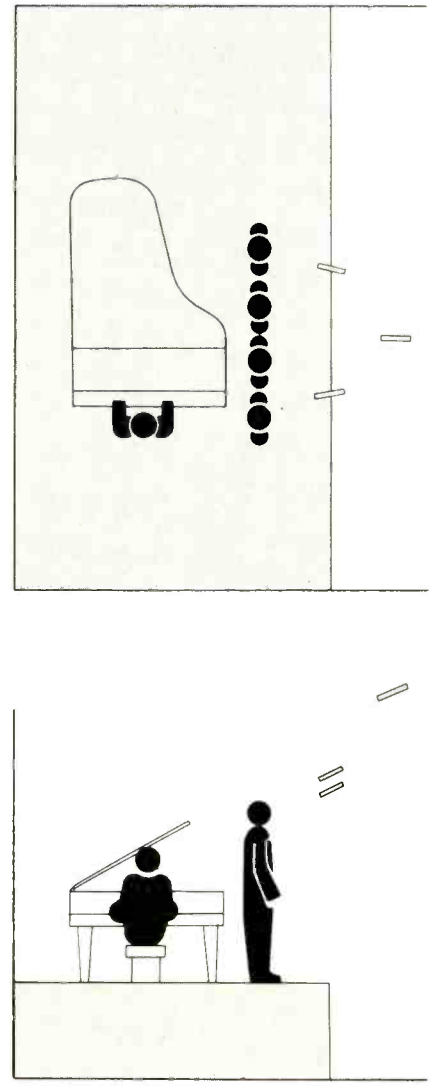


the stereo mics. The level of the accompaniment should generally be between 45-50 percent of the vocal level. If the blend mic is too high, the recording will sound monaural and balance will suffer. If the stereo mics are too high, the result will be a muddy sound, lacking localization of the vocalist.

Vocal Quartet With Piano Accompaniment

In the examples given earlier the blend microphone performed the primary function of picking up the direct sounds from the solo instrument or vocalist. In the following example, the stereo microphones must take over this function since the main source, the vocal quartet, is spread out and requires increased coverage.

Blend mic: This must not be set too close to the singers. Place the mic at least 2 ft. higher and 3 ft. farther away from the soloists than the stereo mics. Exact placement will, of course, depend on the room or hall. Be careful not to place this mic too far from the stage as it must pick up the piano accompaniment.



Stereo mics: Use the guidelines given for the blend mic in the example of the vocal solo with piano accompaniment.

Levels: Since the stereo mics are the primary pick-ups, levels must be set so that the blend mic does not overpower the direct sounds from the vocalists.

String Quartet

Recording a string quartet calls for microphone placement quite different from that of the preceding example. There are several reasons for this. There is, firstly, no piano accompaniment; secondly, balance among the instruments is more likely to be a problem than in the case of the vocal quartet. There is, thirdly, the added

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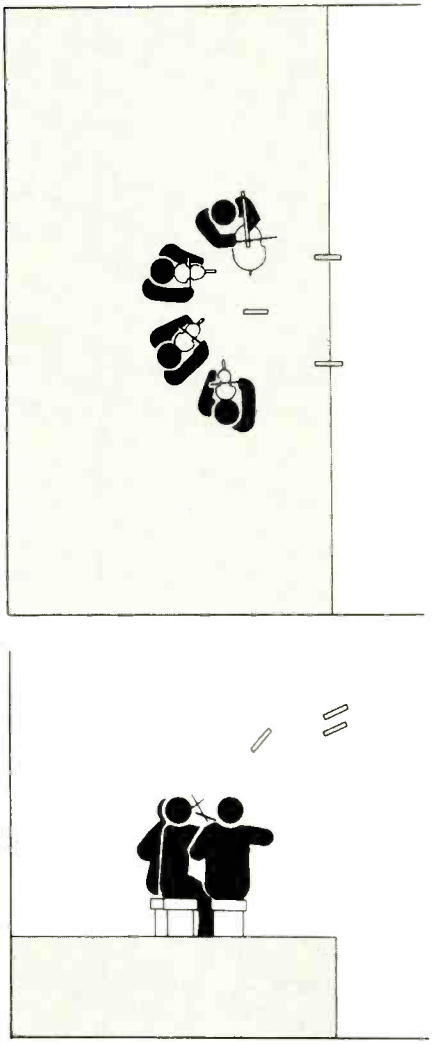
requirement of picking up instrumental ambience as well as the room or hall ambience.

Blend mic: Start with this mic in a central position with respect to the four instruments. If a problem with balance exists, the mic should be placed toward the weaker instrument. The mic should be placed high enough to clear the heads of the players. If the mic is placed too low, the music stands will interfere with pick-up of direct sounds from the instruments.



Stereo mics: Place these microphones according to the room or hall acoustics. They will generally be placed higher than the blend mic and at least 3 ft. from the frontmost players.

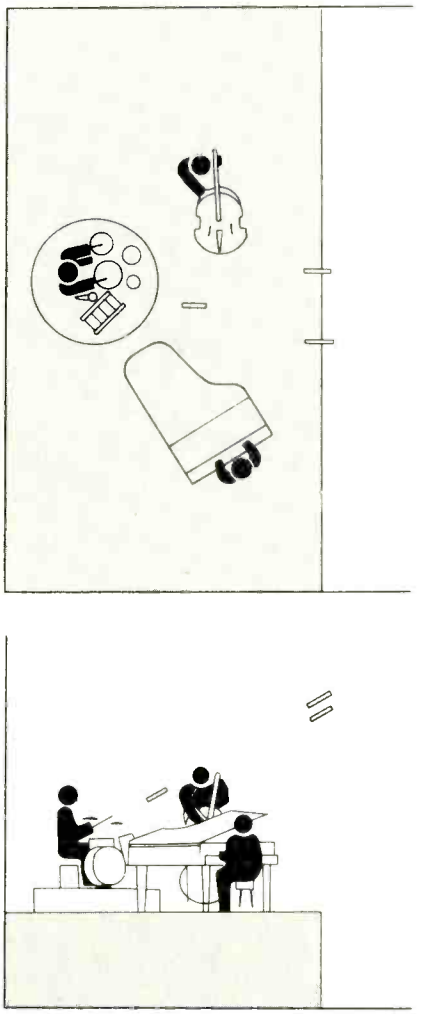
Levels: Although the blend mic is picking up the direct sounds from the instruments, care must be taken to avoid setting this mic too high in level as the resulting sound will be overly monophonic. Start with roughly equal levels for both the blend and stereo mics.

Jazz Trio

Many of the basic principles underlying the previous example apply to this case as well.

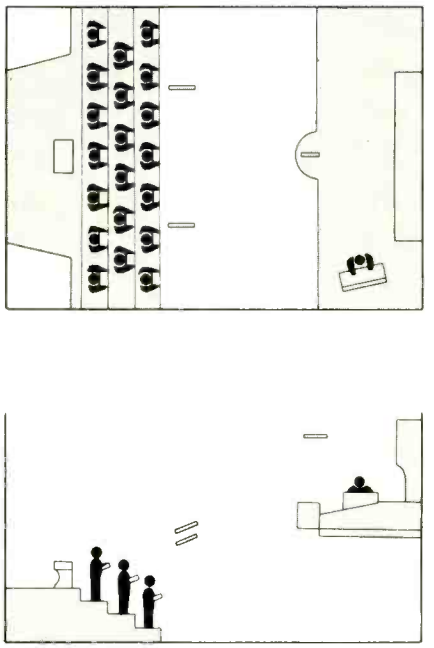
Blend mic: This mic should initially be set in a central position (usually near the drums) and then repositioned, if necessary, to achieve proper balance. It should be placed high enough to clear the cymbals of the drum set.

Stereo mics: The spacing and distance from the ensemble of these mics will of course depend on room acoustics, but the spacing between the instruments will also be a factor. If the piano and bass, for example, are set very far apart, the stereo mics will have to be separated a little wider, placed a bit lower and closer to the ensemble than if the group were compact. Care should be taken, though, to avoid placing them so close that the recording loses "liveness" or the sense that the trio is performing in a room or hall.



Levels: Follow the guidelines given in the previous example.

Church Choir with Organ



Because of the highly reverberant acoustical nature of most churches, critical microphone placement becomes particularly difficult.

Blend mic: Use this mic to pick up direct sounds from the organ. Distance from the pipes, height, and lateral position will depend on the characteristics of the church and the organ. Under most circumstances, an omni-directional microphone would be preferable.

Stereo mics: Place these mics in front of and above the choir. Experiment carefully with placement to achieve a full, rich sound with the right amount of reverberance. The mics must be close enough to capture the diction and far enough to avoid highlighting individual singers.

Levels: Balance between the organ and the choir can be easily achieved by the proper setting of levels.

Church Organ Solo

Most church altars are constructed in such a way that they make ideal pick-up points for reverberant sound.

Blend mic: Place this mic facing the altar. Experiment with height and distance to obtain a broad reverberant sound free from harshness caused by local resonances.

Stereo mics: Position these mics to pick up direct sounds from the organ pipes. They must be close enough to capture all the overtones which give

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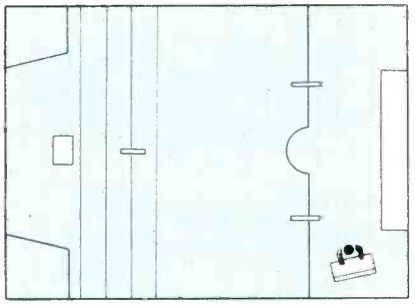
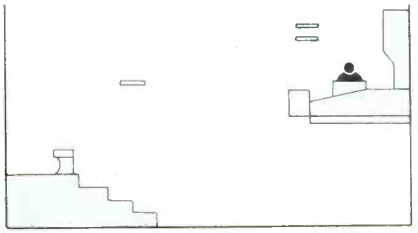
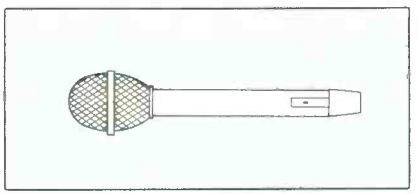
the various stops their particular sound qualities.

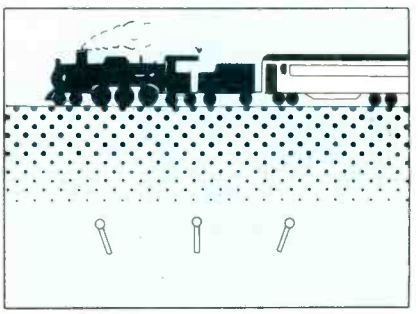


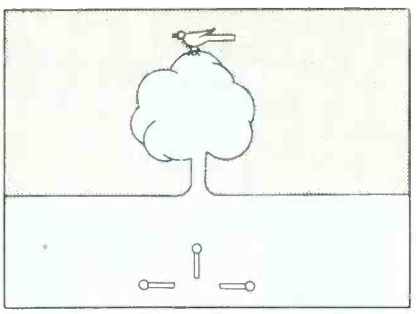
Levels: Relative levels will vary greatly according to the acoustical properties of the church and organ. Keep in mind that the stereo mics are the primary pick-ups.



Outdoor Recording





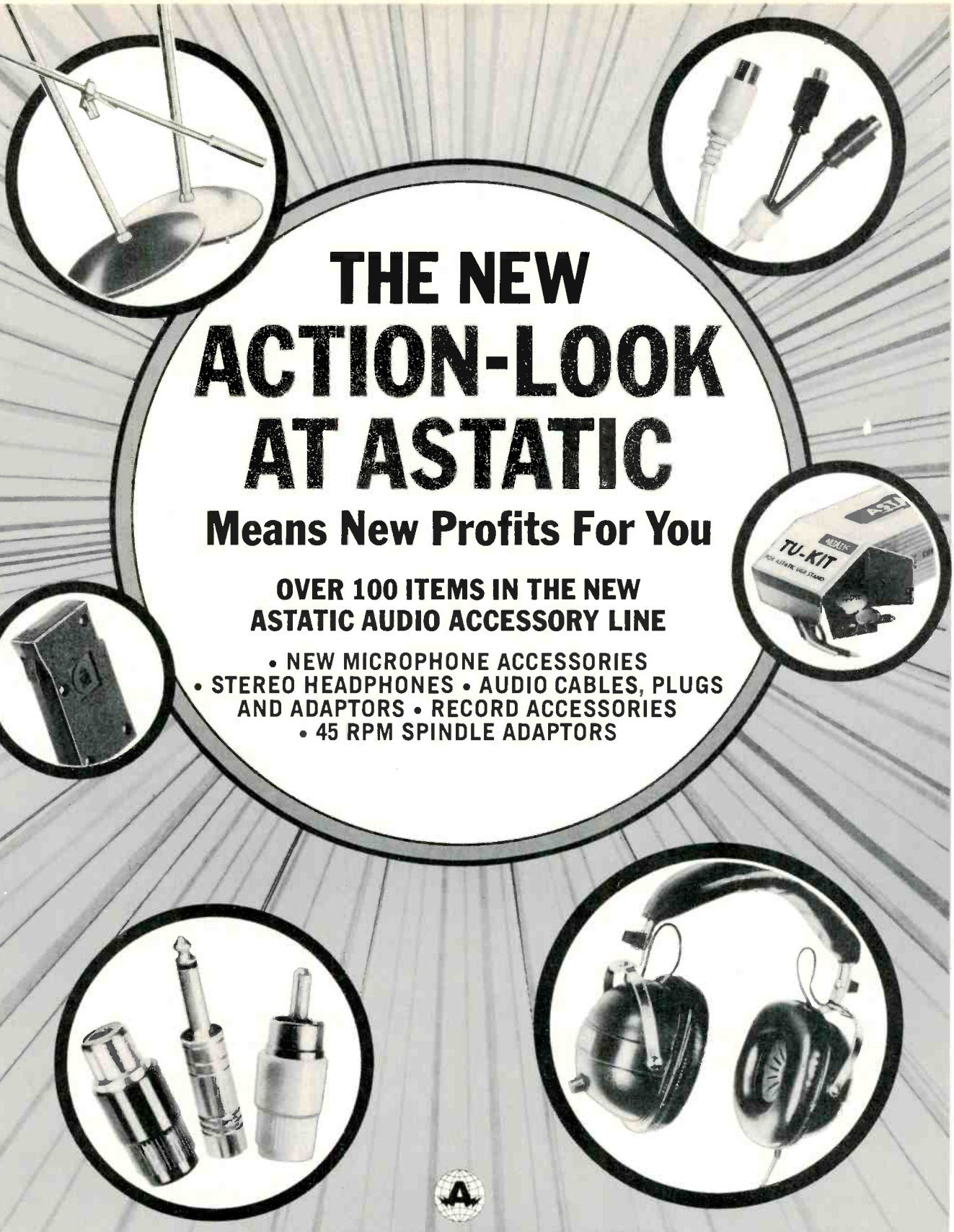


Windscreens are a must for outdoor recording. In some cases the standard windscreen supplied with the microphone may be inadequate. If so, take the thick part of a nylon stocking and wrap it tightly around the standard windscreen.

Moving sound sources: Place the left, blend, and right microphones in line along the axis of motion. Spacing of the mics will depend on the speed of the source. The faster the source, the farther apart the microphones should be. When recording a fast moving steam locomotive, for example, if the mics are placed too close together, there will be very little stereo effect.

Static sound sources: Place the three microphones in a horizontal plane fairly close to each other at 90 degree angles to each other. When recording sounds, such as bird or insect noises, which tend to come from all directions, three cardioid microphones placed in this manner will yield a very natural stereo effect.

Levels: In each case above, set levels to obtain the most realistic balance and separation.



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Language of High Fidelity

Part XIII

Martin Clifford

EVERY ELECTRONIC SIGNAL from whatever source ultimately appears at the signal input of the *main* or *power amplifier*. The FM signal has shucked off the cocoon supplied by the radio-frequency carrier wave; the phono signal becomes the electronic equivalent of the twists and gyrations of the stylus in the record grooves; the tape signal has emerged from the magnetic whirls that produced it. Thus, at the input to the main amplifier, all of these signals resemble each other closely, and you can select any one of them for processing by the main amp.

Up to this point, we have been interested only in the voltage amplitude of the signal, and we've talked in terms of signal voltage, not signal current or power. It is true that the main amp will provide some further voltage amplification, but that is incidental to its main job. What we need is electrical *power* for our speakers. In this sense, we may regard the amp as an appliance—a device for turning electrical power into some other kind of energy—just as a toaster, broiler, or a steam iron is an appliance which converts electrical energy into heat.

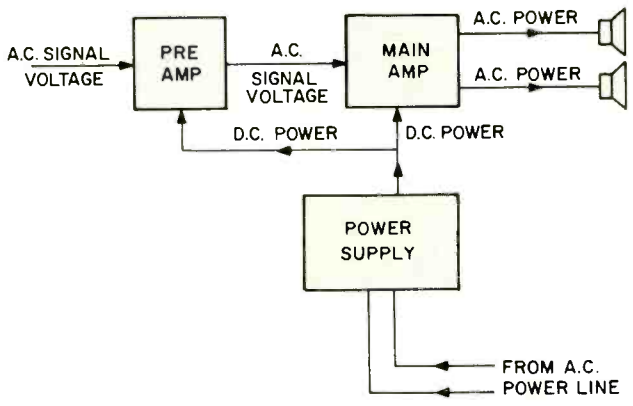

Fig. 1—The power delivered to the speakers by the power amplifier comes from the power supply, but is controlled by the signal voltage.

Although the terms "power amp" and "main amp" are often used interchangeably, "power amp" unfortunately suggests that it somehow manages to *amplify* power; this is wrong. This amplifier takes electrical energy out of the household electrical outlet and delivers it to one's loudspeakers. However, it doesn't do this directly—changes must first be made in the frequency and amplitude of the electrical power. These changes will be dictated by the audio signal input to the main amp.

Whence the Power

While the signal at the input to the power amp is a complex a.c. waveform, it is just a voltage and can exist at the amp's input without any sound coming out of the speakers. This is comparable to the case in your home in which an a.c. voltage is present at every power outlet along the baseboard, yet whether power is used or not is your decision. The moment you decide to use it (by plugging in an appliance), we are no longer dealing just with voltage (which is *pressure*), but with voltage and *current* (electrons flowing). Taken together, these two constitute power.

The power amp does not generate power—it is simply a device for controlling the power made available to it by its power supply (usually on the same chassis). (See Fig. 1.) And that power supply gets *its* power from your a.c. power line outlet. This may seem like a Rube Goldberg way of doing things, but it's the only way we have. The ideal method

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The electromagnetic structure of the cartridge is exceptionally efficient and has been arranged in such a way that the point of transduction is placed as close as possible to the record surface. This enables the distance from the stylus tip to the energized armature to be kept extremely short, thereby minimizing the chances of the motion being significantly changed, and/or extraneous resonances introduced. It further enables the moving element to be kept exceedingly light and rigid. Indeed, we believe the total moving structure to be lighter than that of any other magnetic cartridge of which we are aware.

Great care has been taken with the cartridge geometry, not only to minimize vertical tracking error but also to ensure accurate transmission of the stylus motion to the generating armature. This has been achieved by (among other things) positioning the stylus tip on the same axis as the armature so that none of the stylus motion is lost in rotation or affected by any possible rotational resonances.

The stylus pivot is located at the dynamic center of rotation of the moving system and is fabricated from material having optimum elastomeric properties, providing an extremely linear and highly compliant suspension.

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would be to eliminate the amplifier by connecting the signal voltage to the a.c. power line, and connect the result to the speakers. Instead we must take from the a.c. line the a.c. power, which consists of a sine wave voltage and a sine wave current, and convert it to d.c. This is the function of the amplifier's power supply.

The power amp, then, is a component which receives d.c. power from its power supply section and reconverts it to a.c., which varies in frequency and amplitude according to the input signal (program material). The power line supplies current which is a sine wave, usually 60 Hz in frequency. The audio power coming out of the amplifier varies from about 30 to 20,000 Hz (depending on the amp design), and its amplitude is continuously changing. This current, flowing through the voice coil of the speaker, accomplishes work. It's forced into the voice coil by voltage. Together the two may be measured to compute the amount of power the speaker uses.

Function of the Audio Signal

One way to describe the relationship between the audio input signal voltage and the amplifier is to say that the amp is a faucet and the input signal voltage is the valve in that faucet. While the amplifier directs the current to its appointed location, the input signal controls how much of that signal will reach the locations. The current flowing through the speaker voice coil should also have the same waveshape as the controlling signal. If it's exactly the same (it can never be a perfect copy—that would mean zero distortion!), the amp has done its job perfectly. If it changes very little, it's done a good job. If the output power has things in it that weren't in the input signal, or if it changes their relative amplitude, we have distortion.

Power Amp and Power Supply

Since the power amp gets its power from the power supply, it should be obvious that it cannot deliver more power than it receives from the house current a.c. line. The function of the power supply is quite simple—to rectify the power line a.c. current and deliver d.c. to the power amp. It may help if you consider the power supply as a d.c. power reservoir. The power supply consists of three important parts: a transformer, a rectifier, and the filters. The transformer changes the house current at 115 volts to whatever the amp requires (in tube days it was 300 to 500 volts; generally today it's between 30 and 80 volts). In addition the transformer isolates the amplifier from the power line. If it did not, we'd have the good possibility of lethal shock, which is present in most small TV sets and many other appliances connected *directly* to the power line (they all have insulated cabinets to protect the user). The rectifier converts the a.c. into pulsating d.c. And the filters, consisting mostly of large capacitors, smoothes the pulsating d.c. supplied by the rectifier into nearly perfectly smooth d.c. In the days of tube equipment, power-supply capacitors ranged up to 500 microfarads (μF). But today, with much lower working voltages, the size of many capacitors is in the 10,000 μF range and up.

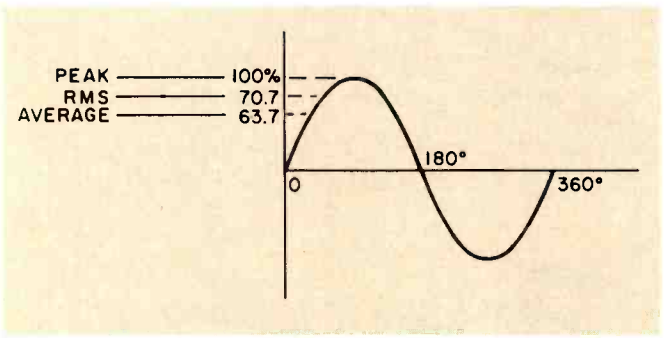

Fig. 2—Peak, rms, and average amplitude points on a sine wave of voltage or current.

Describing Power

Measuring d.c. power is easy. Nor is it all that difficult to measure sinewave a.c. power. But it becomes troublesome when we are talking about complex wave signal currents and signal voltages—that is, signal power. For d.c., we just multiply voltage and current to get power in watts. For example, two amperes of current at 30 volts equals 60 watts power. Simple. For sine wave a.c. (if the voltage and current are in phase), the same simple multiplication process is used: Voltage (E) times current (I) equals watts power (W). The formula is written IxE=W. However, because we use a.c. power in many ways, we make several different measurements of a.c. waves, as may be seen in Fig. 2.

There are three main points at which a sine wave is usually measured. One is at the top, called the *peak* (though it could as well be the bottom). Another is the *rms* value, which is equal to 70.7% of the peak value. This is also called the effective value. Finally we come to the average, which is equal to 60.3% of the peak value. Note that the sine wave values we're discussing here may be either voltage or current but not power.

Remember that except for test purposes, the wave shapes a speaker receives are very rarely simple sine waves. Instead they're complex shapes produced by voices and instruments. Further, the speaker doesn't use just need voltage, or just current, but both, which is power. Now, while many measuring instruments are calibrated in rms units (voltmeters and ammeters), a wattmeter measures average watts. That's because the product of rms volts and rms amperes (voltage and current) is *not* rms watts, as you might imagine, but average watts. Thus, when you read a spec sheet saying so many watts rms, think average watts instead. While rms watts is thus a misnomer, you might also hear rms power sometimes also called continuous power because this is the amount of power the amp can handle for an indefinite period of time without interruption.

Power amps are able to deliver more than their average (so-called rms) power for short periods of time, depending on the demands of the program material. If there is a pianissimo passage followed by a sudden clash of cymbals, the demand for additional power is comparable to momentarily turning on the air conditioner in your room—either the power company delivers or you will remain just as warm as you were. Ditto with the power amp. It will deliver more than the average power, but how much more depends on the size of the filter capacitor reservoir and the current-passing ability of the rectifiers (and the transformer) in the power supply. This emergency power is variously called *maximum* power, *dynamic* output, or *music* power. Music power is the maximum power available for a very short period from the main amp and used to be seen fairly widely on spec sheets and in catalogs until late 1974 when the Federal Trade Commission (FTC) power-rating rule went into effect. Music power described the amp's ability to handle brief power peaks as compared to sustained power levels. Thus, an amplifier capable of delivering 50 watts of power continuously might also be capable of delivering 80 watts for a short period of time. It was this 80 watts which would have been the amp's music power rating. With the FTC amplifier power-rating rule in effect now, only one kind of power rating, continuous, will be used for good high fidelity equipment. All other ratings are now obsolete.

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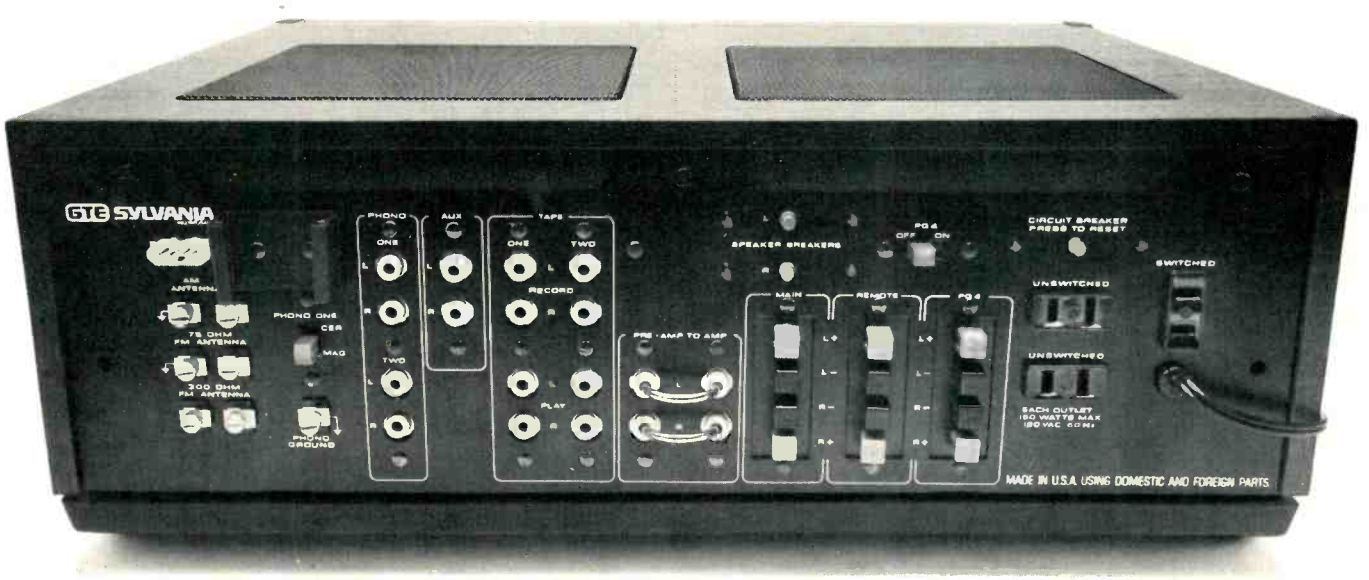

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But don't take our word for it. Or their word for it. Go see the RS 4744 for yourself.

Back or front, any way you look at it, the RS 4744 is one fine stereo receiver.

*Popular Electronics, December 1974 Issue.

GTE SYLVANIA

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Power Output vs. Frequency

Ideally, for a fixed amplitude input signal, a power amp should be able to deliver the same amount of output power over a wide frequency range, extending from subaudible to superaudible, say 20 Hz to 20,000 Hz. Maximum available power output can vary within these limits, sometimes dropping off substantially at the ends of the spectrum or having various peaks in between. At the ends, the power may even decrease by 50 percent or more. In fact, the frequencies at which available power is 3-dB down (which happens to be 50 percent) at each end of the audio spectrum were called the half-power points, and they were used to define the useful power bandwidth of an amplifier previous to the FTC ruling. Under the new ruling, however, the full power of the amplifier must be available at all frequencies mentioned, with no decrease allowed at the ends of the frequency spectrum.

Power Handling Capability

Speakers, as well as power amps, may be treated in terms of their power-handling capabilities, just as electric light bulbs are marked 10, 60, or 75 watts. We cannot draw further parallels between speakers, amps, and light bulbs, however, because the marking on a light bulb means that it always dissipates just that number of watts, not less, not more (provided it's being fed the nominal 115 V a.c.). However, if a speaker is rated at, say, 60 watts, that means it can handle power up to (but not exceeding) that level. It doesn't *demand* (as does the light bulb) that much power when it's hooked up to the amplifier. If we try to run more power through the speaker (by feeding it signals of higher voltage pressure), thus resulting in too much power being dissipated in its voice coil, one of three undesirable things is likely to transpire. Either the voice coil will move too far out of its magnetic gap and stick, never to return, the voice coil may just burn out, or the speaker will just make horribly distorted sounds.

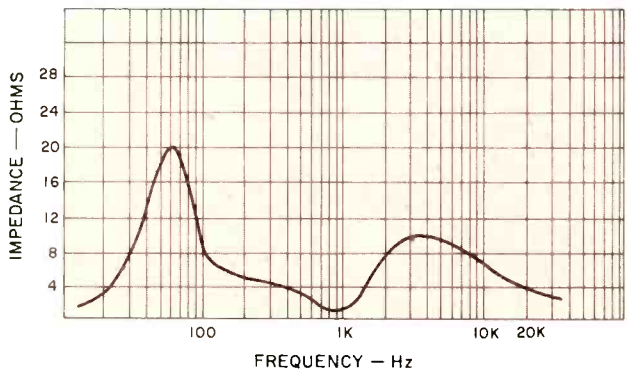


Fig. 3—Impedance versus frequency response for a speaker.

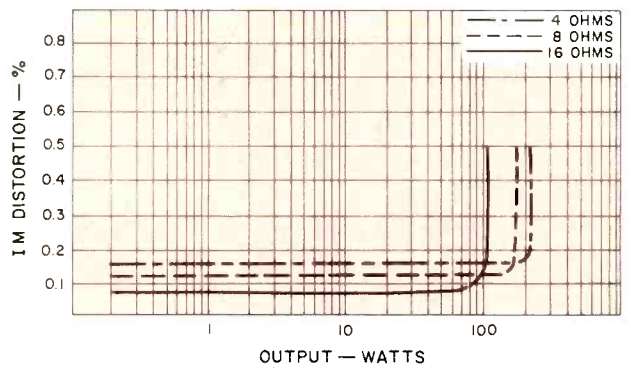


Fig. 4—Intermodulation distortion versus power output for three impedances.

Impedance Matching

A high quality power amp will deliver its rated power provided the load (the speaker) is designed to accept this amount of power. One of the problems here is that the impedance of the speaker is not a fixed value. It varies from its *nominal* value all over the lot, changing as it goes up and down the audio spectrum; at 70, 80, or 100 Hz the impedance may be five times higher than nominal, and it may also measure 40 ohms or more at the high end of the frequency range. This may sound discouraging, and it is, because the result of the peak is a droop in power transfer. If the peak occurs at the low frequency end, there is a reduction in the transfer of power from the amplifier by the speaker, just where we need extra power for those deep bass notes. There is an even bigger problem with impedance dips which, if deep enough, will give the amplifier fits.

Figure 3 is an impedance curve for a hypothetical loudspeaker. At about 100 Hertz this unit does indeed have an impedance of 8 ohms. However, the curve shows that the impedance of this speaker wanders all over the place, with a peak somewhere around 60 Hertz. This peak decreases the amount of current delivered to the speaker at that frequency, resulting in lowered acoustic output. Fortunately, the peak in the curve at that point is due to speaker resonance. Now, a speaker is more efficient around its resonant frequency than anywhere else on its curve. Thus, even though less current is delivered to the unit at resonance, the bass loss there isn't as severe as it might otherwise be, due to its increased mechanical efficiency at that point.

Note also the severe dip in the mid-range region around 1 kHz. The low impedance at that frequency can put excessive current drain on the amplifier, possibly causing the amp's protective relay or fuse to open. Whether this happens or not will depend on the setting of the preamp's gain control as well as the signal level fed into the preamp.

Damping Factor

Many speaker terminals are labelled 4-8 ohms so you might think that this represents the impedance of the amplifier. Not so at all! This is simply a direction to the installer, "Attach the two speaker wires here." There is actually a tremendous mismatch, since the internal impedance of the amp may be measured in tenths of an ohm. The ratio of the impedance of the amplifier to the speaker's voice coil impedance is called the *damping factor,* which describes the amp's ability to control or minimize unwanted, residual speaker movements such as hangover and ringing. If a speaker has an impedance of 4 ohms and the amplifier has an internal impedance of 0.04 ohms, the damping factor would be 100.

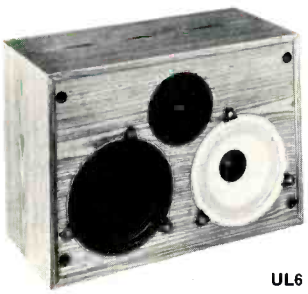
Total Harmonic Distortion (THD)

The amplifier must not only deliver power to the speakers, but should do so with the least possible distortion. To indicate that an amp has a certain amount of THD at a particular frequency is analogous to saying that an auto gets 18 miles per gallon when moving along at 10 MPH. But what about 40 MPH, or more relevantly, 60 MPH? An amp that is listed as having less than 1 percent THD at 1 kHz could easily have several percentage points of THD elsewhere in the sound spectrum. With amps it is best to know the maximum THD over the entire frequency range at maximum power. Then you can be certain that at most frequencies and power

Celestion

loudspeaker specialists since 1924

New Celestion UL6. Compact enclosure provides 35 Hz-29 kHz overall response; ÷3.5 db 80 Hz-20 kHz. Power handling 20 watts continuous RMS sine wave. Can be used with amplifiers up to 80 watts RMS per channel.



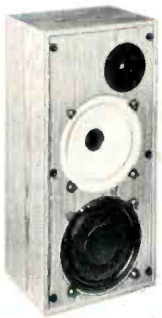
UL6

New Celestion Ditton 33. Overall response 40 Hz-28 kHz; +3 db 60 Hz-20 kHz. Power handling 33 watts DIN continuous.

DITTON 33

New Celestion UL8. Overall response 30 Hz-28 kHz; ÷3 db 70 Hz-20 kHz. Power handling 25 watts continuous RMS sine wave. Can be used with amplifiers up to 100 watts RMS per channel.

UL8

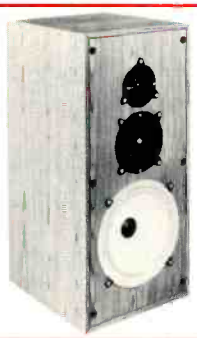


Ditton 44 Monitor. Power handling 44 watts DIN continuous. "It could take 100 watts (at 300 Hz on a steady-state basis) to produce an output of 106 db, and a power pulse of 486.5 watts (973 watts peak) to yield an output of 116 db. These figures attest to both the Ditton's robustness and to its excellent dynamic range . . . " —High Fidelity, June 1973.

DITTON 44

New Celestion UL10. Overall response 20 Hz-40 kHz; +2 db 40 Hz-20 kHz. Power handling 50 watts continuous RMS sine wave. Can be used with amplifiers up to 200 watts RMS per channel.

UL10



Ditton 66 Studio Monitor is top of Celestion Ditton Series and has received rave reviews worldwide. Appointed "Reference Standard" by "Revue du Son" of France. Features 16 Hz-40 kHz overall response, ultra-low distortion, high efficiency. Power handling 80 watts DIN continuous.

DITTON 66

Also available: Ditton 15 "Bookshelf Classic"
Ditton 25 floor standing luxury loudspeaker

The following quality drivers, used in the 8 models listed above, were totally researched, designed, and built by Celestion—Britain's most experienced loudspeaker manufacturer.

HF2000	¾" pressure-dome supertweeter specified for B.B.C. monitors.
HD1000	New 1" pressure-dome tweeter ensures extended treble response, excellent dispersion and complete freedom from listener fatigue.
HD700	New 2" pressure-dome midrange unit.
MD500	2" soft-dome midrange unit covers 500 Hz-5kHz with very low distortion, exceptional dispersion. Extremely powerful magnetic field ensures critical damping and high power handling.
MC5	New 5" midrange unit with low mass fibrous cone for outstanding transient response.
MC6	6" plasticized midrange unit in damped hermetically sealed transmission line.
BASS UNITS	UL bass units have 1.5" voicecoil, massive magnet system and specially treated Bextrene diaphragm. Ditton bass units have specially plasticized fibrous cone to prevent resonances; neoprene roll front suspension permits long linear axial movement for low distortion bass reproduction.
ABR's	Auxiliary bass radiators ensure excellent bass response, raise sensitivity, and reduce distortion to negligible limits.

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levels there will be less distortion than maximum—a reassuring feeling.

Distortion is also related to the power output in watts (Fig. 4). Maximum distortion appears at the maximum power output of the amplifier, where waveform clipping begins to take place as the distortion rises sharply. Figure 5 shows percentages of total harmonic distortion for 4- and 8-ohm arrangements working single channel and dual channel.

THD is a main limiting factor in power amp ratings. If there were no specified THD, then power output would become a "numbers game" and have no real meaning. The power specification of amplifiers, then, must list, in addition to THD, the sine wave continuous or average power output, in watts per channel, for each load impedance, with all channels driven, and with the power bandwidth in Hertz.

Frequency Response

At one time the frequency response of an amp was a sacred cow, and for good reason. The amp, in in those olden days, was about as guilty as the phono cartridge (or other signal source) or the speaker in contributing to degradation of sound. But not any more, so far as amps are concerned, since the frequency response of a quality amplifier can range from a low of 7 Hertz or so to a high of 80 or more kHz with a variation of +0, -1 dB, usually measured at a 1-watt level. Now that is a mighty flat response. When plotted on a graph, it looks as though it was drawn with a straightedge. But before you clap your hands with joy, consider that the load (the speaker) has a response curve quite different—more like a mountain range.

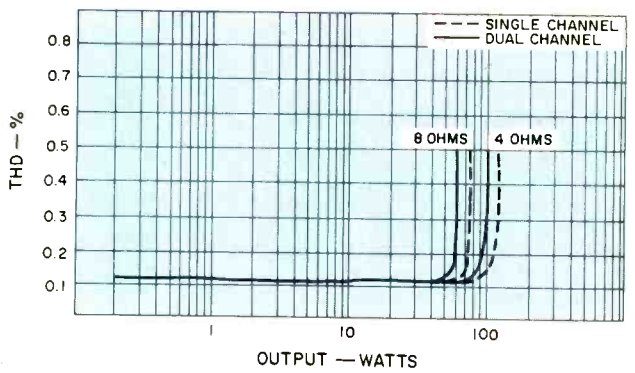

Fig. 5—Total harmonic distortion versus power output for two impedances, showing effect of single- versus dual-channel operation on power output.

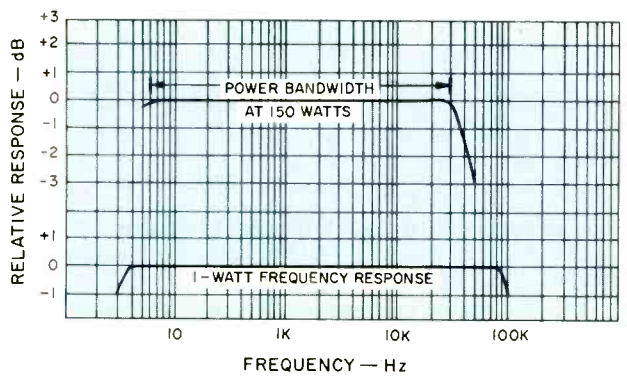

Fig. 6—One-watt frequency response and bandwidth at full power for a 150-watt amplifier.

And if you are going to use low and high filters and tone controls before the signal reaches the main amp, getting terribly perturbed about a 1-dB variation in an amp's frequency response is fretting unnecessarily. This doesn't mean you shouldn't pay attention to frequency response. You should, for having an amp with a flat frequency response eliminates an undesired variable from at least one component. But it does *not* mean you are automatically guaranteed an equally automatically faithful sound output. High fidelity is more than a goal; it is a proper perspective. (See Fig. 6).

Two-Channel Amplifiers

Stereo amps are two-channel devices, that is, two amplifiers built on one chassis, with the power supply for both also on that chassis. In the past specification sheets often indicated the total wattage of both channels when specifying power output. Usually, too, there is less power available when both channels are driven simultaneously, than if one channel is operated alone. The new FTC power statement ruling requires that they be stated *per channel* and with both channels driven at once.

Amplifier Protection Circuits

At one time speakers were isolated from the output stages of the main amp by transformers. These devices transferred the audio current to speaker voice coil while they blocked d.c. current (coming from the power supply). The main amp needs d.c. for its transistor elements and gets this from the power supply. What the speaker voice coil requires, however, is an alternating current whose waveform resembles that of the voltage signal input to the main amp. But while transformers perform the separation function admirably, they are frequency-sensitive devices and so pass some frequencies on easily to the loudspeaker while impeding others.

A direct-coupled stage, now used in most modern amps, is one in which the output stage is directly coupled to the speakers. A problem arising from this practice is that failure of an output transistor may produce a heavy flow of current though the speaker's voice coil, damaging or destroying it. Another possible cause of trouble can be damage to the transistor amplifier tutput stage caused by a short circuit across the speaker leads.

To prevent these problems, amps now have a variety of protection circuits which shut down the power amp at the first sign of trouble. These can be simple thermal fuses or complex circuits which detect any severe drop in output load impedance, especially a short circuit. Some power amplifiers use protective relays which can open the connection between the amp and the speakers, a somewhat more expensive arrangement than a simple fuse. Silicon controlled rectifiers (SCRs), which are faster and thus protect more quickly, are also used to protect the output stage. Still other and even more sophisticated circuits sense the levels of voltage and/or amperage and can shut down the amplifier very quickly should an excessive level of either occur.

Yet another form of protection exists in the speaker relay found in most amplifiers and receivers nowdays. You've probably noticed the few second delay between the time the unit is turned on and when sound begins to be produced by the speakers; this is the action of the relay, which prevents transient current peaks which occur at turn-on from reaching and possibly damaging the speakers.

Speakers and power amplifiers are hi fi's electronically married couple. They not only work together closely, but the actions of one affects the other. It is this relationship we will explore in the next installment.

Introducing one of the finest collections of stereo receivers in the world: the MX 1580.

Power* of the Sony 7065. FM Sensitivity* of the Pioneer 838. Selectivity* of the Sherwood 7900A. Capture ratio* of the Marantz 2270. Total Harmonic Distortion* of the JVC VR-5660.

With so many excellent AM/FM stereo receivers around these days, who needs another? So instead of making just "another" we collected the most significant specs and useful features of five of the best, and "combined" them in one: the MX 1580.

Of course, some of these five receivers have features our one doesn't have (we think you can manage without *two* phono inputs).

But then, ours has features they don't have; features you *shouldn't* do without.

You pay for—and get—what you really need.

The MX 1580 has exclusive ASNC, which automatically reduces the noise level on weak stereo stations without reducing separation on strong ones.

And special thermal protection for output transistors and the power transformer.

Plus lots more we were able to include and, at $479.95,** save you a few bucks in the bargain.

How? It wasn't easy. But we had help.

The oldest new company in the business.

Although we're a completely separate group, we were able to draw on the resources of a company that's been a leader in the industry since 1915. So we could afford to wait until we had the MX 1580 right.

And now it's so right, we insist that every single one be inspected twice before it's shipped. After all, we have one of the world's finest stereo collections to protect.

Features and Specs:

- Sensitive front-end with three dual gate MOSFET's and 4-gang tuning capacitor.
- Two 6-pole linear phase filters for improved selectivity and phase response
- High gain IC quadrature FM detector.
- Switchable signal-strength/center-tuned meter.
- Phase lock loop IC circuit for FM stereo multiplex.
- Computer designed low pass audio filters for suppression of ultrasonic frequencies.
- OCL direct-coupled differential amplifier for extended frequency response and wide bandwidth

Power . . . . . 60 watts per channel, min. RMS

Power Bandwidth 20Hz-20kHz

Total Harmonic Distortion 0.5%

Load . . . . . 8 ohms

IM distortion 0.8%
Frequency response . . 20Hz-25kHz
Usable sensitivity (IHF) 1.8uV
Selectivity (IHF) 75dB
Capture ratio (IHF) 1.5dB
50dB signal to noise mono . . 2.5uV
Stereo separation @ 1kHz . . . 50dB
@ 10kHz . . 40dB

All specs subject to change without notice.
Specs of competitive receivers taken from manufacturers own published data sheets.
**Manufacturer's suggested retail price; optional with dealer.

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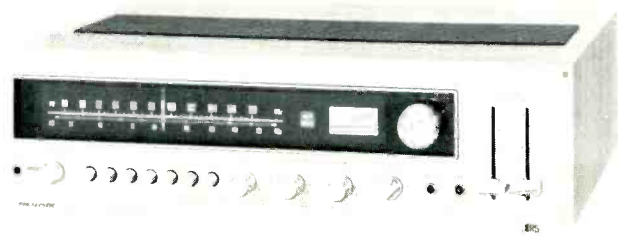
Equipment Profiles

Realistic (Radio Shack) Model STA-225
AM/FM Stereo Receiver



MANUFACTURER'S SPECIFICATIONS
FM Section
IHF Sensitivity: 1.9 μV. **S/N Ratio:** 65 dB. **Capture Ratio:** 1.2 dB. **THD:** Mono, 0.6%; Stereo, 0.8%. **Image Rejection:** 70 dB.
AM Section
Sensitivity: 250 μV/M, internal antenna. **Image Rejection:** 55 dB.
Amplifier Section
Power Output: 50 watts per channel into 8 ohms from 20 Hz to 20 kHz (continuous); THD over entire power band, no more than 1.0%. **IM Distortion:** Less than 0.6%. **S/N:** Phono, 60 dB; Aux, 70 dB.
General Specifications
Dimensions: 19-1/8 in. W x 5-3/4 in. H x 15 in. D. **Price:** $399.95.

There is a good deal to commend in this Realistic stereo receiver distributed by Radio Shack stores, but at the same time we surely would like to have seen Radio Shack give more than a minimum number of specifications. After all, not every prospective buyer gets a chance to read an equipment profile in *Audio* to find out what phono cartridge output matches up best or what the input sensitivities of the *AUX* and *Tape Inputs* are. With too many other firms, such a scarcity of specs suggest poor performance, yet in this case Radio Shack is hiding its light under a bushel since the parameters we measured turned out too good to hide.

The STA-225's front panel has the now-familiar long, black-out dial area, which occupies all but a couple of inches of the panel. When illuminated, the dial area displays a linear FM frequency scale, a 0-100 logging or reference scale, and an AM frequency scale. To the right is a single signal-strength meter, adjacent to which are the illuminated words "Auto Magic" about which we will speak shortly. A good sized tuning knob is located within the blacked-out dial area as well. Two slide controls at the extreme right operate vertically to control volume level for each channel, thereby eliminating the need for a separate balance control. If input program sources are balanced, the two sliders can be operated in unison with a single finger—a nice touch that works as well in practice as in theory.

Below the dial scale area are a phone jack (at the extreme left), seven small push-buttons; dual-concentric clutch-type bass, mid-range, and treble controls; a program selector switch; a dubbing-out jack, and a tape input jack (these are in addition to the usual tape monitoring in and out jacks on the rear panel). A speaker selector switch also turns on power, selects main or remote speakers, or chooses Radio Shack's "Quatravox" passive decoder circuit which synthesizes a four-channel effect from two-channel sources and is not unlike the Dynaco matrix introduced during the earliest days of four-channel excitement.

Those seven push buttons mentioned above take care of such things as switching on the Auto-Magic feature, introducing low and high filter circuits (at a 6 dB/octave slope rate), activating the tape monitor circuitry associated with the rear panel tape jacks (to gain access to the *Tape 2* front-panel jack, the main program selector must be switched to the *Tape 2* position), loudness circuit activation, mono stereo switching, and tone control bypass or defeat.

The rear panel of the STA-225 has screw-terminals for connection of two pairs of speakers, with pin-jacks paralleling the "main" speaker terminals in case your speaker systems come equipped with cables and built-in phono

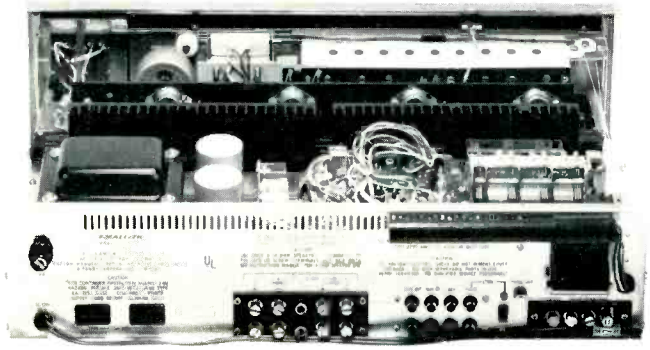


Fig. 1—Rear panel.

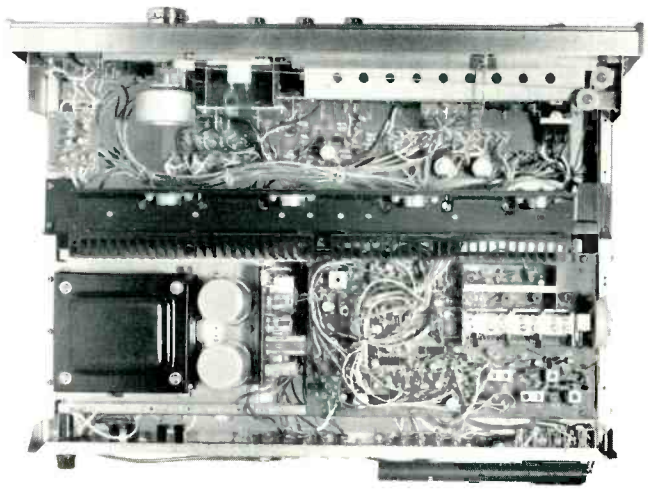


Fig. 2—Interior view.

plugs. Antenna screw terminals are provided for 75-ohm, 300-ohm, and external AM antenna connections, and would you believe that this $400.00 receiver has one of those "capacitor clips" that couples the line cord to one of the 300-ohm terminals to serve as an indoor FM antenna? Since this rather minimal antenna arrangement does a poor job of rejecting multipath, we disconnected the clip for our tests and connected an outdoor FM antenna. Tape out and in jacks, AUX inputs, and phono input jacks are arranged between the speaker terminals and the antenna connections, and a switch near the phono jacks selects high and low input sensitivity. The rear panel also has a pair of a.c. convenience outlets, a line fuse, and a pivotable ferrite bar AM antenna. The rear panel is shown in the photo of Fig. 1.

Circuit Features

The chassis layout and circuitry of the STA-225 is shown in Fig. 2. All tuner parts, including the AM and FM stereo decoder sections, are contained on a single large PC board. The other three major PC modules contain the preamplifiers, the tone control circuitry, and the main power amplifier circuits. The FM front-end is equipped with a four-gang tuning capacitor, an FET r.f. amplifier, and bi-polar oscillator and mixer stages. FM i.f. circuitry includes four IC stages (each tuned to 10.7 MHz with a ceramic filter between stages), a bi-polar input stage, and a conventional ratio detector. Multiplex decoding is accomplished by a single IC which utilizes the well accepted phase-lock loop approach to stereo demodulation. Several additional stages

From Microvolts To Femtowatts

Len Feldman

AS MANY of our readers may already know, new standards for measurement of FM tuners and receivers were recently approved by the three major electronic organizations in this country, The Institute of High Fidelity, The Electronic Industry Association, and the Institute of Electrical and Electronic Engineers. Many new measurements of FM products are now called for in the new standard, including a host of previously omitted performance specifications having to do with stereo FM performance.(We will publish a definitive article on the new standards in the near future; meanwhile, those interested in the new standard can obtain a copy by sending $6.00 to the Institute of High Fidelity, 489 Fifth Avenue, New York, N.Y. 10017 and requesting a copy of Standard IHF-T-200, 1975.)

One important change in terminology needs a bit of explaining right now, since our test reports dealing with FM products already reflect the use of this term—the dBf. dBf stands for "dB referred to 1 Femtowatt" and, for the uninitiated, a Femtowatt is 1×10^{-15} watts—a very small power figure indeed. The new standards require that signal strengths, formerly given in microvolts, now be given in terms of power—or actually in dB referred to 1 Femtowatt. The purpose of this change is to avoid certain ambiguities which were possible so long as the "microvolt" was used. It is the power of an incoming radio signal that really counts, and power involves a voltage developed across a known impedance. Clearly, 2 microvolts across 75 ohms represents exactly twice as much power as 2 microvolts across a 300-ohm impedance ($P = E^2/Z$). A manufacturer who chooses to measure his microvolts by feeding them into the 75-ohm antenna terminals of his FM product will therefore come up looking twice as good (or having half as much signal requirement) as a competitor in terms of such specifications as usable sensitivity (IHF sensitivity), 50-dB quieting signal, stereo threshold signal strength, etc.

By converting to statements of power rather than voltage, such ambiguities are eliminated, since power is power no matter what the impedance involved. The new dBf system will take some getting used to, and in fact, in our test reports of FM product performance we plan to give both μV numbers as the reference, and the resulting dBf numbers that correspond when the most popularly used 300-ohm antenna terminals are used.

To determine the dBf value for microvolt readings not listed (assuming a 300-ohm impedance and the old IHF "terminated" microvolts), the following formula should prove useful:

$$dBf = 20 \log_{10} \frac{\mu V}{0.55}$$

in which μV equals the number of "terminated microvolts" you wish to translate to dBf.

Table I: MicroVolts versus dB re 1 Femtowatt.

"Familiar" Microvolt Readings (across 300 ohms)	Equivalent dBf
1.6	9.28
1.7	9.80
1.8	10.30
1.9	10.77
2.0	11.21
2.1	11.64
2.2	12.04
2.5	13.15
2.7	13.82
3.0	14.74
5.0	19.17
7.0	22.09
10.0	25.19
100.0	45.19
500.0	59.17
1000.0	65.19
10,000	85.19
100,000	105.19

are employed in connection with the aforementioned Auto-Magic feature of this tuner section. When the user touches the tuning knob, an a.f.c. circuit is defeated, enabling you to accurately tune in desired FM stations (by ear, since the tuning meter acts only as a signal-strength meter). Releasing the tuning knob turns on the a.f.c., which then "pulls in" to center of channel, according to the instruction booklet. While we generally do not favor a.f.c. circuits, we must comment that during our distortion measurements, we weren't able to improve upon the "lock in" of this circuitry, which did home in on the minimum distortion point of received (or generated) signals. We found, too, that unlike less sophisticated a.f.c. circuits, the presence of this circuit did not prevent us from tuning to weak stations which were fairly close to strong ones. Obviously, not *all* a.f.c. circuits are alike, and the one in the STA-225 is worth having.

Preamplifier-equalizer circuitry uses discrete devices (two per channel), and the tone controls are of the conventional feedback type. We were delighted to note that each of the slide-volume controls contains two potentiometers—one just ahead of the tone control-circuitry, the other at the input to the power amplifier section. This arrangement makes for best signal-to-noise at any listening level. The main power amplifier circuits feature direct coupling from input to output, a differential input stage, and complementary symmetry output stages. Also included is automatic circuit protection/amplifier shut-down circuitry which will trip if the amplifier is overdriven into too low a speaker impedance.

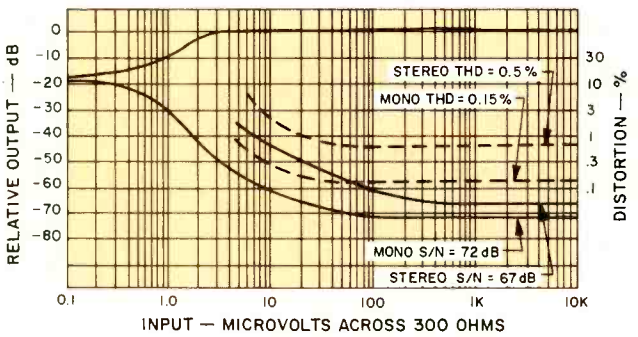


Fig. 3—FM quieting and distortion characteristics.

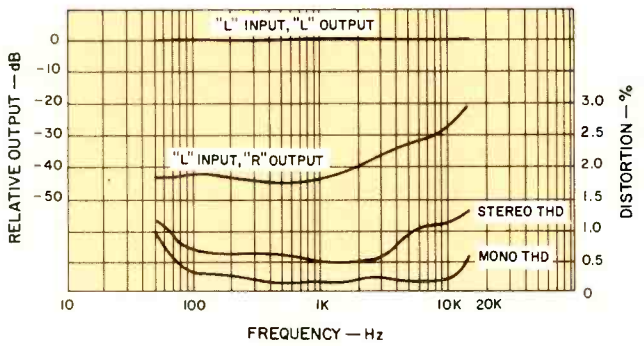


Fig. 4—Separation and distortion versus frequency.

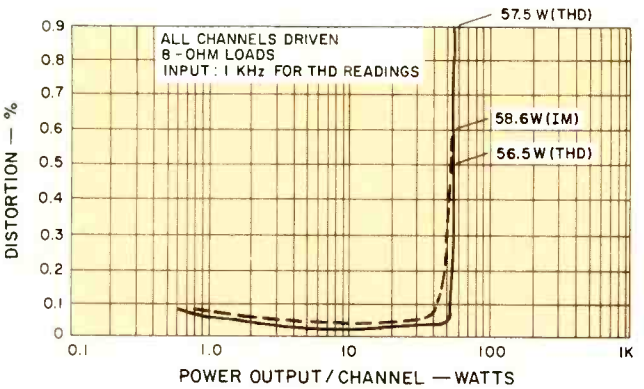


Fig. 5—Harmonic and intermodulation distortion versus power output.

Tuner Measurements

Major tuner performance curves are shown in Fig. 3. IHF sensitivity in mono measured 2.6 μV (equivalent to 13.7 dBf), while in stereo, usable sensitivity measured 6.0 μV, or 20.9 dBf. The 50 dB quieting peak in mono was attained with a signal input of 3.0 μV (14.93 dBf), while in stereo the same level of quieting was reached with a signal strength of 24 μV (33 dBf). Ultimate S/N in mono was 72 dB, while in stereo, maximum quieting measured 67 dB. Mono THD measured a low 0.15%, but was 0.5% in stereo for the same 1 kHz audio signal at full modulation. Capture ratio measured 1.5 dB, while selectivity (alternate channel) was 70 dB as claimed. Image rejection was 73 dB, a bit better than claimed. Muting threshold (which is not adjustable by the user) was a bit higher than we deemed necessary, allowing signals to break through at levels of 10 μV (25.4 dBf). Stereo switching occurs at signal inputs of 6.0 μV (20.9 dBf) or higher—a well chosen threshold that corresponds exactly to the signal strength required to obtain usable stereo sensitivity.

As shown in the graph of Fig. 4, stereo separation was in excess of 40 dB from 50 Hz to 2 kHz, decreasing to 28 dB at 10 kHz. Distortion at frequencies other than mid-band are also shown in this graph.

Amplifier Measurements

At mid-frequencies, the STA-225 delivered 57.3 watts for its rated harmonic distortion of 1.0%. At rated output (50 watts per channel), a 1 kHz output signal contained only 0.147% THD and IM measured 0.33% for this same output level. The rated 0.6% IM was reached at a power output level of 58.6 watts. At all lower output levels, THD and IM were both well below the 0.1% mark, as shown in the curves of Fig. 5.

Distortion was well within FTC limits over the entire frequency band, measuring 0.3% at 20 Hz and 0.63 at 20 kHz. In order to meet claims, the unit could have had as much as

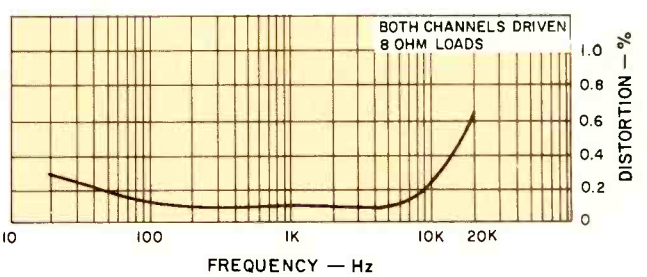


Fig. 6—THD versus frequency.

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Our two-way speaker systems ADS L400, L500 and L700 were developed right along with our more expensive studio speakers for the best possible reason: we wanted to create a coherent line of loudspeakers where every model, regardless of price, would have to reproduce musical sound with an optimum of clarity and a total absense of coloration.

When our engineers finally were able to meet these criteria, we called this remarkably open quality the 'Invisible Sound' of ADS. Since its introduction only two years ago, it has become the standard of excellence for many professionals and dedicated audiophiles.

Our lowest priced speaker, the ADS L400, costs less than $100. Yet it shares with all other ADS systems the 'Invisible Sound' and the technical refinements that make this faithful response to the input signal possible. For instance, we install only one type of soft-dome tweeter, a masterpiece in sophisticated audio design. Also, all ADS speakers utilize similar small-diameter woofers and the same computer-grade materials for the crossover networks. The craftsmanship and materials that go into every cabinet are of uniform, high quality.

When you listen to one of our two-way speakers for the first time, please note how the virtually massless tweeter meticulously renders every treble detail. Discover how smoothly the woofers take over the midrange frequencies, feel the strength and precision of their compliance to a sudden bass signal.

As a total value, we believe the ADS L400, L500, and L700 are without competition in their respective categories. Your local ADS dealer will proudly prove this claim in his sound studio. Take the time to test our speakers critically. Take the step beyond transparency. Experience 'Invisible Sound.' It will then be impossible for you to accept anything less.

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1.0% THD at either of those two frequency extremes, and is therefore conservatively rated by any standards as far as audio power output is concerned. A plot of distortion versus frequency for full rated (50 watt) output is shown in Fig. 6.

Phono input sensitivity measured 1.5 mV in the "high sensitivity" position of the phono rear panel switch and 2.5 mV in the "low" setting. Overload of phono inputs took place with signal inputs of 180 mV or 90 mV, again depending upon the setting of the phono sensitivity switch. Hum and noise was generally much better than claimed, measuring 67 dB for phono (referred to the 2.5 millivolt input sensitivity and full output) and 76 dB in the high-level AUX setting. Input sensitivity for the AUX input measured 200 mV for full rated output. At minimum volume control settings, residual hum measured 102 dB below full output. Overall frequency response of the amplifier section was flat within 1 dB from 20 Hz to 20,000 Hz.

Having recently acquired a spectrum analyzer in our laboratory, we decided to display tone control characteristics "live" instead of plotting them on graph paper. The photo of Fig. 7 is a composite, taken by producing sequential frequency sweeps from 20 Hz to 20,000 Hz. Each sweep is retained on a storage oscilloscope so that by successively boosting and cutting the bass, treble, and mid-range controls on the Realistic STA-225, we were able to assemble this composite display and record it photographically. Beats pushing a pencil on graph paper anytime, and it's far more accurate since every point is shown, instead of the relatively few points we usually take to plot a "continuous" pencil curve.

Inspired by the results (you may expect to see much more sophisticated applications of spectrum analysis in future test reports, including analysis of the spectral content of harmonic distortion), we decided to "plot" the action of the loudness circuit on our rather expensive version of an "etch-a-sketch" toy and the results, for reader's amazement and amusement, are shown in the 'scope photo of Fig. 8. As you can see, the loudness circuit is continuously variable, but what isn't readily apparent is that the circuit is tied in through the volume controls—an interesting arrangement.

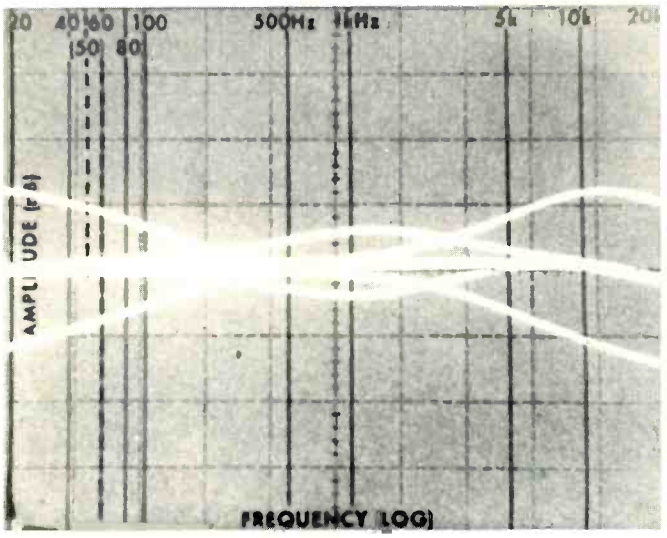

Fig. 7—Bass, midrange, and treble control range shown on spectrum analyzer sweep display. (Scale: 10 dB per vertical division.)

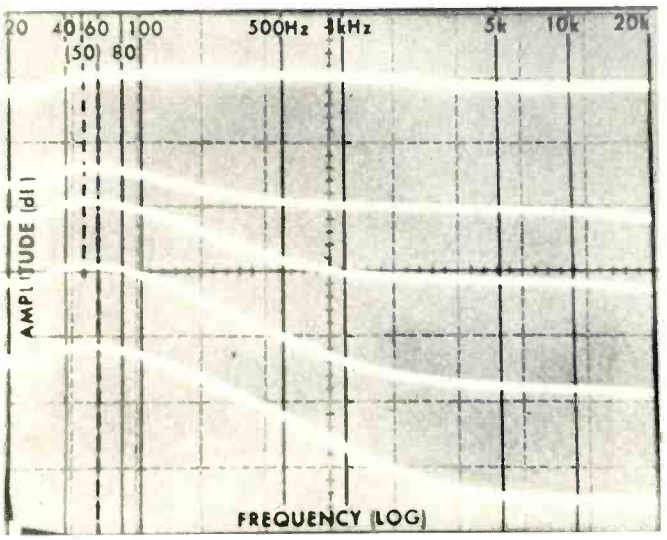

Fig. 8—Action of loudness control shown on spectrum analyzer sweep display. (Scale: 10 dB per vertical division.)

Listening and Use Tests

Getting back to the STA-225, we hooked it up to a pair of low-efficiency, air-suspension speakers and put it through its paces. FM performance was quite good and, if you were wondering about the absence of a stereo indicator light, rest assured it was not forgotten. The dial pointer itself changes color (it glows a bright red) whenever a stereo signal is intercepted on the FM dial. Controls are easy to use and good to the touch, particularly those dual slide volume controls. The mid-range tone control is a useful feature usually found only on separate preamps and amps or much more expensive receivers. Sometimes called a "presence" control (because it can be used to enhance vocalist's sounds and to "bring the vocalist forward" in the stereo sound field), its range in the STA-225 is just right for its intended purpose—about +5 or +6 dB at maximum rotation.

After satisfying ourselves that the STA-225 performed well with our test speakers and a variety of program sources, we attached two more speakers and switched to the Quatravox mode. Depending upon the recordings used, synthesized four-channel effects ranged from barely audible to highly pronounced. Certainly, this circuit isn't intended to substitute for true four-channel but it is of some interest, especially if you own a large record collection and have some discs with sufficient out-of-phase "ambience" information to show off the passive circuit to its best advantage.

In summary, the Realistic STA-225 offers a great deal of value for its modest (these days) price of under $400.00. Power output is solid all the way down to the nether-bass regions, and there was no evidence of excessive heat at the output stages even after several hours of use at loud volume levels. Perhaps Radio Shack is right in promoting the receiver for the more casual user by omitting some important specs and treating the connection panel in a "compact system" way, but we think the audio enthusiast seeking 50 watts per channel has graduated from that level and expects a more audiophilic approach to product presentation. When it comes right down to it, the STA-225 is just too good for anything less than an enthusiastic treatment from its makers and distributors. *Leonard Feldman*

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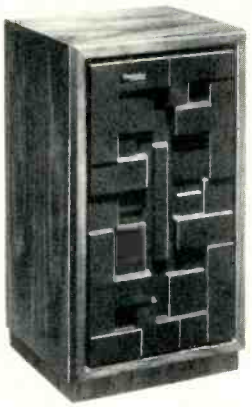
Technics T-400 Speaker System



MANUFACTURER'S SPECIFICATIONS

Frequency Response: 38 to 20,000 Hz ± 3 dB, down 10 dB at 28 Hz, free field. **Dispersion:** 180° at 10 kHz. **Impedance:** 8 ohms. **Drivers:** 12-in. woofer, 5-in. midrange, 3 ½-in. tweeter, two angled 2-in. super tweeters. **Crossover Frequencies:** 700 Hz, 3 kHz, and 7.5 kHz. **Enclosure:** Oiled walnut finish, fully sealed. **Dimensions:** 27 in. H x 15 in. W x 13 ¼ in. D. **Shipping Weight:** 53 lbs. **Price:** $279.95.

Technics by Panasonic is not new in high-quality consumer audio. One of the better loudspeaker systems made under this trademark is the Model T-400, a four-way, five-driver system intended for floor mounting. The enclosure measures 68.6 cm. H x 38.1 cm. W x 33.7 cm. D. (27 in x 15 in. x 13 ¼ in) and weighs 24 kg. (53 lbs.). The sides and top are finished in oiled walnut, and a colorful sculptured foam and cloth grille accents the darker wood tones. Since the T-400 is generally intended for mounting adjacent to a wall, the rear of the cabinet is stained but not furniture finished.

Speaker connection is made to two well-marked terminals in a recessed cavity on the rear of the enclosure. Tweeter- and midrange-level switches are placed directly above the terminals. Each of these is a two-position switch, with the up position corresponding to normal equalization and the down position corresponding to a 3-dB level reduction.

A 30.5-cm (12-in.), high-compliance woofer is mounted on the bottom of the front panel and works into a sealed enclosure. A 13-cm (5-in.) midrange driver and 9-cm. (3 ½-in.) tweeter share the central portion of the front panel, while two 5-cm. (2-in.) super tweeters are mounted at the top, angled away from the front axis for broader dispersion of the highest frequencies A very clearly-written instruction manual accompanies each speaker.

Measurements

Impedance as a function of frequency is shown in Fig. 1. The two extreme positions of level control are plotted since this represents the greatest impedance variation that will be seen by a power amplifier. The highest impedance is presented when the midrange and tweeter switches are both in the down or low position. The lowest impedance occurs for the switches placed upward. The T-400 is rated at 8 ohms, and the lowest value measured was approximately 7 ohms.

The polar impedance plot for the downward switch positions is shown in Fig. 2. In a sense, this polar measurement is a duplication of the impedance plot of Fig. 1. However, Fig. 1 is a plot of the magnitude of impedance and is a rapid overall look at the highest and lowest values of impedance and how they relate to frequency. Figure 2 goes a bit further and shows the nature of load which the speaker presents to an amplifier, including where it is capacitive reactive and where it is inductive reactive.

Two basic resonances exist, one at 58 Hz, the other at 490 Hz. Two worst-case capacitive-reactive loads for power amps occur at 65 Hz and 940 Hz. These are low enough in frequency that any well-designed amplifier should be capable of driving the T-400 without undue stress at high levels.

To check for impedance nonlinearities, a constant-voltage sine-wave signal is applied to the speaker terminals and a spectrum analysis made of the current demanded by the speaker. Impedance nonlinearities show up as distortion of this current and indicate the nature of load which constant-voltage power amplifiers must be able to control. A worst-case nonlinearity in impedance was measured at the bass resonance of 58 Hz. At a constant peak-to-peak voltage drive of 8 volts, corresponding to a drive level of one watt into the rated 8 ohms, speaker-drive current measures 3.2 % second harmonic content (106 Hz) and 1 % third-harmonic content (168 Hz). With the drive voltage increased to ten watts, the second harmonic rises to 5.5 % while the third harmonic drops to 0.8 %. While this indicates a small amount of magnetic field nonlinearity in the woofer for moderate cone excursion, the load current can be readily controlled by any well-designed amplifier, since it occurs at such a low frequency.

The free-field (anechoic) frequency response is shown in Fig. 3 for the amplitude of sound pressure at one-watt drive and a one-meter axial position, and in Fig. 4 for the phase of

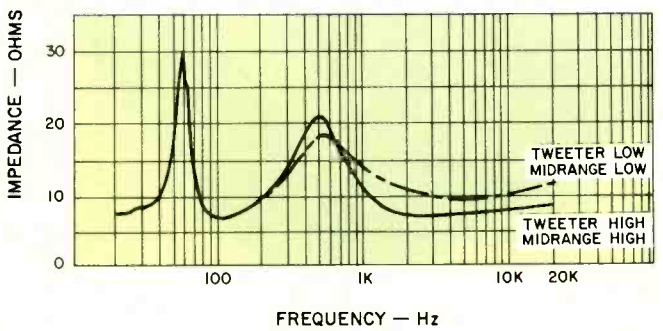


Fig. 1—Impedance versus frequency.

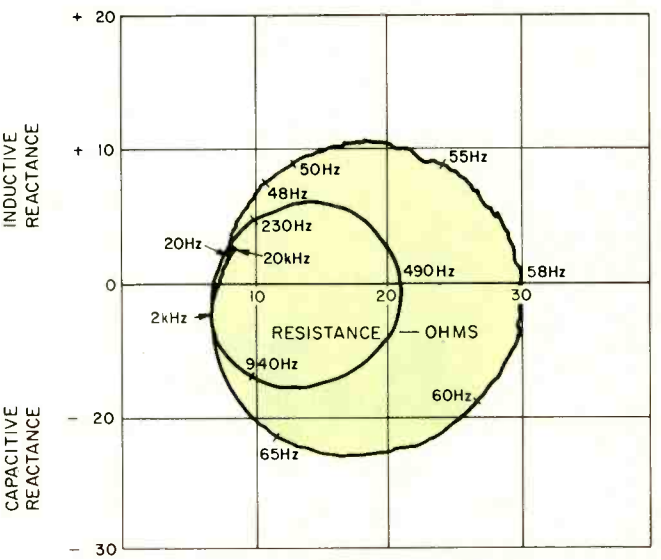


Fig. 2—Complex impedance polar plot.

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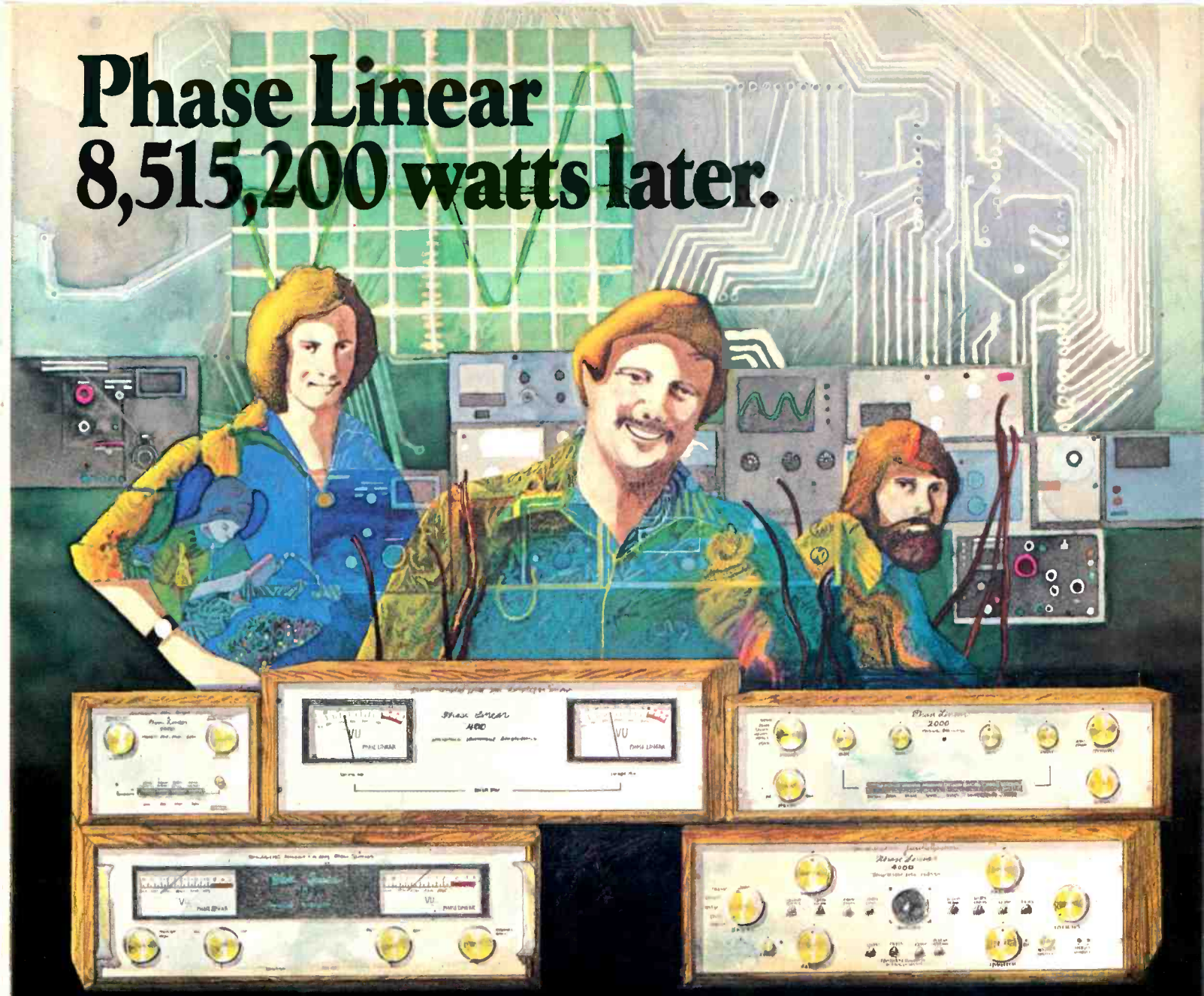

Back in '71 Phase Linear was Bob Carver, an audiophile with 200 square feet in the basement of an A & P store in the Pacific Northwest and one all-consuming obsession: to design and build the world's most powerful stereo amplifier.

Today Phase Linear Corporation is an acknowledged leader in high power technology, selling a complete line of amps and pre-amps throughout the world, operating out of one of the most advanced stereo component plants in the industry.

Phase Linear is now a household word among serious listeners, a word synonymous with power, quality, reliability and way-out-front technology.

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Phase Linear has dispensed over 8½ million watts of power to music lovers everywhere, starting with the famous super reliable, virtually distortion free Phase Linear 700, the first successful 700 watt amplifier. The popular Phase Linear 400 watt amplifier quickly followed. The incredible Phase Linear 4000 pre-amplifier was then perfected followed by a smaller version, the Phase Linear 2000. Recently the Phase Linear 1000 Noise Reduction System was added to the line . . . and there are many more advanced products in the wings.

Technological milestones along the way have included a unique Amplifier Protection Circuit (Patent #3,727,148), the first practical Expansion System, the innovative Auto Corralator Noise Reduction System and a unique Ambience Injection System for pre-amps.

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the sound pressure under the same conditions. The amplitude of sound pressure is plotted for the two extreme equalizer positions. The effect of the equalizers is approximately 3 dB, as specified by Panasonic.

Low frequency response extends down to about 55 Hz, dropping off smoothly below that frequency. Response up through the range of musical instrument fundamentals is smooth and uniform. A dip in response at around 1500 Hz is followed by strengthening of the output at around 7000 Hz. The response drops rapidly above 14 kHz for an axial one-meter microphone position.

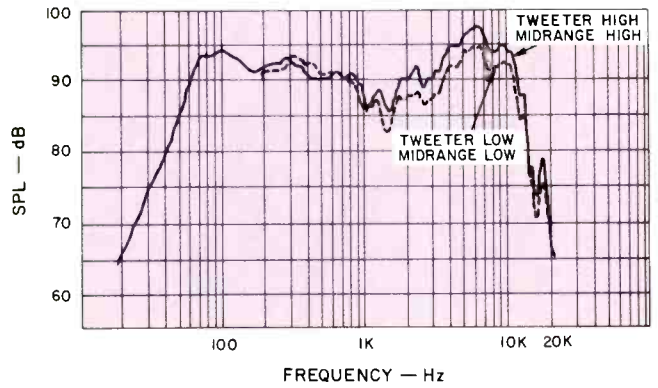


Fig. 3—One-watt, one-meter anechoic amplitude response.

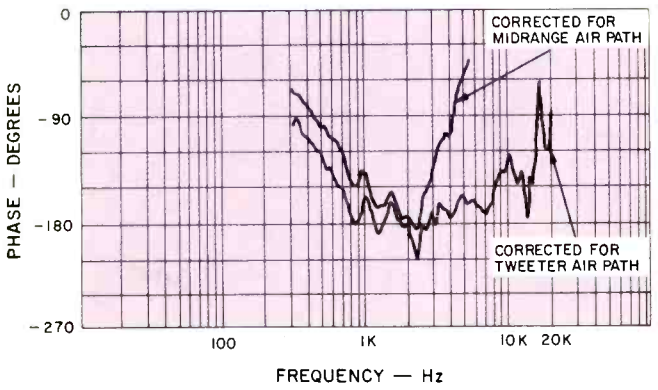


Fig. 4—One-meter anechoic phase response.

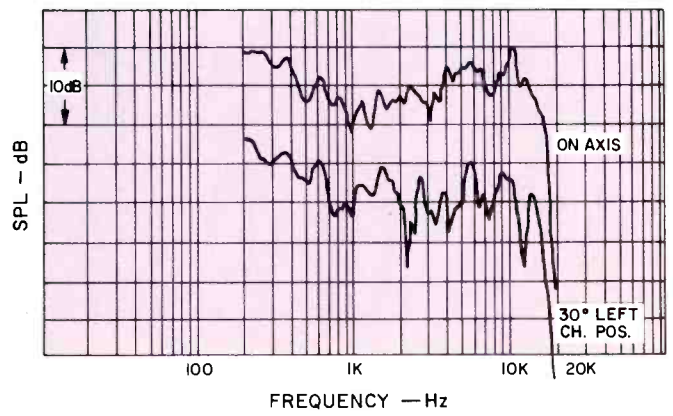


Fig. 5—Three-meter "room" response, tweeter and midrange controls in high positions.

From the phase response, it is evident that the sound from the tweeters arrives before the sound from the other speakers in this four-way system with frequencies above 8 kHz arriving first. Shortly afterward the sound from the 2.5-kHz to 8-kHz range arrives to reinforce the super-tweeter signal. One-tenth millisecond later, the 800-Hz to 2.5-kHz sound is heard, and 0.25 milliseconds after this, the sound spectrum below 700 Hz is received. The phase response is shown for two time delays; the curve marked "corrected for tweeter air path" is plotted for the arrival of sound from 2.5 kHz to 8 kHz, the other curve is plotted for 800 Hz to 2.5 kHz arrival. The sound from all drivers above about 800 Hz is uniform in phase transition but is 180 degrees out of phase with frequencies below that. This will not be significant when T-400s are used throughout the sound system, but indicates that some care may be needed if this speaker is used for a quadraphonic addition to an existing stereo installation.

The phase transitions are smooth and uniform, however, the arrival time differences make the response nonminimum phase. The basic frequency response changes with off-axis angle. At 15 degrees from the direct on-axis position, the high-frequency drivers interfere with each other and create a nonminimum phase characteristic with 540 degrees of acoustic phase angle change at 6.6 kHz.

The way a speaker sounds in a room is far more important to a listener than its anechoic chamber response. Figures 5 and 6 show more nearly the way the T-400 measures in a room. The unit was placed along a wall, as recommended by Panasonic, the listening position located 3 meters away from the speakers and one meter above the floor. The frequency response corresponding to the first 13 milliseconds of sound due to an impulse is shown in these figures. Both a direct-front listening position and a 30-degree left-channel-stereo seating position were measured. The curves are displaced 10 dB on this plot to prevent confusion.

These measurements indicate that the T-400 will tend toward a lower pitch dominance in its timbre at around 200 Hz, a sound some would describe as "chesty." This may be partially corrected by pulling the T-400 away from the wall. The midrange level is down with respect to the extreme top end.

The T-400 is definitely hotter in high-frequency response when pointed toward the listening position than when a normal off-axis stereo listening position is taken. The "chesty" sound may be somewhat offset by rotating the speakers slightly so they point more nearly toward the listening position. The effect of floor and ceiling scatter is minimal in this early sound as is shown by the similarity of this response and the anechoic measurement.

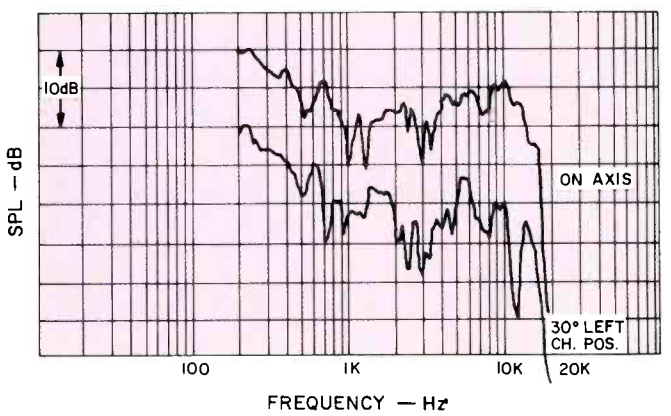
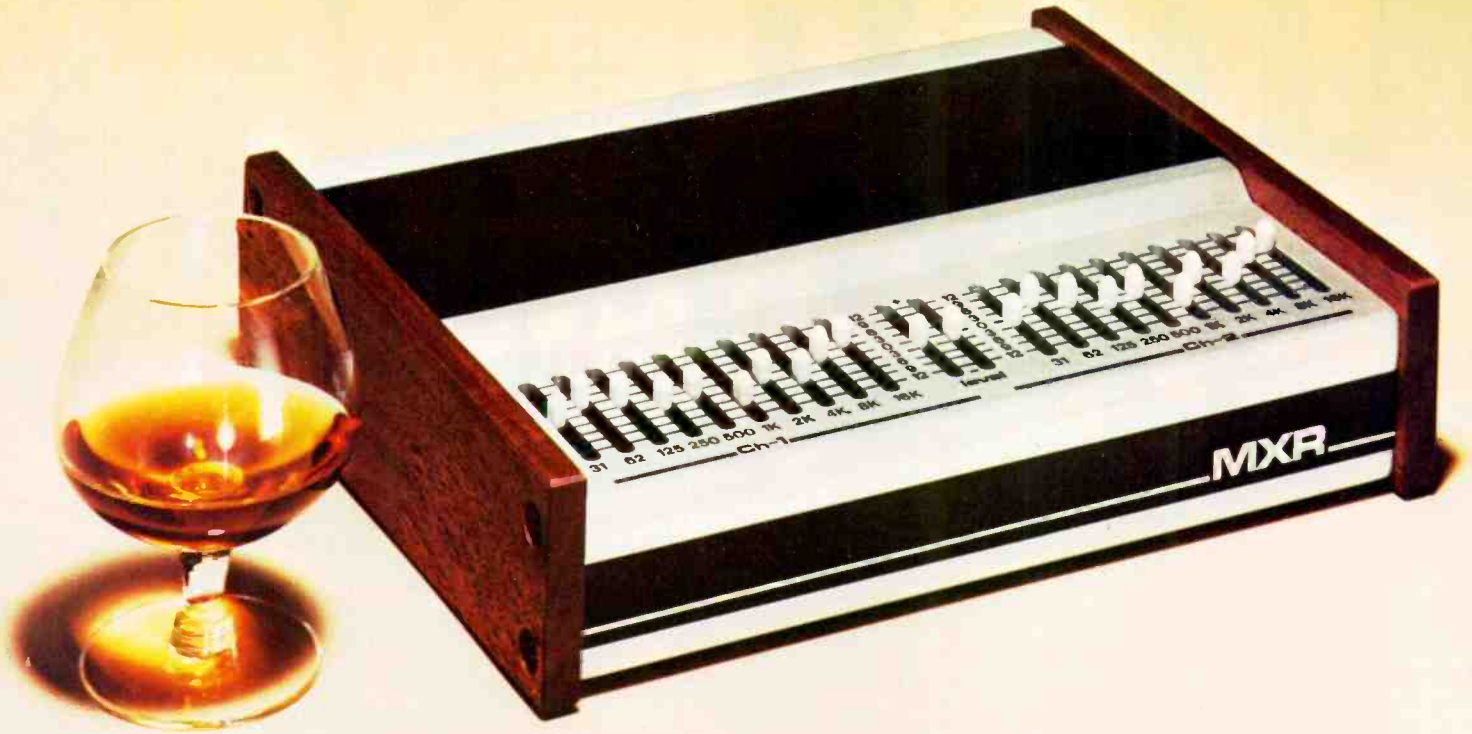


Fig. 6—Three-meter "room" response, tweeter and midrange controls in low position.



To Your Taste

Even the most perfect of high fidelity systems cannot escape those little inconsistencies that nag the ear. Room acoustics, speaker inadequacies, or even recording quality can produce listening environments that are less than optimum.

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The polar energy response is shown in Fig. 7 for a horizontal pattern and in Fig. 8 for the vertical pattern. This measures the angular dependence of the total sound energy from 20 Hz to 20 kHz. The T-400 has a preferred left-versus-right horizontal directivity, as shown. The sound is also directional in its vertical characteristics, with an upward launch angle that is about right for floor-mounted listening. This correlates well with the observation that the room response is similar to the anechoic response, the exception being the 200-Hz reinforcement commonly noted for wall placement with enclosures of this size. In many listening situations, it would appear that better stereo imagery could be obtained by rotating the speakers toward the average listening location. The directional characteristics may prove to be a mixed blessing. Normal room decor will not materially affect the sound, but the stereo image will tend to "walk" with you as you move about the listening area and will also tend to constrict the area.

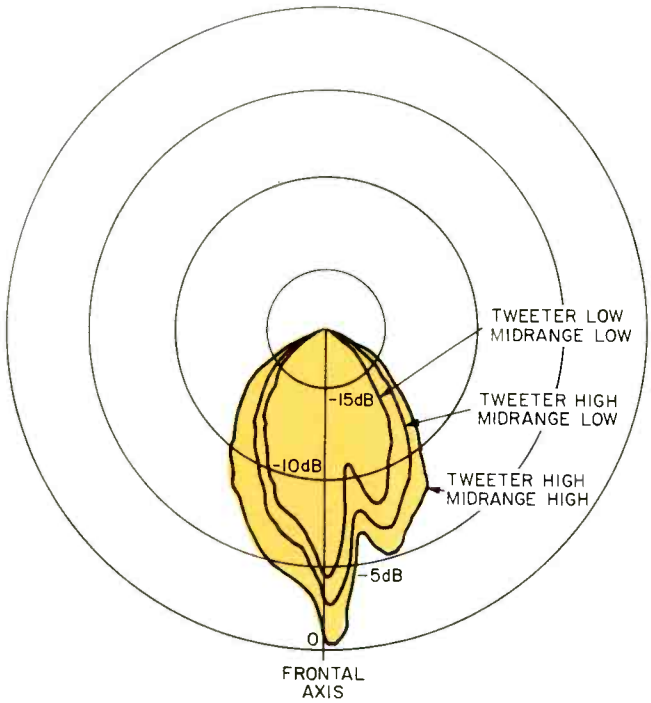

Fig. 7—Horizontal polar amplitude response.

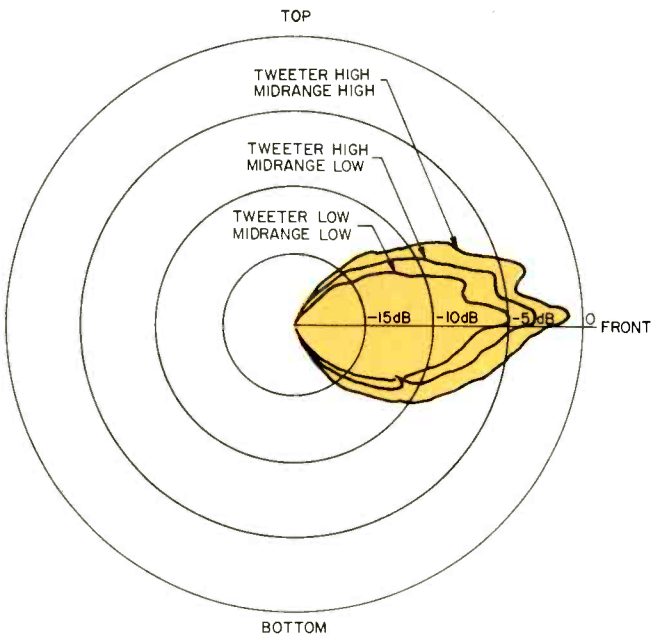

Fig. 8—Vertical polar amplitude response.

Harmonic distortion for the musical tones E1, A2, and A4 is shown in Fig. 9. Third harmonic distortion, which corresponds to the creation of the fifth in the octave higher, is stronger in the T-400 than the second harmonic for A2 and A4. At E1 or 41 Hz, the woofer is having some difficulty, which indicates some nonuniformity of cone motion. At 440 Hz the harmonic distortion is acceptably low, however the average position of the woofer cone moves outward from its no-signal physical location as the sound level is increased. At the maximum drive level of Fig. 9, the net displacement is 1.3 cm. at 440 Hz. This very slight breathing of average physical position with drive is very common in loudspeakers and can account for some stereo image wander under rapidly changing musical program dynamics.

Intermodulation distortion was measured by mixing the tones E1 (41.2 Hz) and A4 (440 Hz) in equal portion. These tones are chosen because of their musical significance and

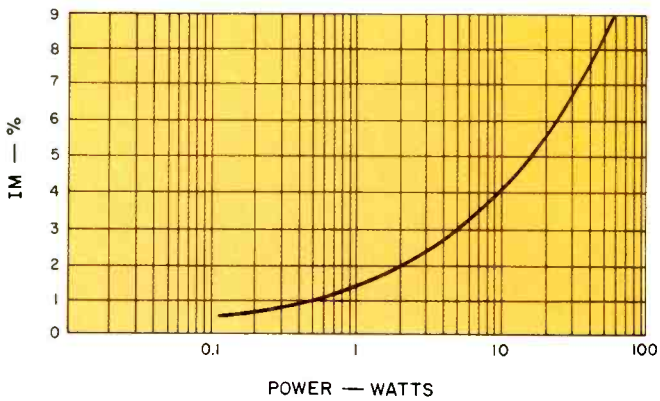

Fig. 10—Intermodulation of A4 or 440 Hz by E1 or 41 Hz, mixed one to one.

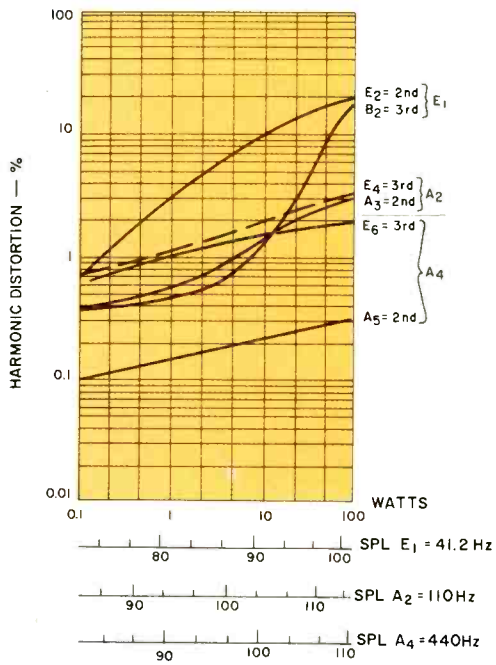

Fig. 9—Harmonic distortion for the musical tones E1 or 41 Hz, A2 or 110 Hz, and A4 or 440 Hz.

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But as good as our new V-FET amplifier is, we're just as proud of the components we make to go along with it.

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It has a direct drive servo motor with a wow and flutter rating of only .03%.

Its base and platter are made from molded compound instead of metal, so resonance has been greatly reduced. It also has air-damped cushions, which compensate for warpness in records (again reducing resonance). The end result is a much cleaner sound.

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*TA-8650: 80 watts per channel, min. RMS @ 8 ohms, 20Hz-20kHz, with no more than 0.1% total harmonic distortion.

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because they are shared by the same driver in the T-400. The measured modulation of A4 by E1 is shown in Fig. 10. The intermodulation is primarily amplitude modulation with very little phase modulation. As the power level is raised, the average position of the cone moves outward and accounts, at 60 watts, for a 15-degree static phase advance of the 440-Hz tone due to the presence of the 41-Hz tone.

The ability of the T-400 to handle broad-band peaks such as applause, is measured in the crescendo test. A representative inner musical voice, such as A4 (440 Hz) or middle C (262 Hz), is measured by itself, and then in the presence of wideband Gaussian noise with an average power (measured over a 20 kHz band) 20 dB higher than that of the musical voice. A crescendo limit is defined when the inner voice is reduced 1 dB in level by the presence of the incoherent noise. In the T-400 the crescendo limit was reached at a peak noise power of approximately 125 watts for the tone A4, and a peak power of 312 watts for tone middle C. This indicates a moderately strong power-handling capability.

The ability of a loudspeaker to provide good reproduction of transient sounds is measured with a perfect transient—the impulse. In the tests performed by *Audio*, the impulse response is computed from the frequency response, that is, the analytic signal is computed and its magnitude is plotted in dB versus time, in a form called the energy-time curve. The energy-time curve for the T-400 is shown in Fig. 11 for a one-meter axial microphone position and in Fig. 12 for a one-meter 30-degree off-axis position—the direction the listener would assume in the left-channel stereo position.

The super tweeters and the main tweeter are positioned on the front panel of the enclosure so that their sounds

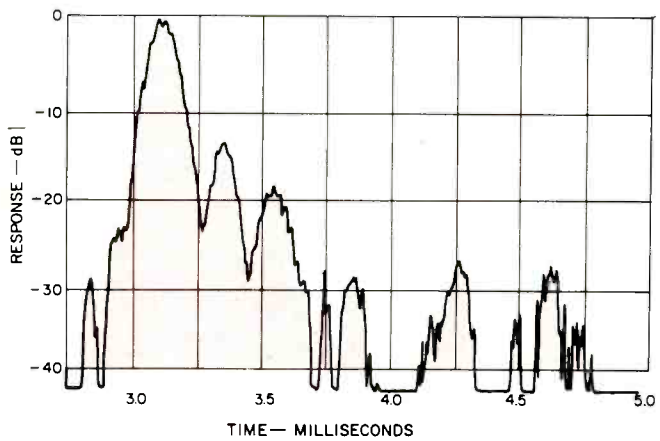

Fig. 11—One-meter energy-time response measured on axis.

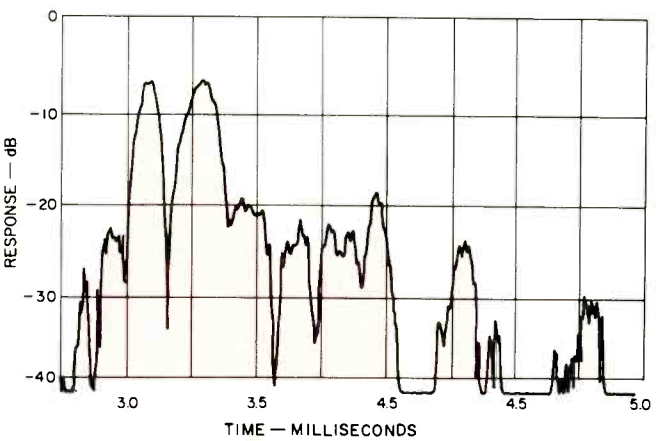

Fig. 12—One-meter energy-time response measured 30 degrees off axis.

coincide and reinforce, for a direct front listening position. This is shown in Fig. 11 by the single energy peak at 3.1 milliseconds. The subsequent peaks at 3.3, 3.6, and 3.8 milliseconds are reverberation components falling off at a rate of about 32 dB per millisecond. These will not significantly color the impulse behavior on-axis because of their rapid decay. The enclosure edge-diffraction components at 4.25 and 5.64 milliseonds are also well down, at levels of 28 dB below the first sound.

The off-axis transient response does not fare as well as the on-axis response because of the lateral spacing between the average acoustic centers of the super tweeters and the center of the midrange and tweeter speakers. This causes a spread of energy over a range of one millisecond from first arrival. The result is a loss of clarity of sharp transient sounds and a change in the timbre between off-axis and on-axis listening positions for frequency components above 1 kHz. The edge-diffraction components are slightly displaced, due to the change in geometry, but remain at a reasonably low level at 4.3 and 4.8 milliseconds. In spite of the difference in appearance between the on-axis and off-axis energy-time curves, 95 percent of the sound energy from both positions arrives within 0.45 milliseconds of the first sound arrival. These measurements lead this reviewer to recommend rotating the T-400 toward the listening position to improve its transient reproduction.

Listening Test

The T-400 speakers were initially placed against a flat wall, as recommended by Panasonic. The listening geometry chosen for stereo material consisted of an equilateral triangle with the spacing between speakers approximately 3 meters. In this position there was a distinct midbass peak that caused an unnatural emphasis of male vocals and midbass instruments. This was partially cured by pulling the speakers away from the walls about a half meter, but the bass was still considered too hot. The T-400 is a good reproducer of organ music, but has a distinct tendency to make you aware of any rumble or hum in your system. A small bass cut with the preamp equalizer finally achieved what was considered the best balance. At high sound levels the bass has a tendency to become less distinct in percussive articulation.

After considerable adjusting and listening, final adjustment positions were the midrange equalizer switch in the high position and the tweeter switch in the low position. The extreme high frequencies were down in level when this was done, but a more uniform balance resulted without top-end spit or annoying levels of audible record scratch.

The T-400 delivers good kick drum sound and can handle a lot of horn and brass peak power without caving in. Solo vocals are well placed and clear in the stereo image. Choral groups seemed spatially smeared and indistinct. Despite this apparent contradiction in reproduction of the human voice, this impression was noted in several types of selections.

The listening position for good stereo imagery is a bit critical for wide range material when the speakers are placed flat against the back wall. Rotating the speakers toward the listening position definitely helped the stereo imagery at the preferred listening position, but restricted the listening area to a best-seat-in-the-house situation. If one listens alone, I recommend pulling the speakers away from the wall and rotating them inward toward your seating location; otherwise, pull them away from the wall but do not rotate them.

The T-400, though not intended as state of the art, does deliver accurate and high quality sound. It demands a good amplifier and clean program material and is well suited for listening areas that are bright in their acoustic properties.

Richard C. Heyser

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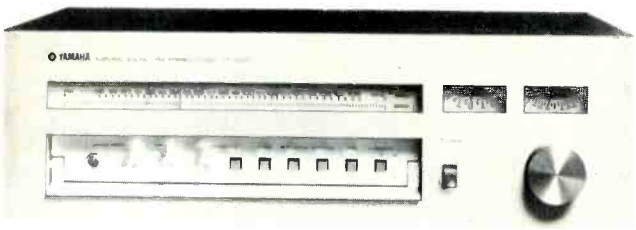

MANUFACTURER'S SPECIFICATIONS

IHF Sensitivity: Normal, 2.0 μV; Wide, 2.5 μV. **Selectivity:** Normal, 85 dB; Wide, 18 dB. **S/N:** Mono, 78 dB; Stereo, 75 dB. **Capture Ratio:** Normal, 0.7 dB; Wide, 0.6 dB. **THD:** Mono-normal, 0.06%; Mono-wide, 0.04%; Stereo-normal, 0.06%; Stereo-wide, 0.04% at 400 Hz. **THD** (from 50 Hz to 10 kHz): Mono-normal, 0.2%; Mono-wide, 0.08%; Stereo-normal, 0.3%; Stereo-wide, 0.15%. **Image, I.F. and Spurious Rejection:** Over 120 dB. **AM Suppression:** Over 60 dB. **Separation:** 400 Hz, normal or wide, 50 dB; from 50 Hz to 10 kHz; normal, 35 dB; Wide, 40 dB. **Frequency Response:** 30 - 15000 Hz ±0.3 dB. **Sub-carrier Suppression:** 70 dB. **Muting Override Signal Level:** From 3 to 30 μV. **Stereo Threshold:** From 3 to 30 μV. **Output Level:** 775 mV fixed; 2mV to 70mV variable.

GENERAL SPECIFICATIONS

Power Consumption: 23 watts, 13 watts with illumination off. **Dimensions:** 17 ¼ in. W x 5 ¾ in. H x 12 ½ in. D. **Weight:** 28.6 lbs. **Price:** $1200.00

The first thing that must be said about this magnificent FM tuner from Yamaha is that it succeeded in giving the test equipment in our laboratory a bad inferiority complex. Frankly, we thought we had upgraded our measurement equipment so that it was a couple of orders of magnitude better than anything we would be called upon to test. Yet the Yamaha CT-7000 specs are, in the main, better than we are able to measure. And rather than repeat that statement with each reported measurement that follows, we thought we'd better get that out of the way right at the beginning. We shall report our measurements as we read them, with the understanding that readers (and the people at Yamaha) will sympathize with our limitations.

As for the operating features, circuit highlights, and appearance of this tuner, those we can describe quite accurately, and the photo of the front panel helps. Many of the goodies are hidden under that sleek hinged door which runs across most of the lower portion of the front panel. But with it closed, all one sees when looking at the brushed silver panel of the Yamaha CT-7000 is a long, linear dial scale, calibrated at every MHz and augmented by a 100 point logging scale for easy station reference. Two small "windows" at the right frame the center-of-channel tuning meter and the signal-strength meter which also doubles as a multipath indicating meter. There's a lever-toggle power on-off switch and a massive tuning knob coupled to just about the smoothest acting flywheel arrangement we've ever spun across the 20 MHz's of the FM band. Ah, but when you tap the door base lightly to open it (it swings downwards), what additional wonders are disclosed! There's a built-in headphone jack powered by its own amplifier and a level control for that output, as well as one for the variable-level output jacks at the rear. There's a *Muting* on-off switch placed adjacent to a control which varies muting threshold, an *I.F. Mode* switch which varies the i.f. bandwidth (about which we'll have much more to say shortly), a button which selects mode of operation of the dual purpose signal-strength meter, an *Auto-Blend* switch which, when activated, introduces two degrees of high-blend when listening to weak-signal stereo, depending upon actual signal strength. Also hidden behind the hinged door are a mono/stereo *Mode* switch and a pushbutton which turns the dial *Illumination* on and off.

The rear panel, pictured in Fig. 1, contains antenna input terminals for 300-ohm connection and two types of connection facilities for 75-ohm transmission lines—one a coaxial connector, the other a combination of cable clamp (to retain the cable by gripping the outer shielded conductor) and screw terminal for the inner conductor. There are two pairs of output jacks, one for the fixed level outputs, the other for the variable level outputs controlled from the front panel. A pair of jacks designed for connection to an external oscilloscope comes next, followed by an i.f. output jack (which might perhaps been labelled more clearly as a detector or 4-channel output jack which is what it is). A chassis ground terminal, fuseholder and unswitched convenience a.c. outlet complete the rear panel layout.

Circuit Details

Details of the circuitry contained in the Yamaha CT-7000 would take longer to enumerate than the entire length of this report. We shall try to describe a few of the more important and innovative ones. (Refer to Fig. 2, an internal view.) Three dual-gate MOS FETs are used in the frontend, which contains two full stages of r.f. amplification and employs what Yamaha claims is the world's first *seven-gang* tuning capacitor. A seven-stage differential amplifier is used in the i.f. section together with ceramic and LC filter blocks. There are actually two separate i.f. stages; "normal" mode is for best selectivity in "crowded" signal areas, while "wideband" works best where station crowding is not a problem

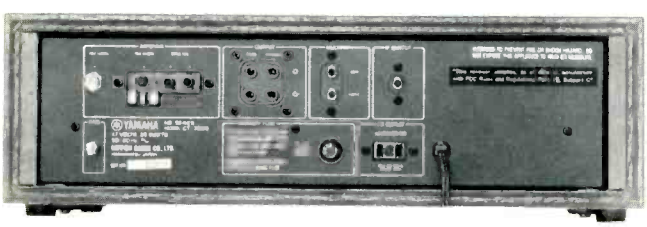

Fig. 1—Rear panel.

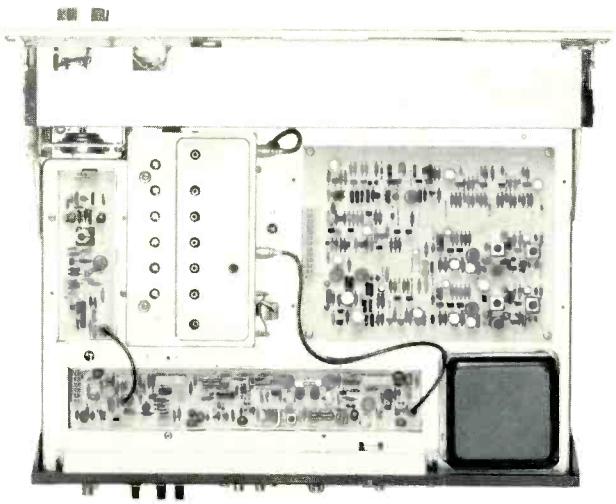

Fig. 2—Interior view.

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★**BROADCAST TEST RECORD STR 151** Developed especially to meet the needs of broadcast engineers, audiophiles, and other professionals seeking a convenient signal source for the testing and adjustment of all audio equipment. Tests include: phonograph pickup response and separation, speed accuracy at 33 1/3 and 45 rpm, wow and flutter, rumble and hum detection, ballistic test of V.U. meters and many others."

★**RIAA FREQUENCY RESPONSE TEST RECORD STR 130** Provides RIAA frequency characteristics for the calibration of professional recording equipment and for testing the response of professional and consumer record reproduction equipment. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation. Spot frequency bands for use without automatic equipment are included.

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★**QUADRAPHONIC TEST RECORD SQT 1100** Designed for calibration, verification, and adjustment of SQ™ decoding equipment. The record provides test bands for pickup measurements, for adjustment of decoder electronics and for channel identification and balance. Each band is described in terms of recorded characteristics and its intended use.

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Laboratory Measurements

Again, with apologies for our test equipment, we measured an IHF sensitivity of 1.9 μV in the "normal" i.f. position and 2.4 μV in the "wide" position. Some 50 dB of quieting was attained at 2.8 μV and 3.4 μV for these two operating modes respectively. Figures 3 and 4 show our measured S/N results of 78 dB and 69 dB for mono and stereo in the "narrow" or "normal" position and 75 dB and 68 dB for the same measurements made in the "wide" setting. We suspect that our generator's limit in mono is therefore 78 dB in mono and somewhere around 70 dB in stereo, which accounts for our inability to measure claimed specs. Note too that our THD measurements at mid-frequencies (1 kHz) for both the "normal" and "wide" settings were the same, indicating clearly that we were limited by the built-in distortion of our signal generating equipment. We are therefore in no position to dispute Yamaha's claim of 0.04% in the wide position for both mono and stereo. It's very likely true!

We had previously suspected that the stereo separation capability of our stereo FM generator was about 50 dB, since that's the most we ever measured for any tuner or receiver we ever tested. Much to our surprise, we obtained a reading of 53 dB for mid-frequency separation when operating the CT-7000 in the narrow position, as plotted in Fig. 5. Interestingly, in the "wide" operating mode, although mid-band separation was slightly less, high frequency separation was clearly better, remaining above 40 dB all the way out to 15 kHz. These two plots clearly prove the importance of wide bandwidth for good high-frequency stereo separation, as well as the need for excellent phase linearity throughout the i.f. and detection system. Yamaha obviously has a good measure of both. Even within the limitations of the generator, the distortion curves shown at the bottom of Fig. 6 clearly show that increased bandwidth leads to lower high-frequency distortion in stereo. Note that when this setting was used, THD at 10 kHz in stereo was less than 0.3%—the lowest we have ever encountered. No low-pass filters were used in making this or any other measurements. There was just no evidence of the usual "beats" with the 19-kHz carrier we find with so many other FM tuners.

As for spurious, image, and i.f. rejection, our instrumentation permits us to read up to 100 dB for these specs. That's what we read with the Yamaha under test. The manufacturer claims better than 120 dB for each. What more can we say? Measuring capture ratio below 1.0 dB is tricky at best, but we managed to confirm at least one of Yamaha's claims for this important spec: 0.7 dB in the normal setting with a 100 μV input. Fantastic!

Muting level was found to be adjustable in our sample over the signal strength range from 4 μV, while stereo threshold was factory set at about 7.0 μV, a suitable point for this tuner. Transition from mono to stereo is noiseless and absolutely positive. At signals below 100 μV, blending of high frequencies as well as upper mid-frequencies takes place automatically, reducing separation substantially above 1 kHz, but reducing noise to listenable levels. Between 100 μV and 1 mV signal strengths, the auto-blend feature, if activated, blends highs to a lesser degree, retaining adequate separation while accomplishing noise reduction which makes medium-strength signals received from stereo broadcasters quite good, in terms of background noise.

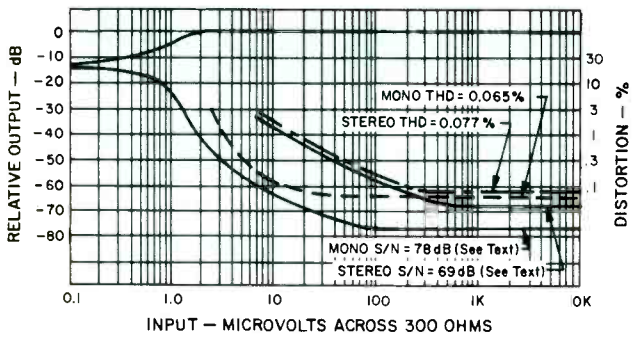

Fig. 3—FM quieting and distortion characteristics, "Normal" i.f. position.

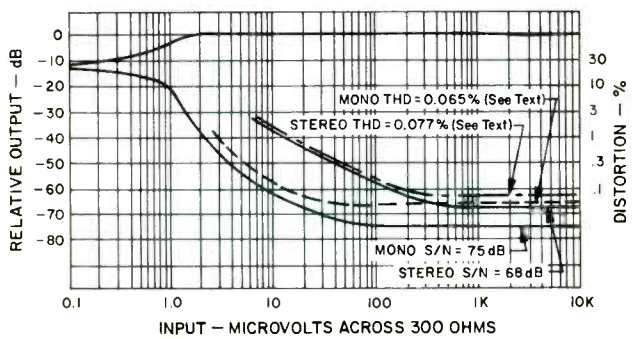

Fig. 4—FM quieting and distortion characteristics, "Wide" i.f. position.

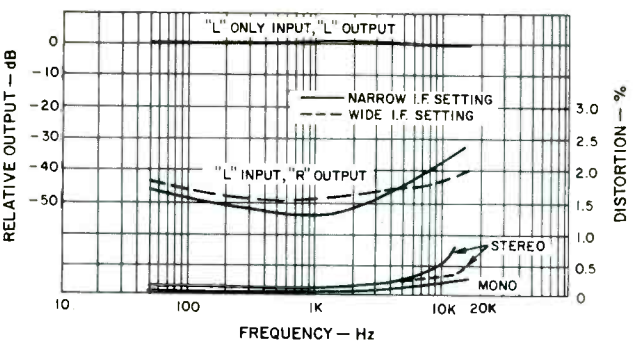

Fig. 5—Separation and distortion versus frequency.

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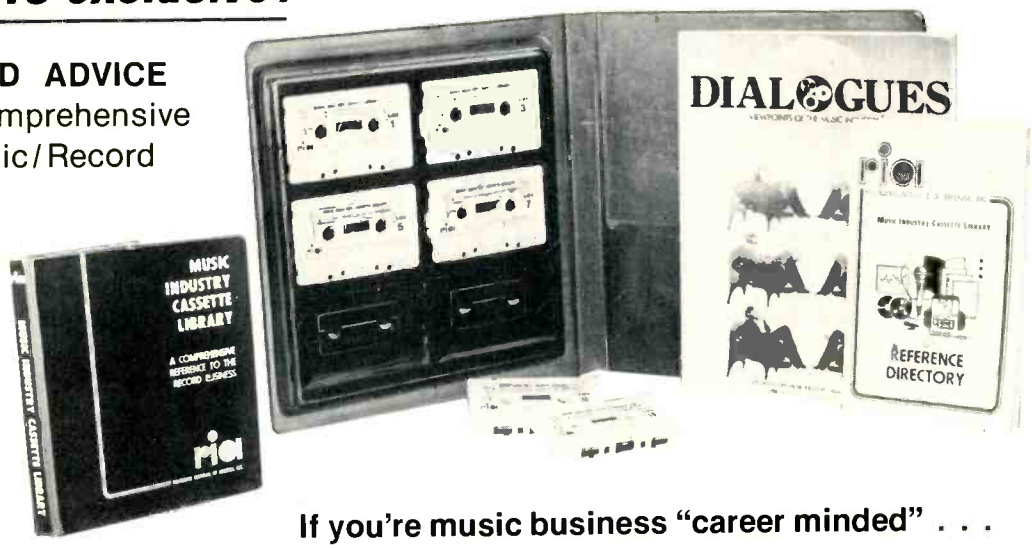

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Listening and Use Tests

We were in for a few more surprises when we got down to our listening tests and evaluations. It was then that we first began to appreciate what Yamaha calls its "auto-touch tuning" system. The large tuning knob is actually part of a capacitance switch which is activated by the user when he touches the knob. While tuning to a station, the built-in a.f.c. circuitry is turned off to enable the user to zero in precisely on the desired station signal. While this tuning is in process, the tuning indicator lamp is extinguished. As a station signal is approached, it glows softly and, when tuning has been completed and the user lets go of the tuning knob, the a.f.c. circuit comes back on and the tuning indicator is illuminated to full brightness. Normally, we have frowned upon a.f.c. circuits in general as it was our feeling that they usually contribute to distortion and non-linearities in a tuner circuit, and that given today's heat-free solid-state stable circuitry, there is no need for a.f.c. as a drift-prevention crutch. Well, this a.f.c. circuitry contributes absolutely *no* added distortion to the audio output of the Yamaha CT-7000. In fact, all our measurements in the lab were made with the a.f.c. active since we obviously didn't keep our fingers on the tuning knob while making the measurements. When we became aware of the a.f.c. feature and the way it works, we decided to check some of our measurements to see if we could fine-tune the tuner (with hands on tuning knob to deactivate the a.f.c.) for lower distortion than we had previously observed. If any improvement occurred under these conditions, it was too low for us to observe, since we were already below 0.065% in our previous mono THD readings. Nor could we detect even the slightest shift or change of appearance of the output waveform as observed on our monitoring oscilloscopes as a.f.c. was activated and deactivated. The only time the a.f.c. did anything was when we deliberately detuned the signal. Under those conditions, the a.f.c. was strong enough (when reactivated automatically) to pull the tuning close enough to optimum so that distortion was once again below 0.1%. Here is an a.f.c. circuit that doesn't "get in the way" of performance and can be of genuine assistance to the "sloppy" knob twirler who doesn't have the patience to tune as carefully as he or she should!

(Editor's Note: Yamaha says they designed the a.f.c. circuitry in their tuner sections as a final tuning compensator, to minimize distortion and increase separation.)

It goes without saying that the signals received were limited in quality entirely by the broadcast practices of the stations we received. Which, of course, brings us to the ultimate question. Should one spend $1200.00 on what is probably the best performing tuner presently available, when most stations are becoming worse and worse insofar as the quality of their broadcast signals are concerned? That depends largely upon where you are located and whether or not you have stations in your area that are careful about the kinds of signals they transmit. Is this the "best" tuner we have ever measured? Well, the previously tested Sequerra Model One does as well (we can't say "better" since in both cases our test equipment was not as good as the product demanded), but it costs more than twice as much as the Yamaha. Of course, the Sequerra has all kinds of nice things like digital frequency readout and panoramic oscilloscope displays, use of a scope instead of meters for tuning and signal analysis, and the like. There would therefore seem to be two choices for the absolute perfectionist who seeks the best in FM tuners. If you are fascinated by digital readout, scopes and the like and seek absolutely tops in specifications and performance, take home a Sequerra Model One. If you are strictly a purist, and want a super FM tuner, that's equally first-rate in its specifications and measured performance, that's flawlessly designed, simple to operate, and offers that important wide-band mode (we were able to take advantage of it even in the crowded New York metropolitan area down at the bottom of the dial), you're not likely to find a better performer than the Yamaha CT-7000.

Leonard Feldman

Check No. 92 on Reader Service Card

Koss HV/1A Headphone

MANUFACTURER'S SPECIFICATIONS

Elements: 50-mm dia. (2 in.) Decilite™ dynamic, velocity operated. **Source Impedance:** 157 ohms at 1 kHz, designed to operate with source impedances of 3.2 to 600 ohms. **Frequency Response:** 15 to 20,000 Hz. **Sensitivity for 100 dB SPL:** 0.9 V rms, sine wave, at 1 kHz; 0.5 V rms pink noise. **THD:** Less than 0.5% at 1 kHz, 100 dB SPL. **SPL at 1% THD, 1 kHz:** 108 dB. **Power Handling Capability:** 5 V continuous. **Cord:** 3-conductor, coiled, 3 meters (10 ft.) extended. **Earcushions:** Soft acoustical sponge. **Headband:** Extendable, with self adjusting, pivoting yokes and soft, padded vinyl cover. **Weight:** 285 grams (10 oz.) less cord. **Price:** $49.95.

The Manufacturer's Specifications section above just about tells the entire story, since there is very little more that can be said. However, some additional details may be interesting to the reader. For example, the foam pads are doughnut-shaped, 2¾ in. outside diameter with the "hole" opening 1-5/16 in. diameter, and the depth is ¾ in. The color is dark drown, matching the brown plastic cups which have a shiny chromed trim ring. The cups are vented both in back and around the sides, which accounts for the low isolation from external sounds. The cups themselves are 3 inches in diameter and are held by a double swivel, permitting full adjustment to the wearer's ears. The extendable portion of the band has detents to ensure that it remains in the selected position. The band itself is a sturdy steel strip, vinyl covered, with the detent mechanism encased in molded plastic terminations of the band. The cord is dark brown in color, miniature in dimension, and is coiled in a very compact form, with the three leads terminating in a detachable plug, rather than a molded one which is difficult to replace if ever one wants to change to some other form of plug. The d.c. resistance of each phone was measured at 148 ohms in the maximum-volume position and 869 ohms in the minimum-volume position, indicating that the level control is a series resistance, which would be a distinct advantage if the

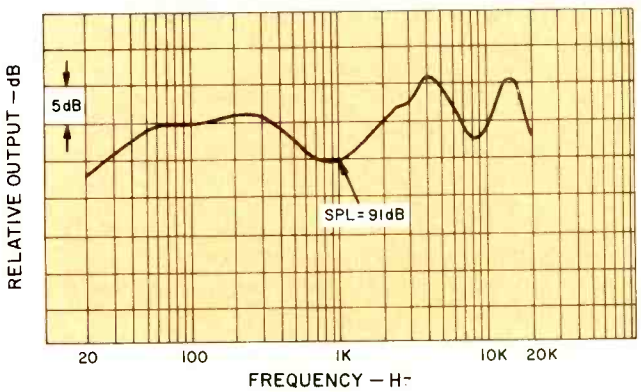


Fig. 1—Frequency response of Koss HV/1A stereophones.

phones were to be used on 600-ohm circuits. The impedance of the single phone was measured at 240 ohms. Weight is specified as 10 oz. for the phones, less cord, though the cord and plug add only another 3 oz. to the total.

Measurement Method

Determining the performance characteristics of headphones is a fairly complicated project. The phones must be coupled to a microphone by means of an artificial ear of specific characteristics—and here there is a difference of opinion. In general, the cavity between the microphone diaphragm and the headphone diaphragm is specified as 6 cu. cm for headphones and 2.5 cu. cm for hearing-aid phones. For some years, this observer has used a shop-built artificial ear which gets modified occasionally in striving for improved performance. The "ear" consists of a maple block 5 ½ inch in diameter and 6 ½ inches long—about the dimensions of the average head as far as spacing goes. Through the center is a 3/4-in. hole to accommodate an AKG C-451E condenser microphone, and on the front is a B & K metal adapter. The microphone is inserted just far enough to provide the 6-cu. cm cavity. The microphone—suitably modified for single-ended use rather than for the phantom powering normally used—has its output fed into the proper receptacle on a graphic recorder, the Justi-Meter III. For a frequency run, the source is the B & K QR-2009 test record, which has a sweep from 20 to 20,000 Hz, and it's equalized in such a manner that it can be reproduced "flat" with networks using R and C elements, as is the case with Justi-Meter III. The record is reproduced, and the output fed to an amplifier with the signal terminated by the amplifier's normal load resistance. The signal is adjusted to 3.0 volts, and the headphone driven from this 3-volt signal through 100 ohms—about normal for receiver headphone jacks.

Frequency runs are made for both phones, and a second measurement is made by reproducing a 400-Hz square wave through a loudspeaker and with the headphones off the "ear," the output of the microphone is measured. The phones are then placed on the ear, and the output again measured. This gives the isolation, in dB, with the phones on the ear, as compared with the signal without the phones. There are many uses where a high degree of isolation is desired, as where one is recording in the presence of a live source, and airborne sound from the source should be reduced as much as possible in order to hear the actual sound that is being recorded.

Performance

Figure 1 shows the frequency characteristic of the HV/1A phones, averaged between the two phones of the pair. While that may seem a little unscientific, it is actually almost the way we hear the phones. And besides, the two curves were never more than 3 dB apart over the entire range from 20 to 20,000 Hz—a remarkable feat. Furthermore, these phones offer the best—thus, flattest—response of any that we have measured with the exception of the Koss ESP-9.

Sound pressure level from these phones measured 91 dB with the 3-volt signal applied through 100 ohms, a value which is lower than the loudest ones tested, but still within the ball park. The HV/1A phones are still 3 dB louder than the Koss ESP-9, and to the average user, adequately loud for any normal purpose, though perhaps not loud enough for the rock buff. In any case, they were comfortable to wear for periods up to one hour, at least, and were not tested for more than that at one sitting.

Because of the openings in the cup and the softness of the foam pads, isolation from outside sounds was less than 2 dB, so the phones would not be suitable for recording in the vicinity of the live source, but for simply listening to music, they are excellent. *C. G. McProud*

Crown VFX2 Electronic Filter-Crossover

MANUFACTURER'S SPECIFICATIONS

Frequency Response: 18 Hz to 38 kHz ±0.5 dB with 600 ohm load. **Output:** 10 V maximum, 2.5 V rated with 600 ohm load. **Gain:** 0 to 15.5 dB. **Hum and Noise:** 100 dB below rated output, 20 Hz to 20 kHz. **IM Distortion:** Less than 0.01% at rated output. **Filters:** Separate 18-dB Butterworth high and low pass with adjustable corner frequencies. **Dimensions:** 19 in. rack mount with W.E. hole spacing, 3 ½ in. H, 5 ¾ in. D. **Weight:** 6 lbs. **Price:** $299.00

The Crown Model VFX2 is a dual-channel filter/crossover unit designed to provide continuously variable filters to perform either high-pass, low-pass, or bandpass functions in a professional, commercial or home high fidelity system. The unit is ruggedly constructed and fits the standard 19 in. rack mount, occupying only 3 ½ in. of vertical rack space and 5 ¾ inches in depth.

The front panel has four sets of range/vernier knobs for the high- and low-pass frequency setting of the filters in the two audio channels. A shadow mask pushbutton switch controls the power. The rear panel controls are a screwdriver-adjustable level (attenuator) control and a mode switch for selecting either the crossover (low pass) or filter (bandpass) outputs for each audio channel. Rear-panel connectors include a variable-gain bridging input for each channel in ad-

dition to the unity-gain unbalanced input. Output connectors (both high and low pass) are provided for inverted and noninverted (normal) modes.

For greater reliability, the VFX2 uses ¼-in. phone jacks; input is by 3-conductor jacks balanced/unbalanced or 2-conductor jacks unbalanced unity gain; output is by 2-conductor jacks. To prevent the accidental moving of the range/vernier settings, the VFX2 has a smoked plastic cover that can be attached over the front of the unit.

The VFX2 filter set is quite useful for reprocessing or playing all types of records, particularly the early 78-rpm acoustics and electrics as well as the more recent monophonic 78s and LPs, the current stereo and matrix recordings. Other equally important uses include equalizing deficient program material in a manner not possible with the usual tone controls, constructing one-third octave or other narrow-band pink-noise sources for use in acoustical measurements, etc.

Of particular interest to the professional and the audiophile is the use of the VFX2 as a high-quality dual-channel crossover with 18 dB/octave slopes and continuously variable crossover frequencies. Currently, there is renewed interest in electronic crossovers for use in bi- and tri-amplified speaker systems, with great interest in achieving true high fidelity bass performance by utilizing speakers specifically designed for low bass reproduction.

The VFX2 utilizes five RC4558 dual operational amplifiers

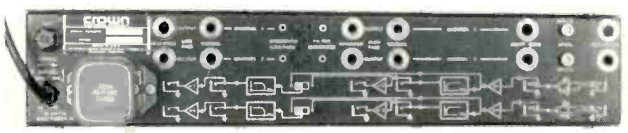


Fig. 1—Rear panel.

Fig. 2—Internal view.

in each channel, in effect, 20 op-amps equivalent to 402 transistors, 44 diodes, and 2 zeners. The circuit appears to be a variant of a non-inverting voltage-controlled voltage-source (VCVS) design, and consists of a 6 dB/octave stage cascaded with a second 12 dB/octave section. The latter is implemented with two operational amplifiers. Results of this design approach are very high input impedances, low output impedances, and low sensitivities to drift arising from temperature changes and circuit aging.

The liberal use of operational amplifiers in the VFX2 is apparent throughout the unit. There are buffer amplifiers at the inputs to assure very high (1 megohm) input impedances which permits use of the crossover with long cables and any type of preamplifier. Use of high supply voltages for the op-amps, e.g., ± 15 volts, assures that the crossover can handle up to 10 volts without overloading. At unity gain, this type of output is far greater than is required by any power amplifier. The liberal use of op-amps is also apparent in the availability of inverting outputs. Each of these inverting outputs requires one op-amp so that four of these op-amps are used to supply the four inverted outputs. The inverting outputs, although not essential, are a very useful addition because phasing of the loudspeakers can be made at the crossover rather than changing connections at the speaker or power amplifier. Phasing becomes particularly important when the crossover is set at very low frequencies (e.g., 100 Hz) such as when used with a high quality extended-bass system. An out-of-phase condition between the low-frequency speaker and the rest of the system would appear as an attenuation in the upper bass region and would definitely be audible. By merely changing the outputs from *Normal* to *Inverted* for one of the sections (high pass or low pass), the listener can quickly determine which jack gives the correct phasing.

The filter characteristic is a third-order Butterworth, which has a maximally flat response in the pass band of the filter to a time dependent signal such as is encountered with musical material. The phase shifts for this type of filter are, however, not linear with frequency. A linear response would be an ideal case since this would lead to a constant group delay at all frequencies and, consequently, the time dependent signal would not be distorted. However, human hearing is relatively less sensitive to distortions of this kind than it is to amplitude variations with frequency, e.g., ripple in the pass band.

Measurements of harmonic distortion products using a wave analyzer with an 80-dB range showed that second harmonic distortion was always less than 0.1% at input voltages less than 9 volts and at frequencies below 10 kHz. Third harmonic and all higher order distortion components were nearly unmeasureable, i.e., less than 0.01%. The second harmonic distortion reflected the internal residual distortion of the oscillator and not of the VFX2. The frequency response measured was the same as given in the VFX2 specifications.

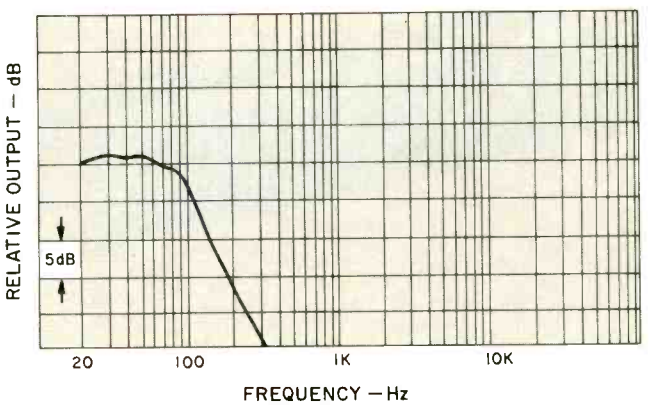


Fig. 3—Response with crossover frequency of 100 Hz.

The slopes of the filters were within 0.5 dB down to −60 dB relative to the bandpass output.

The corner frequencies as indicated on the front panel are reasonably accurate. However, for exact frequency settings, use a simple a.c. voltmeter, an audio oscillator and, if available, a frequency counter. Figure 3 shows the response curve for the VFX2 when set for a crossover frequency of exactly 100 Hz.

In using the Crown VFX2 as a crossover in our system, we noted two deficiencies. The first is a lack of level controls on the high- and low-pass sections, which means that power amplifiers used with the VFX2 should have a volume control to compensate for varying power amplifier sensitivities and loudspeaker efficiencies. The second deficiency is the omission of a summed left-plus-right output for the low-pass filter. Experience shows that for reproduction of low bass, a single monophonic bass speaker (woofer) is adequate in small rooms where the left- and right-channel speakers are not widely spaced, particularly since bass frequencies below about 100 Hz are not directional. A crossover such as the VFX2 cannot be used in this monophonic mode, but must be used with two subwoofers. However, a suitable op-amp mixer is very easy to add to the VFX2 because of its op-amp design, thus permitting the use of one subwoofer in the common mode.

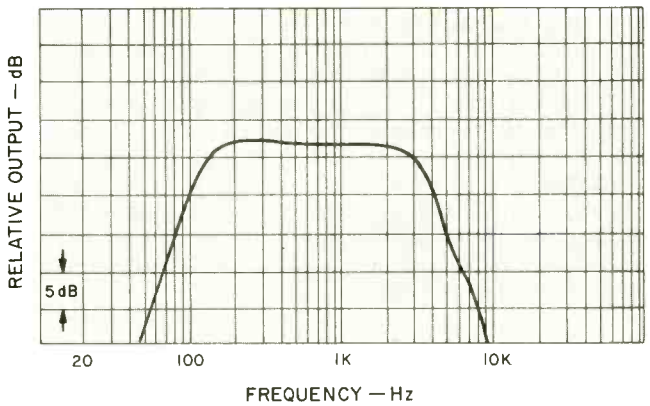


Fig. 4—Bandpass setting with cutoff frequencies of 160 and 3000 Hz, 18 dB/octave slope rate.

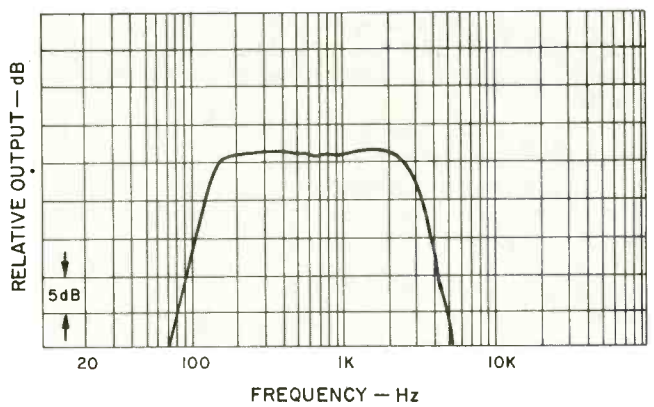


Fig. 5—Bandpass setting with cutoff frequencies of 160 and 3000 Hz, 36 dB/octave slope rate.

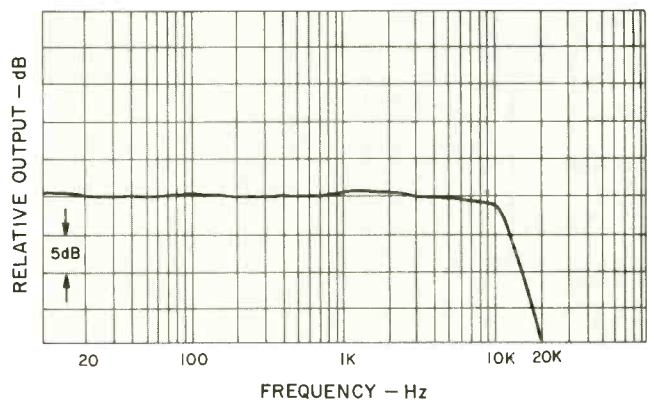


Fig. 6—Setting for noisy modern discs, high-pass filter at 20 Hz or off, low-pass at 10 kHz with 18 dB/octave slope rate.

As mentioned earlier, the VFX2 is very useful as an 18 dB/octave filter for record collectors, particularly collectors of early acoustic and electrical 78-rpm shellac records. The unit is inserted in the *Tape In* and *Out* circuits or between the preamplifier and amplifier when they are separate units. Figure 4 is a response curve for the playback of early acoustic 78-rpm records. The high-pass filter of the VFX2 is set at 160 Hz and the low pass filter at 3000 Hz. In practice, the low-pass filter (cutoff frequency) is usually adjusted for each recording as it is being played until the noise elements are removed or diminished appreciably. In Figure 4 the cutoff frequencies are at 160 and 3000 Hz with an attenuation rate of 18 dB/octave, while Figure 5 shows the same response, but at 36 dB/octave attenuation. Note that with such a steep attenuation, the cutoff point has shifted to about 2800 Hz at the high end. A shift towards a narrower bandpass has also occurred at the low end. In Figure 6 the high-pass filter is set at 20 Hz or turned off and low-pass cutoff frequency is set at 10 kHz, with an attenuation rate of 18 dB/octave. This is a useful setting when playing noisy LPs. As mentioned earlier, in practice the low-pass and high-pass filters are usually adjusted while the record is playing and the bandpass limits set for the least amount of noise.

During the past six months, the Crown VFX2, used as a crossover, has performed faultlessly in our music system. The unit is set for a low crossover frequency of exactly 100 Hz and the common mode output is fed to a 60-watt amplifier having a high damping factor. The output of the amplifier is coupled to our Janis Audio Associates W-1 subwoofer.

Use of the VFX2 crossover and the W-1 subwoofer permitted us to hear the bass frequencies below 100 Hz in an extremely clean manner and *in toto*. In the usual high quality music system, the very low bass frequencies are too often missing since very few speakers can adequately reproduce musical frequencies much below 40 Hz. This is particularly true of the low-bass pedal organ frequencies such as the 23 Hz note recorded on the Advent 5009 record (**Lemmen•Vierne•Dupre•Widor**) and the 27.5 Hz note on the ARK 10251-S (**Organ Music From Westminster**). There are many classical recordings in which the nine-foot concert bass drum, generally tuned to 31 Hz, is prominently featured, but the actual fundamental is rarely reproduced. On the Columbia MQ33172 (**Carmina Burana**), the Angel S-35430 (**Pictures at an Exhibition**), or the RCA QuadraDisc ARD1-0707 (**Citizen Kane**), to name a few, there is liberal use of this great drum, and this system reproduces it with awesome power and sonority. In the currently popular music the various bass instruments and, in particular, the ultra-low frequencies produced by synthesizers is superbly reproduced. The Crown VFX2 dual-channel filter/crossover is undoubtedly a very excellent crossover in this application.

B. V. Pisha

Nakamichi Reference Monitor Loudspeaker System

MANUFACTURER'S SPECIFICATIONS

Frequency Response: 40 Hz to 16 kHz ±5 dB, on axis; 40 Hz to 10 kHz ±10 dB, 60° off axis. **Power Rating:** 60 watts peak, 20 watts intermittent, 3 watts continuous. **Nominal Impedance:** 8 ohms. **Sensitivity:** 96 dB SPL for 1-watt input at one meter on axis. **Harmonic Distortion:** Less than 7 per cent at 10-watts input (106 dB SPL at one meter on axis) above 50 Hz. **Dimensions:** 25 ½ W x 34⅝ H x 17 ¼ D. **Weight:** 110 lbs. (50 kg). **Price:** $2,400.00 per pair.

ers, has expanded their product line to include loudspeakers. The loudspeaker introduced under the label Nakamichi Reference Monitor is new in this country, but is a system developed and manufactured by Mitsubishi Electric Corp. and reportedly is used as a studio monitor by the Japan Broadcasting Corporation (NHK) as well as broadcasting stations and recording studios throughout Japan. (Editor's Note: Smaller version of this Nakamichi Reference Monitor Speaker with 8-in. woofer and 1 ½-in. tweeter is also available at $1,600.00 per pair.

A 12-in. woofer is used with a bass reflex enclosure of the phase inverter type and is intended to carry the spectrum up to 1500 Hz. Frequencies above that are carried by a 2-in. cone tweeter.

Except for an optically opaque grille cloth which covers most of the front surface, the front, top, and sides are finished with dark lacquer so smooth you can see your reflection in it.

Speaker connection is made through either of the two XLR type receptacles provided, one on either side of the enclosure. While this is fine for a studio monitor, it is not the thing for a normal user to wire up and connect to his home system, even though XLR plugs and complete wiring instructions are included. We would like to see this changed to a more conventional connector for domestic use.

There is no equalization control provided, and the system comes equalized for flat response. To prove that fact, Nakamichi provides an anechoic frequency response measurement and impedance measurement for each system.

When you take delivery of this loudspeaker system, invite a husky neighbor over to help you set it up. At 110 lbs. per speaker and with smooth lacquer sides, this system is *quite* a handful. Part of the reason for this is that Nakamichi recommends the Reference Monitor be mounted 12 to 15 in. away from a wall and 15 to 20 in. off the floor. Four standard cinder blocks are suggested for this purpose under each speaker. The cinder blocks do not come with the unit, so be prepared in the finest spirit of *noblesse oblige*.

This system is very efficient and can provide brisk sound levels with low and medium power amplifiers. No unusual requirements are imposed on the remainder of the audio system with the obvious exception that only the highest quality components should be contemplated with a loudspeaker system of this quality. Nakamichi supplies a short, but very thorough instruction brochure with the Reference Monitor.

Technical Measurements

The magnitude of the measured impedance is shown in Fig. 1. The two resonance peaks in the bass frequency region are due to the fact that this system is a vented design. There are some interesting details in the 400 Hz to 4000 Hz region that indicate some interaction of the loudspeaker drivers with their local acoustic environment. The more complete polar impedance plot of Fig. 2 and the expanded scale plot

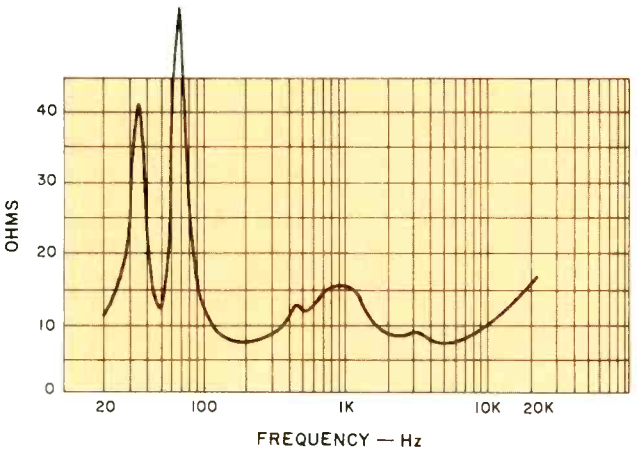


Fig. 1—Impedance.

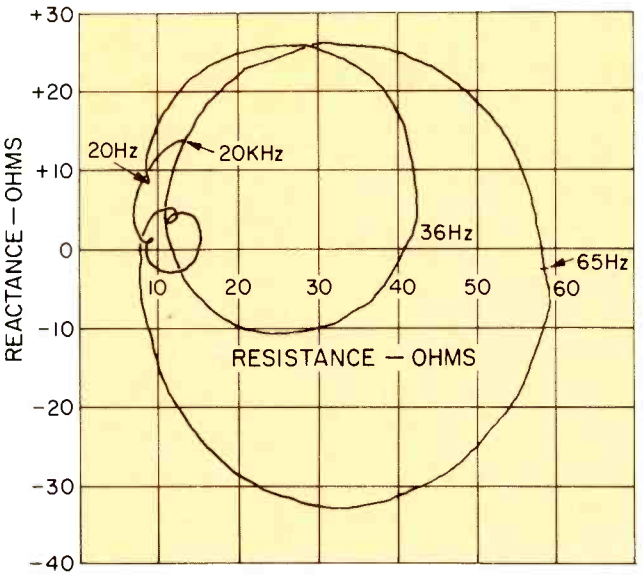


Fig. 2—Polar impedance plot.

of Fig. 3 show the details of this situation. The two bass resonances occur at 36 Hz and 65 Hz, with values of 42 and 58 ohms respectively. The size of these peaks is not significant to the acoustic response.

The expanded plot in Fig. 3 shows the type of load which this speaker imposes on a power amplifier for the frequency range of 100 Hz to 20 kHz. The nature of this plot indicates that a small amount of acoustic interaction is occurring, probably standing wave patterns within the enclosure.

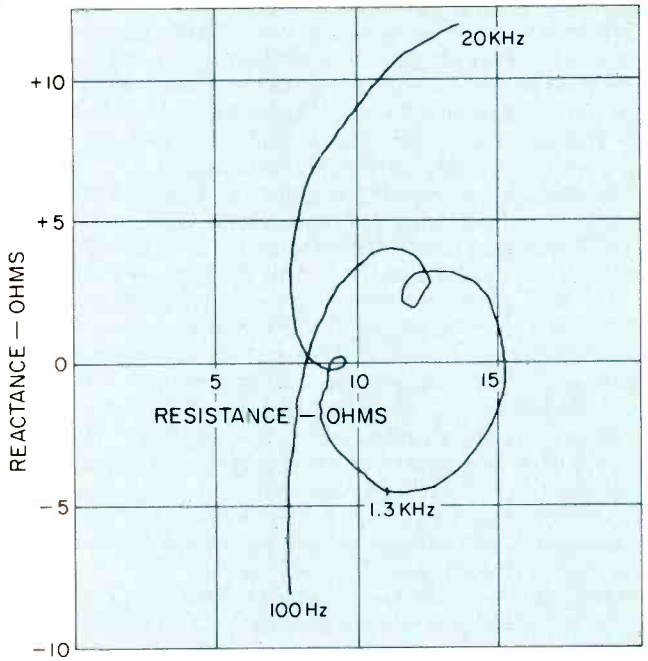


Fig. 3—Expanded-scale polar impedance plot.

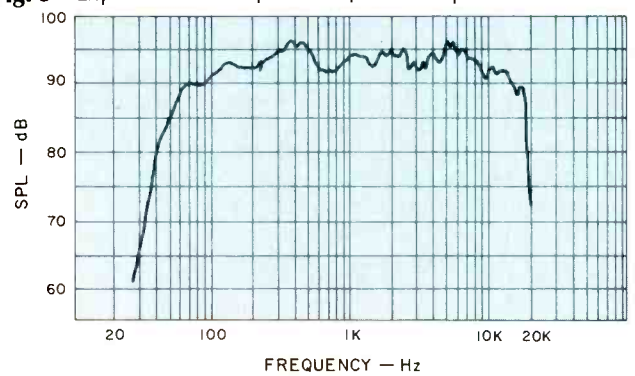


Fig. 4—One-meter anechoic amplitude response at one-watt drive.

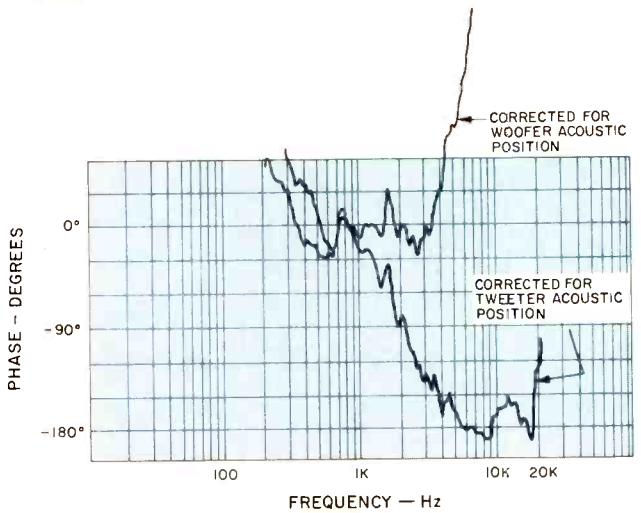


Fig. 5—One-meter phase response.

The lowest high-frequency capacitive load exists at 1.3 kHz and is 12 ohms at an angle of about 30 degrees lagging, which should offer no problems for any good power amplifier. The lowest impedance measures slightly less than 8 ohms.

The one-meter anechoic frequency response is shown in Fig. 4 for its magnitude and Fig. 5 for phase. The sound pressure level in Fig. 4 for a one-watt drive level averages better than 94 dB, which indicates a moderately high efficiency for this system. The low-frequency response falls off rapidly below 50 Hz, a surprisingly high frequency for a professional monitor of this physical size. Since this is a vented system and acoustically unloads so rapidly, it's probably a good idea to use a subsonic cutoff or rumble filter in the preamplifier to prevent subsonic signals from driving the woofer outside its linear range and muddying the response by cross modulation. Such signals could arise from warped records, for example. In a professional recording studio, such program defects do not exist, so a designer need not worry about them. But the signal environment outside the professional studio is quite another story.

Interestingly enough, an anechoic response plot on this particular speaker, as it was tested in Japan, was supplied with the unit. Our measurements duplicated those of Mitsubishi perfectly with the exception of a slight difference above 10 kHz which was due to the fact that we test on the geometric center line of the speaker, rather than in front of the tweeter where Mitsubishi's measurements were taken. Moving our microphone to tweeter level verified this, but for standardization we will continue supplying the response taken on the geometric axis. What makes this result significant is not simply the honesty of Mitsubishi, but that their measurement is done in the classic anechoic chamber, while ours is by coherent signal processing, time delay spectrometry, in a quite substantially reverberant room.

The overall response is quite uniform on the average, but has localized variations. These are shown by the subsequent energy-time plot to be due to enclosure and grille diffraction. The effect should be an overall balanced sound with some coloration in timbre as one moves his listening position relative to the enclosure.

For those technically minded readers, the sound pressure, measured directly in the vent, peaks at 50 Hz, while the near-field woofer cone pressure dips at 43 Hz and has a lower peak at 39 Hz.

The phase response Fig. 5 was duplicated for the two acoustic positions of the woofer and the tweeter. The response is in-phase for the woofer and, as is common for passive crossover two-way systems, 180 degrees out of phase for the tweeter. The impulse response will be a preliminary underpressure, followed in a few tenths of a millisecond by a swing to overpressure as the listener's location, as the woofer response arrives slightly after the tweeter response. With the exception of the crossover between drivers, the overall response is principally minimum phase.

Of course, the average listener does not live in an anechoic chamber, but uses a room. The three-meter room test of the Nakamichi Reference Monitor is shown in Fig. 6. This test was made, in fact, in the exact position used by this reviewer for the listening test. The speakers were placed on a pedestal formed from four cinder blocks, exactly as recommended by Nakamichi. The speaker was away from the wall and angled toward the listening area. The microphone was placed three meters away from the front of the enclosure and at an ear height of one meter above the floor.

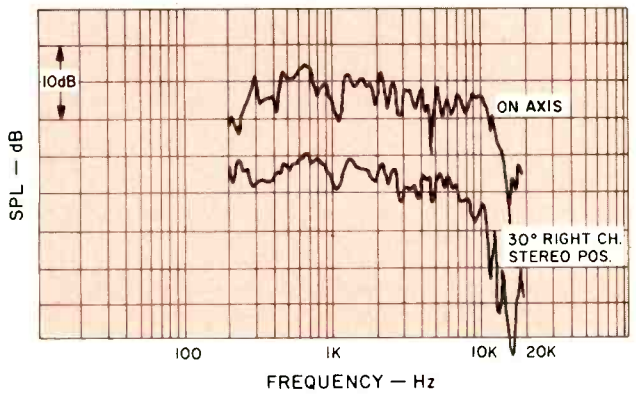


Fig. 6—Three-meter or room response.

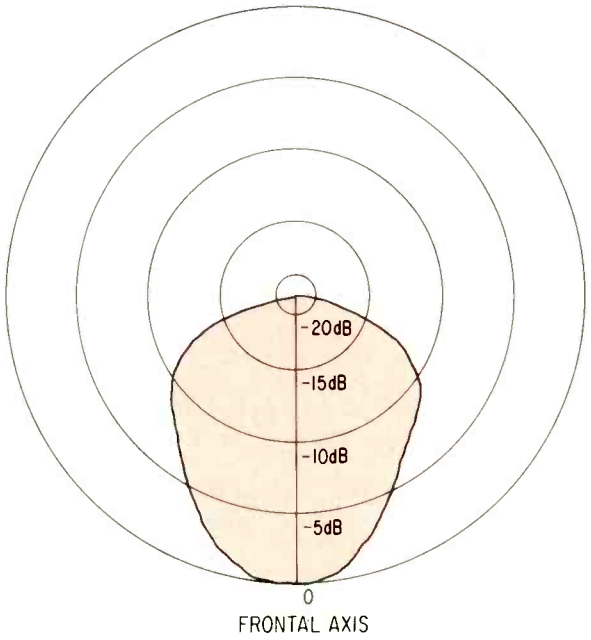


Fig. 7—Horizontal polar energy response.

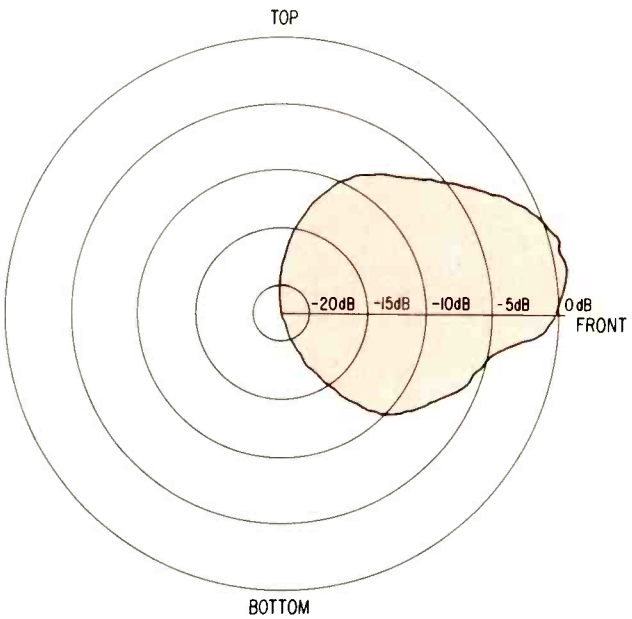


Fig. 8—Vertical polar energy response.

The frequency response that is shown is the Fourier transform of the first 13 milliseconds of sound due to a perfect impulse. Two measurements are shown, one with the speaker oriented toward the microphone and the other with the speaker angled 30 degrees away in a manner corresponding to a right-channel stereo unit that is pointing to the right of the listener. The plots are displaced 10 dB for clarity.

The room response is very good for both positions. The extreme top end dropped inexplicably compared to the anechoic response, though a number of early scatter signals were picked up, and the response is good overall. The fact that the average response is so similar for both angle positions indicates high probability of good stereo imagery. While the off-axis response is some 2 or 3 dB lower than the on-axis, the important thing here is their similarity.

The amount of fall off with horizontal off-axis is shown in the polar energy plot of Fig. 7. This is a computation of the total energy in all components from 20 Hz to 20 kHz and is plotted as a function of angle. This plot shows that the Nakamichi Monitor System should be angled toward the listening position for the most uniform energy balance. There is no apparent left-versus-right bias of energy.

The vertical energy response is shown in Fig. 8. This loudspeaker launches most of its energy upward. The plot shows that, given a choice, this speaker should be mounted closer to the floor than the ceiling. If the speaker is too close to an acoustically hard ceiling, a distinct coloration will result due to ceiling-scattered sound.

Harmonic distortion for the musical tones E1 or 41 Hz, A2 or 110 Hz, and A4 or 440 Hz is shown in Fig. 9. The woofer showed substantial waveform change in the reproduction of E1 (41 Hz) above the 12-watt average level and this is signified by the identifying marks on this plot. All other frequencies were easily handled to 100 watts average power. However, with the efficiency of this system, I could only recommend such power levels as a means of breaking leases. With the exception of E1 (41 Hz), which is really below the acoustic cutoff of this speaker, harmonic distortion is reasonably low. The break in characteristic in the 0.1- to 1-watt range will be explained later.

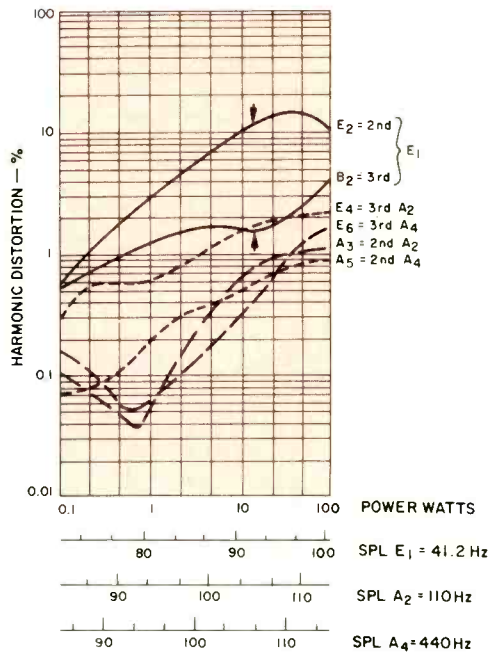


Fig. 9—Harmonic distortion for the tones E1 or 41 Hz, A2 or 110 Hz, and A4 or 440 Hz.

Fig. 10 shows the intermodulation of A4 by E1 (or 44-Hz by 41 Hz) when they are mixed in equal portion. The IM at high power levels is astonishingly low. The type of distortion on A4 at an average power of 60 watts is composed of both amplitude and phase modulation, with 3 per cent peak-to-peak amplitude modulation and 5 degrees peak-to-peak phase modulation at 41 Hz. At this drive level, the woofer shifts position toward the listening area by an amount corresponding to 0.02 milliseconds of air path delay, which is totally inconsequential as far as the sonic effect on the frequencies which the woofer is called upon to handle. The IM falls rapidly with decrease in power to a plateau of about 1.3 percent.

The Nakamichi Monitor has an acoustic transfer function that, at frequencies below 350 Hz, has a shelving type increase above 0.1 watt. This is approximately a 0.6 dB increase in gain, somewhat like a program expander. This should give a mild emphasis to sound peaks above this power level, but will also cause a small lateral spread of musical partials in the stereo stage when instrumental voices are in the one watt and above power range. This characteristic is the reason for the unusual low power harmonic distortion property.

The crescendo handling test was passed easily for three sigma noise peaks up to 350 watts. This means that inner musical voices will not become smeared for sudden momentary random signals, such as applause, that have average power in a 20 kHz band that is 20 dB higher than the average power of the musical tone it is riding over.

The energy-time response, which is the square of the true amplitude of the impulse response, is shown in Fig. 11. The main peak at 3.15 milliseconds. The subsidiary peaks are due to diffraction and scatter within the enclosure. The peak at 3.6 milliseconds, which is the largest contributor, is due to sound from the tweeter that travels along the front grille and reradiates from the top of the enclosure. Other subsidiary peaks are due to reflections from grille and associated housing. This is not as good an impulse response as one might expect from a professional monitor speaker. The problems are associated with the physical housing and manifest themselves in two ways. First, the basic frequency response is made somewhat nonuniform for these peaks, and, second, there is a distinct change of timbre with listening position for the very highest range of frequencies that gives an effect equivalent to polar response irregularities. The average energy is uniform, as has been shown, but the details of the response will be very slightly modified.

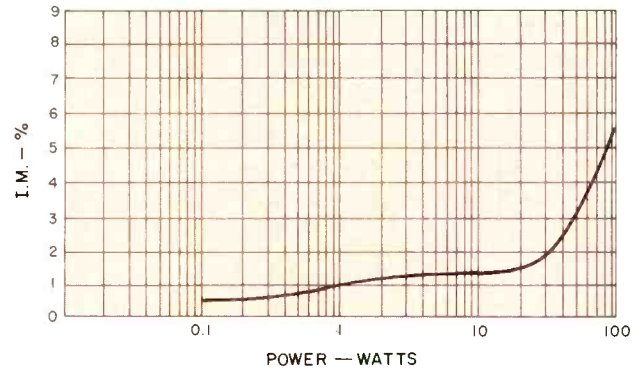


Fig. 10—IM distortion of A4 or 440 Hz by E1 or 41 Hz mixed one to one.

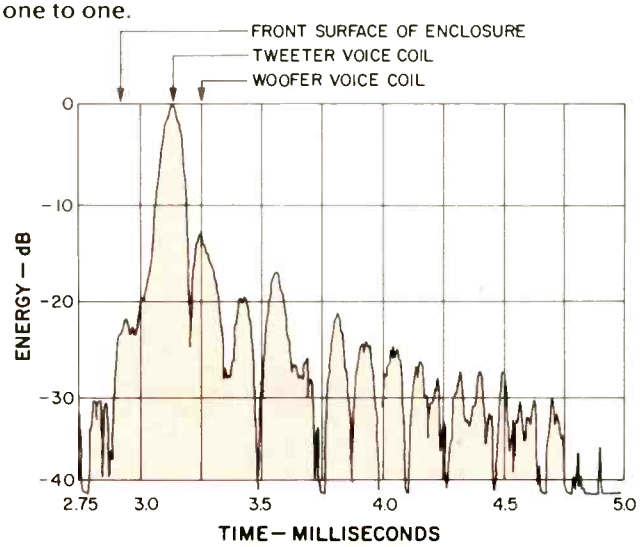


Fig. 11—Energy-time response.

The sides of the Nakamichi Monitor System are rounded, which is a correct way to minimize diffraction from the vertical edge discontinuities. This is why there are no broad "clumps" of energy more than a half millisecond following initial sound.

The first dominant arrival at 3.15 milliseconds has the peak of its response at 8.3 kHz, which means a relatively bright sound. Ninety-five percent of the sound energy arrives within 3.3 milliseconds, and ninety-nine percent arrives within 3.7 milliseconds.

Listening Test

Nakamichi Research provides very explicit recommendations concerning the physical placement of their Reference Monitor System, which were followed to the letter. Four "standard" cinder blocks, measuring 7 ½ X 7 ½ X 15 ½ in. were placed under each speaker to bring them 15 inches off the floor. At 110 lbs. (50 kg) per speaker, the use of cinder blocks is quite logical, if incongruously undecorous. A cloth covering was placed over the cinder blocks prior to hefting the speakers into place.

Standing more than 15 in. away from the back wall, these monoliths make a formidable obstacle that should not be placed where the unwary guest might collide with them. Believe me, the speakers won't budge.

The speakers were tried in both a forward-facing configuration and rotated toward the listening area. Because of discernible polar characteristics, the angled position was chosen for the listening test.

A word of comment on speaker hookup is in order. The Nakamichi Reference Monitor clearly shows its professional heritage by the fact that connection is made to a four-pin XLR type connector. There is an XLR receptacle on each side and they are provided with a locking cap to cover the receptacle not in use. Though it appears this system was originally designed for flush wall mounting, Nakamichi wisely recommends pulling it away from the wall. One problem might arise with the Cannon XLR-4-11C plugs which Nakamichi supplies for hook up. Despite the good instructions supplied, this is not a task many non-professional users will enjoy, even if they have a soldering iron.

Nakamichi also recommends that the user employ a fast-acting 2.5-ampere fuse to protect the loudspeaker from damage. In view of the substantial investment which this system represents, this is a wise precaution.

Overall listening impression is that this system is very analytical in that there is very little coloration of timbre over most of the frequency range. It is a sound, or lack of it, that is needed in certain studio applications. But it will not blow your ears off with robust midrange peakiness, if that is the kind of "monitor" you are expecting. While there are definite polar response "fingers," these can be eliminated by rotating the speakers toward the listening area.

The low bass response was found to be somewhat thin, and in fact, a check was made to be certain that the polarity of one channel had not accidently been reversed with respect to the other. Though this thinness was most noticeable with super low frequency organ music, percussive bass sounded clean to my ears, with no trace of a boomy hangover. The bass spectrum, once it gets going, is so well balanced with respect to the midrange that no position of preamplifier tone control sounded more accurate than flat equalization in the low end.

Piano music sounded most accurate with a very slight cut in treble, corresponding to about 2 dB at 10 kHz with the Marantz preamp this reviewer uses. The overall response was a bit bright with what to be a mild upper treble peak.

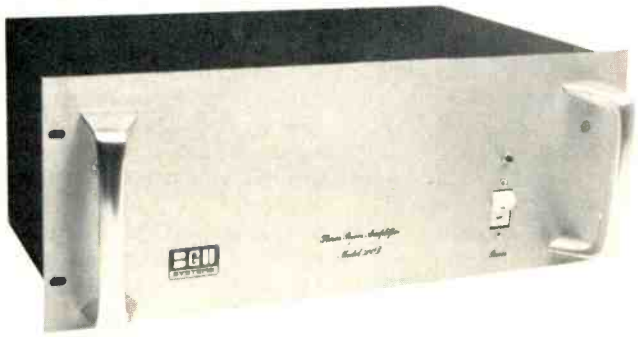
There were two subjective or personal impressions that detracted from perfect performance, which might not be judged as detrimental by others. One of these was a slight sense of compression of dynamic range on program peaks. This showed up as a strained sound on orchestral and vocal peaks in what seemed to be the 3-to-5-kHz range. To those who know the sound I refer to, it was a very mild case of "cone cry." Perhaps a part of this two-way system is called upon to carry too much of a load.

The second subjective impression was that horns appeared somewhat back in the stereo stage, though the general impression I had was that the stereo stage was compressed in depth and pulled forward to lie on a surface passing through the location of the loudspeakers.

But these were the *only* problems I sensed. In general, stereo lateralization and accuracy of instrument location in angle is exceedingly good. Center-channel vocals come smack from stage center and do not broaden into "jolly green giant" voices. The sound of percussion is very good and overall transient accuracy is excellent, although not as well articulated as the very best electrostatic top ends I have heard.

One of the interesting observations of the Nakamichi Reference Monitor is that it can be listened to at low sound levels without losing balance. This is a trick of the trade with which one can quickly separate the clean loudspeaker from the impressive, but peaky responsed loudspeaker. This Nakamichi is definitely clean in spectral balance. At a price of $1,200 per speaker, the sound had better be good, and the Nakamichi's sound *is* good. *Richard C. Heyser*

BGW Systems Model 500D Basic Power Amplifier



MANUFACTURER'S SPECIFICATIONS

Power Output: 200 watts per channel, both channels driven into 8 ohms, with less than 0.1% total harmonic distortion or intermodulation distortion, from 20 Hz to 15 kHz; 251 watts per channel, both channels driven into 4 ohms, with less than 0.25% total harmonic distortion or intermodulation distortion, from 20 Hz to 15 kHz; 501 watts mono mode with less than 0.25% total harmonic distortion or intermodulation distortion from 20 Hz to 15 kHz. **Signal-to-Noise Ratio:** 110 dB. **Damping Factor:** 500. **Dimensions:** 19 in. W x 7 in. H x 12 in. D. **Weight:** 49 lbs. **Price:** $839.00

The BGW 500D, yet another addition to the 20 to 30 stereo power amps in the 150 to 200 watt per channel power class, appears to be quite well made, about as solid as a brick. The basic chassis is a rectangular steel box with the top open. The power transformer is appropriately large and is mounted on the inside left (as viewed from the front). An L-shaped bracket is attached to the internal floor of the chassis and has mounted to it two 10,000 μF/75V capacitors, a diode bridge rectifier, a silicon controlled rectifier, and a three-terminal barrier strip to terminate the incoming line cord. Two large power resistors are mounted on the bottom of the chassis; one is in series with the a.c. line to reduce inrush current and gets relay shorted after a short time delay, and the other is in series with the SCR which is wired across the plus and minus terminals of the power supply.

On the inside rear of the enclosure is a barrier strip for primary strapping of the power transformer, the cooling fan, and a PC board containing the turn-off time delay and the SCR crowbar control circuitry.

Covering the top of the enclosure (except for about an inch in the middle) are the two heat sink/amplifier modules. These are large sinks with two rows of six TO-3 power transistors mounted on them. On the non-fin side of the sinks are the amplifier circuit boards. Connections are made to the power supply's input and output through an 11-pin connector mounted on the circuit board. Over the top of the heat sinks is the top cover of the unit, which is solid on the top and rear and open at the left and right ends. The ar-

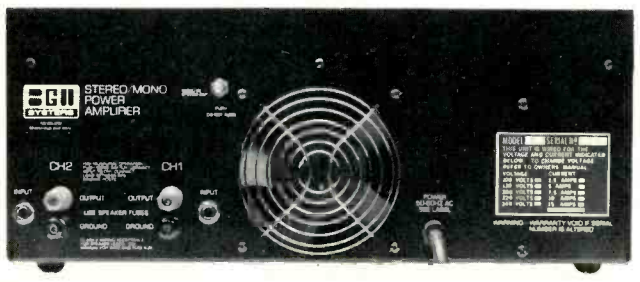


Fig. 1—Rear panel.

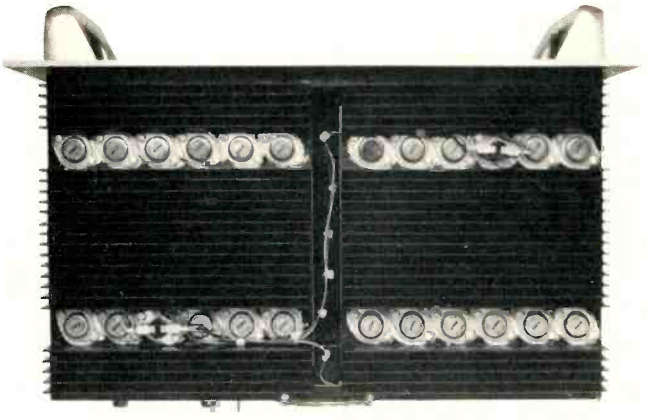


Fig. 2—Interior view.

rangement is such that the air flow from the fan comes up between the heat sinks in the middle and is forced to travel horizontally through the fins to the exit ports in the top cover. All in all, a very effective cooling scheme.

The front panel, which is 3/16-in. thick, has two beefy handles, a rocker-type power switch/circuit breaker, and a LED power-on indicator. On the rear panel are two pairs of fiveway binding post speaker connectors, two phone-jack input connectors, the power cord, and a protruding 1/4-in. shaft that operates the stereo/mono switch.

Circuit Description

The first stages of the 500D are those of a LM318 operational amplifier. The output of the op amp feeds a complementary pre-driver stage, Q1 and Q2, operating at a collector current of about 25 mA. Considerable emitter degeneration is present in this stage, which raises the output impedance, giving the output stage more of a current source, improves stage linearity, and helps the stage quiescent current stability.

Connected between the collectors of Q1 and Q2 is the bias shunt regulator, Q3. The output stage is a quasi-complementary emitter-follower. Q4 and Q6 are Darlington-connected followers, driving the composite plus half-cycle output transistor, consisting of Q8, 10, 12, 14 and 16 in parallel. Q5 is the input to the compound-connected minus half-cycle side of the output stage. Q7 is an emitter-follower, driving the minus half-cycle composite-output transistor, Q 9, 11, 13, 15, 17 in parallel. Q6 and Q7 drivers are RCA multiple-emitter-site devices, and all outputs are RCA single-diffused types.

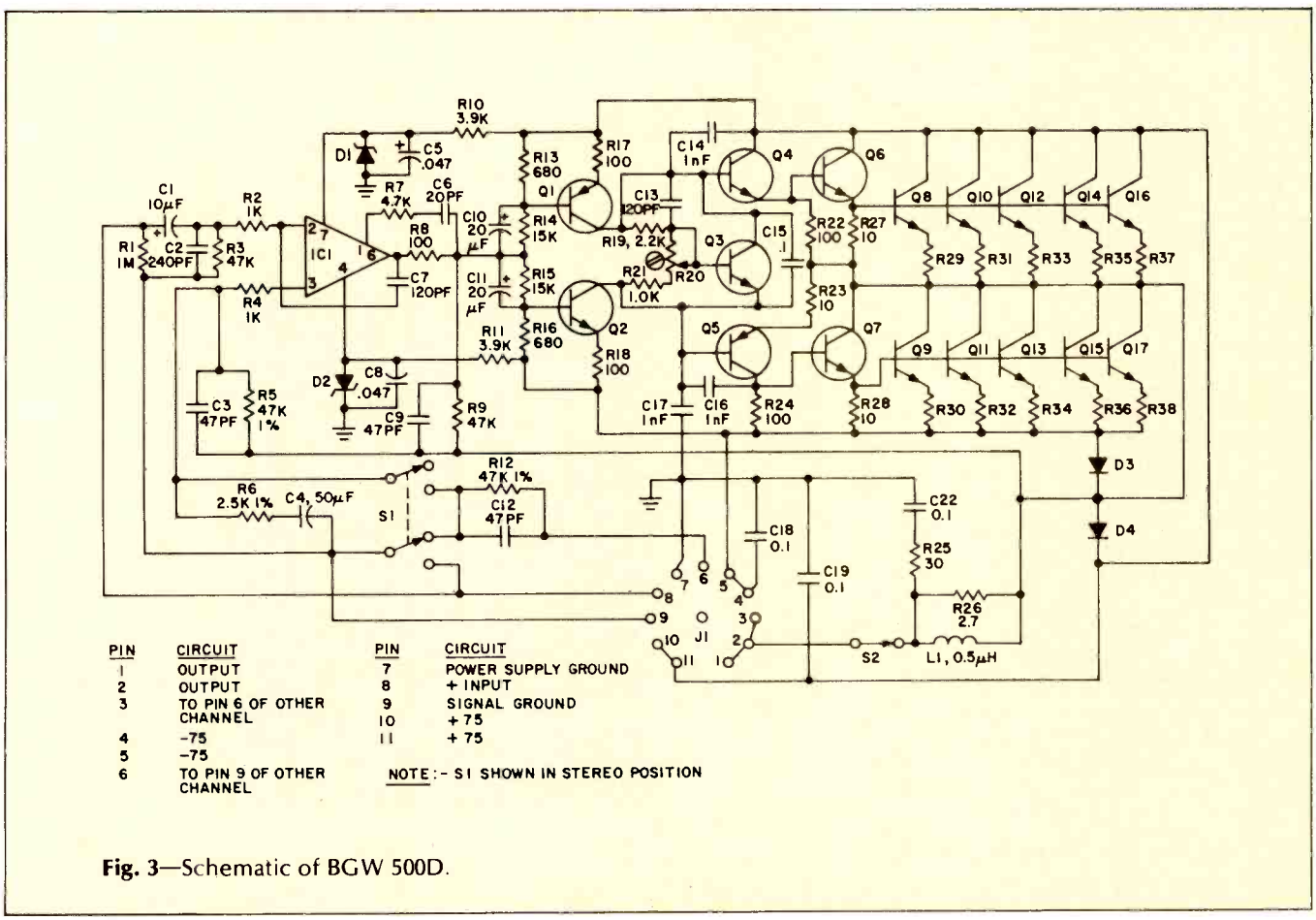
Negative feedback is taken back in two loops. One loop, via R9 and C9, is around the predriver and output stage, and the overall loop, through R5 and C3, is around the total amplifier.

Mono full-bridge operation of this unit is selected by pushing in the shaft on the rear panel. A switch on one amplifier's circuit board converts one channel to a unity gain inverting circuit with its input fed from the output of the other channel. The load is then taken between the hot terminals of each channel and effectively doubles the output voltage giving the per channel four-ohm power into a single eight-ohm load.

There is no instantaneious VI limiting in this circuit, adequate safe area being provided by the multiplicity of output devices. A circuit on the time-delay circuit board senses plus and minus d.c. levels in the output of each channel and if considered excessive, triggers the SCR crowbar device which shorts the plus and minus 75 V supply together through a two-ohm resistor. This discharge of the power supply causes the primary circuit breaker to open, thus shutting off the amplifier and protecting the load.

Listening Tests

The 500D was listened to on the reviewer's arrays and a pair of Dahlquist DQ-10s recently loaned to *Audio* for amplifier review purposes. The bass reproduction on this amplifier is excellent,giving good control of the DQ-10 woofers. It is relatively free of upper bass boominess and has good lower bass punch. The midrange sound is similarly good, though the high end sound has a bit of brightness or edginess.



PIN	CIRCUIT	PIN	CIRCUIT
1	OUTPUT	7	POWER SUPPLY GROUND
2	OUTPUT	8	+ INPUT
3	TO PIN 6 OF OTHER CHANNEL	9	SIGNAL GROUND
		10	+ 75
4	-75	11	+ 75
5	-75		
6	TO PIN 9 OF OTHER CHANNEL		

NOTE:- S1 SHOWN IN STEREO POSITION

Fig. 3—Schematic of BGW 500D.

Measurements

The 500D was first run at one third of rated power, 66.6 watts, into eight-ohm loads for one hour with a 1 kHz test frequency. Under these conditions, the fan alternately ran at low and high speed. The unit was then run for a second hour into four-ohm loads. Rated power into four ohms is 251 watts per channel and the test power was therefore 83.7 watts per channel. This time, the fan ran continuously at high speed and exhausted plenty of heat. Fan noise at high speed is fairly loud and could be objectionable to some people in a home music installation but would probably be okay in industrial and PA applications. However, if one is really pushing the amp hard and the fan does go to high speed, the resulting music level would in all probability drown out the fan noise. All things considered, this unit has excellent thermal capability and is one of the few units on the market that has adequate cooling for low impedance loads.

Voltage gain was measured and found to be 20X or 26 dB, which is normal gain for power amps. IM distortion along with 1 kHz THD is shown in Fig. 4. The measured behavior of this amp is different from any other thus far in that the IM and 1 kHz THD are virtually independent of power over a very wide range. The predominant harmonic distortion is even order, stemming from a gain imbalance per half cycle. It wasn't determined just where in the circuit that this gain imbalance occurred, but it could be in the way the unit is internally grounded and/or in the output stage where the minus half cycle or compound side has more gain than the cascaded emitter-followers in the plus half-cycle part of the circuit. The distortion products on IM are essentially a 60-Hz square wave which indicates even-order nonlinearity, and on THD, the residue looks like a full wave rectified sine-wave, again indicative of even order nonlinearity. There are some higher order odd harmonics present also, mainly due to crossover distortion and are shown in Fig. 4. The fact that they peak at about 100 mW instead of disappearing below 1-10 watts, as has been characteristic of the better amps tested, may be partially responsible for the slightly harsher high end exhibited by this amp in the listening tests. The predominance of even-order products may be responsible for the apparent extra brightness observed.

Figure 5 illustrates the one-watt frequency response and THD vs frequency and power. The high end rolloff is at a lower frequency than usual, being 3-dB down at 80 kHz. The THD curves reveal increasing high frequency distortion with decreasing level. This is mainly caused by crossover or notch distortion where the magnitude starts to increase with frequency due to the falling compensated open-loop-gain characteristic. The magnitude of the notch starts to override the half-cycle gain unbalance, which is about 0.03% above 3 kHz. The 200-watt curve has the lowest magnitude, but starts to rise above 13 kHz or so due to early peak clipping due to common mode conduction in the single-diffused output devices dragging down the power supply. There were no observable aberrations in THD near 120 Hz due to beating of the signal test frequency with the 120-Hz power supply ripple.

Figure 6 shows a 80-V p-p, 200-watt, 50-Hz square wave into 8 ohms and a 10 V p-p, 10-kHz square wave into 0.22 μF. The 50-Hz waveform exhibits relatively low tilt which is de-

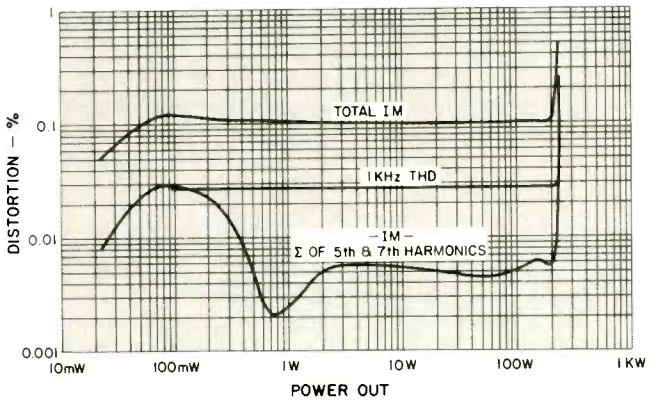


Fig. 4—Distortion versus power into 8-ohm loads.

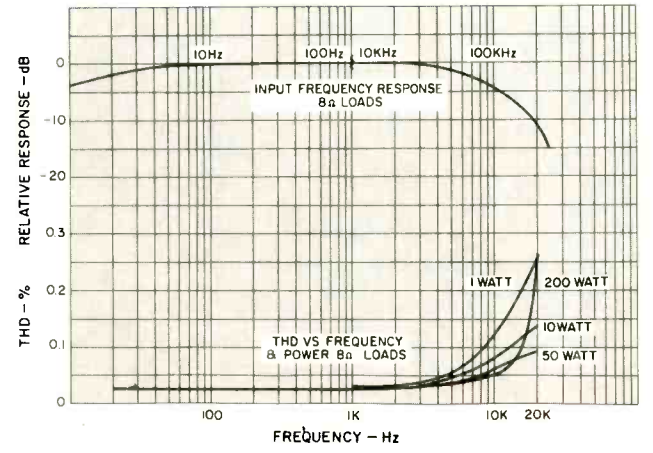


Fig. 5—Upper curve, 1-watt frequency response with 8-ohm loads (note break in scale at 100 Hz-10 kHz); lower curve, THD versus frequency and power with 8-ohm loads.

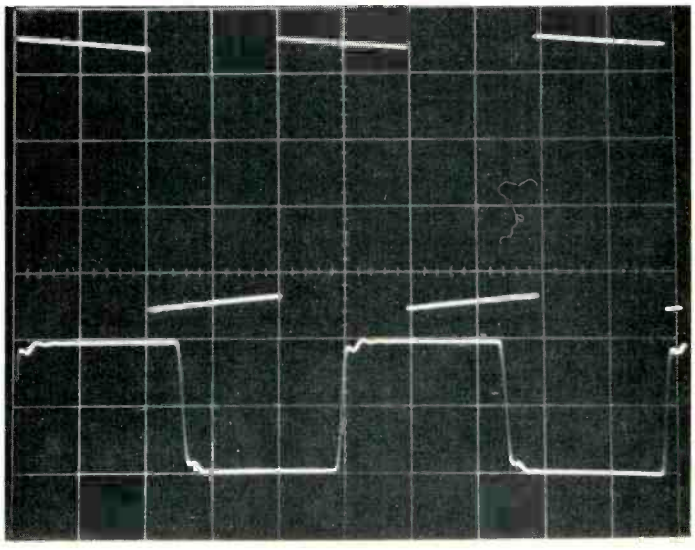


Fig. 6—Top curve, 200-watt, 50-Hz square wave with 8-ohm load (scale: 20V/cm, 5 mS/cm); lower trace, 10-V p-p, 10-kHz square wave into 0.22-μF load (scale: 5 V/cm, 20 μS/cm).

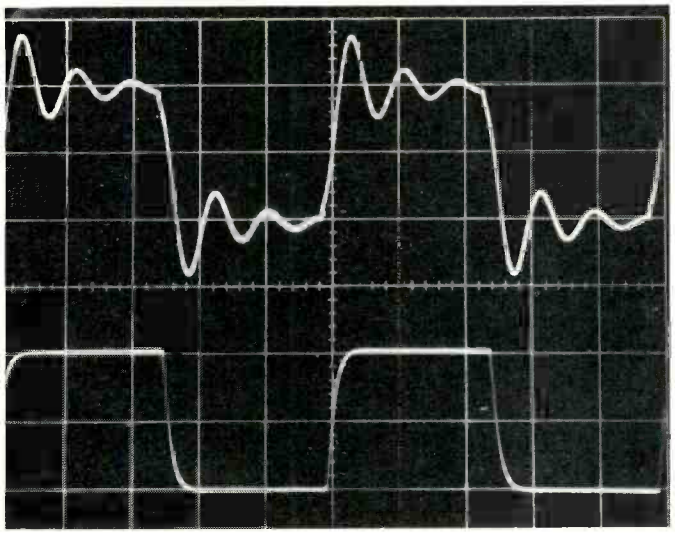


Fig. 7—10-V p-p, 10-kHz square wave into, top, 2-μF load and, bottom, 8-ohm load. (Scale for both: 5 V/cm, 20 μS/cm.

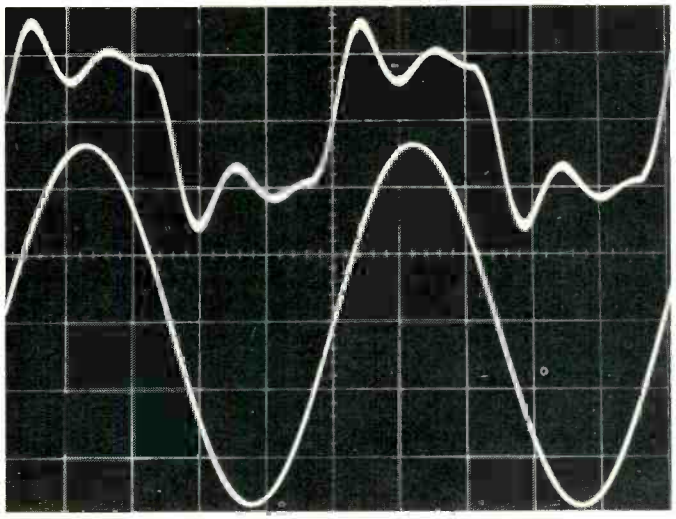


Fig. 8—Behavior at 20 kHz into 1-μF load. Top, square wave; bottom, sine wave. (Scale for both: 20 V/cm, 10 μS/cm.)

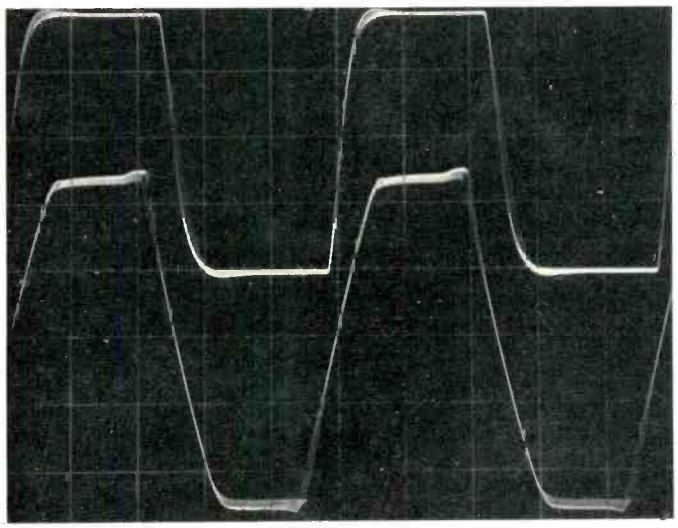


Fig. 9—Top curve, 20-kHz square wave into 8-ohm load; lower curve, 20-kHz sine wave into 8-ohm load with 2-dB overdrive. (Scale for both: 20 V/cm, 10 μS/cm.)

sirable. A reader recently suggested that amplifiers be tested with capacitive loads in the range of 0.05 to 0.2 μF to see if any real amplifier instability occurs. Accordingly, the second trace of Fig. 6 shows the 500D's behaviour with 0.22 μF. As capacitance is raised from zero, the circuit starts to ring at about 0.05 μF and rings more and more with decreasing resonant frequency as capacitance increases to the low microfarad range. With this amplifier, no sign of amplifier instability *per se* was observed. The ringing shown is caused by the RLC network formed by the series buffing inductor typically paralleled by a resistor in the 1-15 ohm range and the capacitance load itself.

Figure 7 is for a 10-kHz, 10-V p-p square wave into a 2-μV load and an 8-ohm resistive load. Ringing with 2 μF is typical of other solid-state amps. The rise time of the resistive load waveform is slower than most other solid-state amps, reflecting the designer's philosophy on required or desirable bandwidth. Of greater interest in this regard, however, is the fact that the rise time as a function of signal level is more constant than any amp so far tested, being about 4-5 μS. Furthermore, at 80-V p-p, the shape is still exponential instead of straight sided which suggests that the amplifier isn't allowed to slew rate limit by the relatively slow overall rise time. (See top trace of Fig. 10.) Fig. 8 shows behaviour at 20 kHz into a 1-μF reactive load. The top trace is for square-wave drive. Attempts at higher levels simply blew the primary circuit breaker. The level that was achieved (40-V p-p) is suggestive that the amplifier is behaving equally for plus and minus transitions and would probably look good at higher outputs if the breaker would permit. The sine wave level is 40 V rms or 200 volt-amps. THD under these conditions was 0.4%.

The top trace of Fig. 9 is an 80-V p-p, 20 kHz square wave into 8 ohms. Note the rise and fall portions are exponential in shape, and both transitions behave about the same. The blurring at the corners is a 120-Hz power-supply-ripple modulation effect that decreases as power is reduced. The lower trace is for a 2-dB overdrive beyond the onset of visual clipping with a 20-kHz sine wave. Not evident in this trace is the sudden reduction of peak amplitude when clipping occurs, which must be accompanied by increased common mode conduction in the output stage, thus dragging down the power supply. "Sticking" *per se* is relatively absent.

Damping factor was measured as a function of frequency and varied from 225 at low frequencies to 200 at 1 kHz, decreasing to about 25 at 20 kHz. Output noise as a function of measurement bandwidth is shown in Table I below. The higher noise level in the 20 Hz to 20 kHz band was caused by line harmonics, and the 122 μV figure is 110 dB below 200 watts into eight ohms—quite good. Power at 1 kHz at onset of visual clipping into four-, eight-, and sixteen-ohm loads was 380, 231, and 129 watts, respectively.

In summary, the 500D is a strong, well-built amplifier that should be quite rugged in use, especially with lower impedance and capacitive loads. It would be a very excellent choice as a woofer amplifier in a multi-way system. As a wide range amplifier, the 500D will drive difficult loads with stability and safety. *Bascom H. King*

Table I—Output noise as a function of bandwidth, in μV.

Bandwidth	Left	Right
20-20k	122	70
400-20k	60	63

Directory Addenda

Audio General
1631 Easton Road
Willow Grove, Pa. 19090

Gale Electronics
c/o Roth-Sindell
Suite 102
540 Kelton Ave.
Los Angeles, Calif. 90024

Sennehiser Electronics Corp.
10 West 37th St.
New York, N.Y. 10018

McIntosh Laboratory, Inc.
Two Chambers St.
Binghamton, N.Y. 13903

The listing for Infinity's Servo Statik IA on page 86 of the October Directory contained several errors. System type is electrostatic, rather than ported, and has a sealed bass comode operating below 70 Hz. It does not have a Walsh tweeter.

Amtroncraft Kits, Ltd.
1 West 13th St.
New York, N.Y. 10011

Stark Designs Co.
7621 Fulton Ave.
North Hollywood, Calif. 91605

STR
3000 Orange Grove Ave.
North Highlands, Calif. 95660

Jensen Sound Laboratories notes that the prices listed for their speakers in October's Annual Equipment Directory are for speaker pairs.

AMPLIFIERS

MANUFACTURER	MODEL	FTC power/chan., 8 ohms, watts	Freq. range for rated power, Hz - kHz	Highest THD from 0.25W to rated power, %	Highest IM from 0.25W to rated power, %	S/N phono, re 10 mV input, dB	Phono sensitivity, in mV, Phono 1, phono 2	Phono overload, in mV, Phono 1, phono 2	Mike input sens., mV	High level input, V	Headphone output level, V	Headphone load impedance	Output impedance, ohms	Damping factor, 1 kHz	Dimensions, in inches	Weight, lbs. (net)	Price, $	NOTES
AMTRONCRAFT	(B) UK-192 UK-185	25 10	5-80 20-20	1.0 0.5		80	3			0.07			4 4		12½x9x4¾	5	139.95(K) 99.50(K)	Requires power supply.

All models solid-state except where mod. no. preceded by (T).
Basic power amps have mod. no. preceded by (B).
(K) indicates kit price; (W) wired.
(Ω) with mod. no. indicates quad.

PREAMPLIFIERS

MANUFACTURER	MODEL	Frequency response 7Hz - 7kHz, ±? dB	Rated output, V	THD at rated output, %	IM at rated output, %	S/N ratio, phono, dB re 10 mV input	Phono sens., mV, phono 1/phono 2	Phono overload, mV, phono 1/phono 2	Mike input sens., mV	High-level sens., V	Tape mon. impedance, ohms	Tape mon. output level, V	Dimensions, in.	Weight, lbs.	Price, $	NOTES
AMTRONCRAFT	UK-175 UK-118		1 1	0.3		80	2			0.1 1.0			9x6½x4¼ 11⅞x7x4	2 1½	99.50(K) 115.50(K)	Powered by amp. As above.
AUDIO GENERAL	511	20-20 ±0.1	5	0.005	0.005	80	2.3	70		0.23	38k	0.23	14x10x5¼	15	400.00	No tone controls.

All models solid-state except where model no. is preceded by (T).
(K) indicates kit price; (W) wired.
(Ω) with mod. no. indicates quad.

SPEAKERS

MANUFACTURER	MODEL	Enclosure type	Woofer dia., in.	Woofer resonance (in system)	Midrange dia., in.	Midrange type	Tweeter dia., in.	Tweeter type	Level control(s) M=Mid, T=Tweeter	Anechoic freq. response, Hz±kHz, ± ? dB	Sens. for 1 W input, dB SPL, 1 mtr. on-axis, 100 Hz-10 kHz	Power handling capability continuous watts	Crossover frequencies, Hz.	Impedance, nominal	Dimensions, inches	Wood finish	Grille material, color	Weight, lbs.	Price, $	NOTES
GALE ELECTRONICS	GS-401	Ac.sus.	(2)8		(2)4	Cone	¾	Dome	M,T	55-20 ±3		100	475, 5k	8	23¾x13 x10¾	*	*		385.00	*Choice.
STARK DESIGNS	SR-1	Ac.sus.	10	43	5	Cone	1	Dome	M,T	40-20 ±5	79	40	450, 4.5k	8	24x15 x11½	Wal.	Foam 5 colors	42	165.00 Each	(1)
	SR-2	Ac.sus.	12	38	5	Cone	1	Dome	M,T	35-20 ±3	81	50	450, 4.5k	8	24x15 x14	Wal.	Foam 5 colors	48	195.00 Each	(1)
	SR-3	Ac.sus.	12	38	(2)5	Cone	(2)1	Dome	M,T	35-20 ±3	81	60	450, 4.5k	8	24x16½ x14	Wal.	Foam 5 colors	57	240.00 Each	(1) (2)
STR	Beta	Ported	8	75	–	–	3½	Dome	–	55-22 ±5	93	18	1.5k	8	16x9¾ x10	Vinyl	Foam, blk.	18	74.50	Fused
	Gamma	Ac.sus.	10	42	3½	Dome		PZ	–	37-21 ±5	93	30	1.5k, 10k	6	23¾x14¾ x12½	Wal.	Foam, blk.	43	179.00	Fused
	Gamma II	Ac.sus.	10	42	–	–	3½	Dome	–	37-21 ±5	93	30	1.5k	6	23¾x14¾ x12½	Vinyl	Foam, blk.	43	108.00	Fused
	P-10	Ported	10	65	4½	Dome	3½	Dome	T	40-20 ±5	95	75	1.5k, 5k	6	25¾x13¾ x15¾	Wal.	Cloth, blk.	65	249.00	Fused
	P-12	Ported	10	65	4½	Dome	(2)	Dome PZ	M,T	30-21 ±4	91	125	300, 5k	8	31¾x15¾ x15½	Wal.	Cloth, blk.	80	349.00	Fused
	Sigma II	Ported	12		4½	Dome	(2)	Dome PZ	M,T	40-21 ±4	94	200	900, 5k	8	31¾x15¾ x15½	Wal.	Cloth, blk.	85	399.00	Fused
	Omega II	Dual slot	(2) 12		8	Cone	(2)	Dome PZ	W,M,T	23-18 ±3	93	200	150, 3k	8	31¾x15¾ x31¾	Wal.	Cloth, blk.	170	649.00	Fused, bi- and tri-ampable.
	Theta III*						(3)	PZ	T	5k-25k	100	150	4k	20	6x6x12¾	Wal.	Cloth, blk.	5	149.00 Pair	*Add-on tweeter; fused; for parallel operation.

REFERENCE NOTES: (1) Rotatable High Frequency Dispersion Unit. (2) Rear mounted mid and high frequency drivers.

MICROPHONES

MANUFACTURER	MODEL	Directional pattern	Operating principle	Case material	External finish	Impedance, ohms	Freq. resp., Hz±kHz, ± ? dB	EIA sensitivity, dBm	Mic. connection	Cable length, ft.	Cable plug type	Dimensions, in.	Weight, oz.	Mounting method	Price, $	NOTES
SENNHEISER	MD-441	Super card.	Dyn.	Metal	Chrome plastic	200	30-20	–146	XLR	15	–	10.6x 1.4x1.3	16	5/8 x 27	275.00	Adj. Freq. resp.
	MD-421	Card.	Dyn.	Plas.	Chrome plastic	200	30-17	–146	XLR	15	–	7x1.8 x1.7	14	5/8	193.00	
	MD-416	Card.	Dyn.	Metal	Satin nickel	200	50-16	–151	XLR	15	–	7 x 2	11	5/8	180.50	
	MD-413	Card.	Dyn.	Metal	Satin nickel	200	50-15	–151	XLR	15	–	5 x .87	10	5/8	140.00	
	MD-211	Omni.	Dyn.	Metal	Satin chrome	200	30-20	–151	XLR	15	–	5 x .87	4.5	5/8	214.50	
	MD-402	Super card	Dyn.	Metal	Chrome	750	80-12.5	–151		5	Phone	5.7 x .83	6½	Clamp	50.00	
	MD-412	Super card	Dyn.	Plastic	Plastic	800	50-12.5	–151		5	Phone	5⅛x1½ x1½	2.1	Clamp	72.50	
	MKH-815	Beam	RF cond.	Metal	Satin nickel	10	50-20	–115	XLR	–	–	22x¾	14	Clamp	629.00	
	MKH-415	Club	RF cond.	Metal	Satin chrome	10	40-20	–121	XLR	–	–	10x¾	6	Clamp	529.00	
	MKH-435	Card.	RF cond.	Metal	Satin chrome	10	40-20	–121	XLR	–	–	7½x¾	5	Clamp	495.00	
	MKE-201	Omni.	Elect. cond.	Metal	Satin nickel	15k	50-15	–135		5	Phone	7x¾	4	Clamp	126.50	
	MKE-401	Card.	Elect. cond.	Metal	Satin nickel	15k	50-15	–135		5	Phone	7x¾	4	Clamp	147.50	
	MKE-2002	*	Elect. cond.	Metal	Enamel	1.5k	40-20	–141		10	DIN		2		330.00	*Double mike for binaural stereo.

HEADPHONES

MANUFACTURER	MODEL	Type (dynamic, electrostatic, etc.)	Freq. response, Hz±kHz, ± ? dB	Impedance, ohms	Sensitivity, dB SPL for 1 mV input	Maximum input, mV	Distortion, %, at rated input, 1 kHz	Cord length, ft.	Weight, oz.	Price, $	NOTES
SENNHEISER	HD-44	Dyn.	40-15	640	94	8k	1.5	10	1.2	29.75	
	HD-414	Dyn.	20-20	2k	102	18k	1	10	4.8	49.75	Open-aire design.
	HD-424	Dyn.	16-20	2k	102	18k	1	10	6.7	79.95	Deluxe version of 414.
	HD-4004	Dyn.	100-6	17	82	5k	1.5	25	0.6	12.00	Mono, for TV listening.
	HD-110	Dyn.	20-20	200	98	7k	1	5	10	111.50	High isolation, for monitoring.

The Column

Atlantic Crossing: Rod Stewart
Warner Brothers BS 2875, stereo, $6.95

Sometimes it's fairly interesting to take a wild animal and domesticate him, but such experiments aren't very interesting if extended over a period of time. This is Rod Stewart's album in which the backing musicians are dressed in business suits rather than dungarees—producer Tom Dowd (replacing regular producer Rod Stewart) has taken Rod out of the garage band bash sessions and placed him in front of seasoned session men who play with precision/taste more often than exuberance/flash. Sometimes it works (mostly on the slow side), and sometimes it doesn't—but this is an experimental album rather than your usual Rod Stewart disc. I like it quite a bit, especially compared to the majority of records out on the shelves, but it's as flaw-laden as Alice's *Welcome to my Nightmare* or Roger Daltrey's solo efforts. You can take the man out of the jungle, but you can't totally take the animal out of him—but Tom Dowd almost does from time to time.

Dowd knows more about getting a band to sound right than getting the most out of a vocalist—Stewart doesn't sing his best on the fast side, particularly on *Stone Cold Sober*. The players seem to be hitting the right notes, and the track seems to sound good, but somehow Stewart has the kind of voice that rocks best when pitted against a chunky rhythm guitar like Ronnie Wood's than a precise rhythm section and rather restrained guitar. Good old Roddy knows how to deal with a slow tune when the backing is right, and songs like *I Don't Want To Talk About It*, the Al Green-isms of *This Old Heart of Mine*, and Sutherlands' *Sailing* come off as sterling gems with no comparable tracks in the entire Stewart catalogue. When Stewart's done a ballad in the past, it's usually been marked by the same rough edges that characterize his uptempo numbers. Now his ballads are smooth, well-crafted pieces of plastic, but his rockers lack the raunch—I suppose how much you like this album depends largely upon (1) how important you think raw punch is to Stewart's music and (2) whether you value Rod's rockers higher than his "down" tunes.

Don't get me wrong—I enjoy listening to this album quite a lot, and Rod'll shine through any muck that you place around his voice. He's one of the most recognizeable vocalists on the scene today, and this is his first al-

bum to sound like the "finished product" that I've heard Rod gripe so much about, he being a great defender of looseness and spontaneity. I just hope that in the future Rod recognizes the importance of the "ka-chunk" to his music, and with Ron "He's Good-Looking, Girls" Wood moving over to the Rolling Stones (we suspect) and The Faces dissolving, my guess is that the Stewart-Wood collaborations may re-emerge as the dominant force on Rod's solo outings, as the reason for all this gloss on *Atlantic Crossing* is just to prove that there's a difference between Faces albums and Stewart albums. Point proved, let's get back to basics. *Jon Tiven*

Sound: A — Performance: B

The Dream Weaver: Gary Wright
Warner Bros. BS-2868, stereo, $6.98

Gary Wright is yet another solo artist who came out of a band that has been around for quite some time. His origin is Spooky Tooth, a band I never could really get a handle on, yet often enjoyed. Wright played keyboards with that band and it's only fitting that, apart from the vocals and the drums of Andy Newmark and Jim Keltner, all the sounds are from keyboard instruments (Ronnie Montrose's guitar is heard on one cut). Moog bass, Arp strings, Fender piano, Hammond organ, and other brand name sounds provide an exquisite framework for more relaxed vocals than you would ever expect from a Spooky Toother.

The lyrics are in keeping with our times. Rock frankly has run out of words and in general lost interest in lyrics other than as a hook to give the title some meaning. On this album, except for the poetry of *Dream Weaver*, poetry takes a minor role in the whole of any song. In this time, where Do-ahah and Da-da-diddy-dum are definitely a no-no, an artist like Gary Wright has a real difficult time of it keeping current and keeping himself inside the framework of tried and tested Rock-type tunes. The lyric is needed to preserve the identity of the music as Rock and Roll, and also to satisfy old fans from his Spooky Tooth days. Without them **The Dream Weaver** would have to face the marketplace as an instrumental disc. Even though it merits this carping about words, **The Dream Weaver** is successful no matter how you approach it. In striking a balance between his voice and his instruments Gary produces a laid-back, comfortable album that has no outstanding tune or element, other than start-to-finish competence. The whole is greater than its parts and

should appeal to many tastes. The ease and smoothness of the performance lifts this far away from the Spooky Tooth mold, as does the superb recorded sound.

Gary Wright is maturing right along with his audience. He even avoids hollering even once. He brings home **The Dream Weaver** with taste, flair, and warmth. *Fred De Van*

Sound: A Performance: A

Land's End: Jimmy Webb
Asylum 5070, stereo, $6.98.

This record earns my first Red Scrawl Award. I listened to it once and then scrawled *total loss* across the cover. If you are looking for great song writers performing their own material (and Webb *is* a great writer), try Janis Ian **Between The Lines**, Columbia PC33394, and **Stars**, Columbia 3285; Gordon Lightfoot, **Cold On The Shoulder**, Warner MS 42206; Van Morrison, **Veedon Fleece**, Warner BS 2805; Jackson Browne, **For Everyman**, Asylum 5067, or even Paul Williams, **Here Comes Inspiration**, A&M 3606.

Avoid this Jimmy Webb album. As good as he is, he just doesn't make it with this one. Maybe I could accept someone less well-known coming up with something like this—maybe Tim Moore, or Michael D'Abo, but I heard this Jimmy Webb album first. This review comes after listening the third time and the red scrawl still applies. *Total Loss!* *Fred DeVan*

Sound: B Performance: D

Upchurch/Tennyson: Phil Upchurch/Tennyson Stephens
Kudu KU 22S1, stereo, $6.98.

This is a delightful R&B, jazz-rock, Stevie Wonder, Kool-and-The-Gang blend, done with the sensitivity that only pure jazz musicians have. It's performed with the eloquence and assurance of a studio musician who is doing just fine being on other folk's albums (ranging from Cat Stevens, reviewed in *Audio*, Feb. 1975, to Jerry Butler and Howlin's Wolf). Phil Upchurch is now part of the cooking CTI house rhythm unit that backs George Benson and other CTI stars. CTI is Kudu's parent label, and Kudu is CTI's style and quality, aimed at non-purists (like me).

Bassist/guitarist Upchurch and his constant cohort Tennyson Stephens (vocals and keyboards) put on a sterling performance and really show us how well an idea can work. The music is tight, smooth, and professionally executed.

Tennyson's voice can not be ignored. It's a sort of blending of Lou Courtney **(I'm In the Need of Love,** Epic KE 33011) and Les McCann (on any Atlantic). His piano is that tasteful Rhodes sound that Les pioneered, but this is no copy. There is no special cut on this album that stands out above the splendid whole, but there is one I just don't like, *Ave Maria*. I can't understand why they did it. Don't judge the sum from this one of its nine parts. On the rest of the album the CTI/Kudu creative forces are joined in their normal state of deft perfection. Arranger Bob James and the incomparable Rudy Van Gelder ("master ears") together provide arrangements and recording with a sheen of strings and voices around the basic quintet.

The result of all this is a very lovely, easy-to-listen-to album that has its creative feet in many places. It's very relaxed. Its alluring prettiness will tease you to play it often. Just don't take it too seriously. Relax—Upchurch/Tennyson are relaxed (and relaxing). Their music is calm and complete. Betcha the jazz fussbudgets won't think much of it. But they

should understand it wasn't meant for them. *Fred DeVan*

Sound: A+ Performance: A

Tomorrow Belongs To Me: Sensational Alex Harvey Band
Vertigo VEL-2004, stereo, $6.98

Exactly what you get in a big suburban singles joint anywhere in the country—no better, no worse. Strictly a dollar at the door, 75 cents a drink until nine. That's the sort of music it seems to be until you get into the disc. Then it begins to sound like a minor-league version of Genesis (on **A Lamb Lies Down on Broadway,** Atlantic 401). Let's say it's an amalgam of both. Alex Harvey brings a touch of "kultchur" to trivia, a gourmet treat for London punk-band lovers. It's a step up, or a step down, depending on where you're coming from.

This record doesn't offend me, but I doubt that I'll ever listen to it again. *Fred DeVan*

Sound: B+ Performance: B –

Born to Run: Bruce Springsteen
Columbia PC 33795, stereo, $6.98

Here we have the biggest star in Asbury Park, New Jersey being pushed onto the World Stage as T.N.B.T. (The Next Big Thing) produced by a fairly famed Rock Critic (Jon Landau) and refusing to do interviews unless he gets the cover. He's been called the New Dylan since his first record was released two years ago, and certain members of the press have gone on personal crusades for the fellow. If ever there was an advance industry buzz about a record, this must be it.

But with a hype that huge, there better be something there.

Now I'm not saying that Bruce Springsteen isn't good (heaven forbid he should get a bad review), but I'm not so sure he's God's ultimate gift to rock 'n' roll. His first two albums were excusable because they were dismal representations of the artist, and a few of the songs (just a few) were appealing. This is far more of an accurate picture of Bruce, and although his talent shines, so do his influences. Bruce Springsteen = Bob Dylan + Johnny Rivers + *Exile on Main Street* + Van Morrison + Eric Anderson + The J. Geils Band + "Not Fade Away" + A Whole Lot More That I Can't Put My Finger On.

I've always been a big fan of Rock 'n' Roll Synthesis myself, but I find this whole business of Bruce Springsteen

being "The Future of Rock 'n' Roll" very unrealistic, because he's at least knee-deep in the rock 'n' roll past and can't seem to break loose except for an instant. He writes pleasant enough songs, but I can't decide whether it's solely because he knows how to plunder the best. On stage he pays his debt to Jackie DeShannon & Jack Nietzsche by doing one of their songs, and he does Stones songs, and Spector songs; on record it's strictly original (ahem) material. I suppose he feels his main task is to get the songs *he writes* across, but if we'd once get a chance on record to hear Bruce Springsteen as something other than a writer, those of us who consider records to be the predominantly important historical document issued by any artist could get a feel for his sense of past. And his voice is nothing to write home about—it's closer to a mumble than the primal scream.

I like the guy, I really do, even more on this record than live. I think it's time that somebody like Jon Landau (who's paid his dues to rock 'n' roll over the years) broke loose within the record industry and got a decent royalty check. As for this album, it might sell fairly well, but it's not the type of record that's going to explode across the nation. Bruce Springsteen simply does not have the kind of voice to make it on AM radio, and if I was 15, I wouldn't idolize him, and if I was a 15-year-old girl, I wouldn't want to go out with him, so what's the point?

Jon Tiven

Performance: B+ Sound: B

Check No. 47 on Reader Service Card

Blues for Allah: Grateful Dead
Grateful Dead Records GD-LA494-G, stereo, $6.98
Bay City Rollers
Arista AL 4049, stereo, $6.98

Here we have two records which are recordings of a lifestyle more than any kind of musical document. This is not to say that both of these albums lack musical worth, but that ultimately there are more important factors here than the notes played. Any impact that these records make in musical history will most likely be in terms of social rather than musical style.

The Rollers vs. The Dead is an interesting proposition for a battle of the bands, for the real test is not "Who will play their instruments with less competence?" (this competition would undoubtedly be a standoff) but "Do you like music that will help you fall into a stupor or music that will rev your heart to the Nth degree?" Personally, this writer finds being excited preferable to being laid-back, but I suppose that you listeners will have to decide that for yourselves; and when you go to the record shops you will have to ponder the crucial question—which of these two albums to bring home? Let me then present each of these musical associations in their context.

The Dead, ah, those bastions of the San Francisco sound championed by Rolling Stone magazine more often than the magazine's namesake, the original hippie band that seems to live forever. There's more hair on this band than on the Bay City Rollers, Slade, and The Rubettes combined! Musically speaking, the Dead are really past their prime, and it seems that attacking them in 1975 is no better than kicking a dead horse (or setting fire to a greaser's hair in 1965) so I shall stop. *Blues For Allah* is one of the best-recorded albums I've heard in a long time, full of crystal clear bass lines (and as Phil Lesh is the only real musician in the band, this is a plus).

But *really*, there's about as much energy here as on both sides of George Harrison's last single.

But the Rollers, *they're* another matter entirely. Many people (Clive Davis, Sid Bernstein, et al.) would have us believe that this is what's in store, or in the words of one ex-rock critic, "I have seen the future of rock 'n' roll and its name is Les McKeown." The BCR's sound more like a throwback to early Sixties rock than the trumpets beckoning of what's to come, more or less an amalgamation of Roy Wood, The Four Seasons, and The Archies. There is no brilliant songwriter in the group, although occasionally the Faulkner/Wood team comes up with a palatable tune (mostly Beach Boys regurgitations, but I hold no grudges for plagiarism); Yea, the winningest material on their first American album stems from the pens of others. They have funny haircuts, the best of intentions, toothy smiles, amphetoteen rock, and a hot record company on their side—but it's yet to be seen whether a group this limited musically (can't play their instruments for beans, can't write particularly well, sing only in fairly antiseptic voices) can take the public by storm. The Monkees did it once, but I think there was more personality there—yet both they and the Rollers were a result of a lot of people in the background (producers, managers) sweating through TV shows, photo sessions, and record dates more than any triumph of innovative powers within the music.

But in any case, it's your choice to make, The Grateful Dead or the Bay City Rollers. I'm not sure I'd put my money down for either of them, but Arista and United Artists already have done so with theirs, so I suspect you consumers are expected to follow suit. *Jon Tiven*

Sound: A Performance:

The Brecker Bros.: Randy & Michael Brecker
Arista AL 4037, stereo, $6.98.

This album is refreshingly different, not everybody's cup of tea, yet even those to whom it does not appeal must respect the strong musicianship it shows. Play it back as loud as your ears and speakers will permit. Study it. It's amazing how many rules of structure the Breckers successfully break with their fresh, inventive, exploratory, and highly personal style. The energy level is high, almost overpowering. Their sound assaults your ears if you're not prepared for the tight, high-speed, high-sound-level

trumpet/tenor pairings or the feel of Randy's electric trumpet. Mike's tenor solos are full, heady excursions into the entrails of the tenor saxophone. The instrumental virtuosity both Breckers display is sufficient cause for celebrating the whole album.

Once the listener adjusts to the perspective of this music, its unfamiliar elements will be less uncomfortable though on your first LOUD hearing you may be nailed to your seat, transfixed, awed, dazed or confused (or shot out the door).

It seems inevitable that the Breckers and executive producer Steve Backer would meet. When Steve was at Impulse Records he (and Bob Thiele) blazed new trails, including pioneering the first quadraphonic-only label. Steve is a perfectionist, closeting himself away from the commercial madness on his hideaway farm in Massachusetts. He always produces something different musically as well as sonically. His Impulse association probably helped change the sound on this album—it's strange, but not like the strident, weird sound which had previously come from Todd Rundgren's Secret studio where this disc was taped.

Randy and Michael came up to New York from Philadelphia in the sixties (even as Rundgren), and they've established themselves as the dynamic duo of the New York studio musician scene, providing trumpet and tenor on hundreds of records in every musical style. Both now in Billy Cobham's band, Randy was the original trumpet with Larry Coryell's Eleventh House (that chair now well filled by Mike Lawrence).

This music, put together by the Breckers and Backer shows a different approach, and it's leading up to something good. The Breckers, Maynard Ferguson, Cobham, Coryell, Jeremy Steig, Peter Frampton, Tom Scott, Jeff Beck, Stanley Clark, Michael Urbaniak, Brian Auger, Oregon, Anthony Braxton, Keith Jarett, Rick Wakeman, McCoy Tyner, Les McCann, and Kool and The Gang are all pointing their respective audiences in the same direction. Towards an omni-music. An omnipresent musical awareness and pragmatism that's creatively just a bit ahead of tomorrow. March on! *Fred DeVan*

Procol's Ninth: Procol Harum
Chrysalis CHR 1080, stereo, $6.98

Procol hasn't changed in any major way since their inception eight or so years ago, since those who differed in opinion with group leader Gary Brooker (Matthew Fisher, Robin Trower) were promptly thrown out of the group. While the group has gone through temporary transistions, the Procol Harum of 1975 sounds almost identical to the group which produced *Whiter Shade of Pale*. Though the Booker/Reid team hasn't written a single song on a par with that, save some close misses with *The Devil Came From Kansas* and a couple of other recent classics, the group still *sounds* exactly the same.

On stage they're unaltered as well. Brooker delivers his vocals adequately, yet his stage presence is lacking—in fact, the only showman in the group is drummer B.J. Wilson, who is an incredible powerhouse. In concert halls, you'll rarely find a group more boring to look at. Still they persist, making one album a year and waiting for the world to catch up with them, waiting for their fan-dom to come together merely through persistence.

Their latest album is pleasant, if only because the tunes are typically Pro-

colly and the drum sound is given so much attention; this last item must be due to the efforts of producers Leiber & Stoller. One would expect that such famed and accomplished producers (The Coasters, Stealer's Wheel, et.al.) would have some great audible effect on the Harum sound, but no such luck. There are only minor differences—a cleaner wall of keyboards without the Chris Thomas drones, otherwise it's the same. I suppose they'll always stay the same—too bad I can't say the same for their writing ability. *Jon Tiven*

Performance: C+ Sound: B+

The Album of the Soundtrack of the etc.: Monty Python's Flying Circus **Arista AL 4050**, stereo, $6.98.

There's no doubt in my mind that the Monty Python group is not only very funny, but that they're very accessible to U.S. audiences, despite many rumours to the contrary. Just as audiences lapped up TW3, Americans are now guffawing over Python—for a multitude of reasons. Some find MPFC amusing largely for its Britishness. Obviously this is not the reason UK audiences enjoy it; there are many "in" jokes that Americans can make little sense of, except for those who read the London Times.

But people like to laugh—whether they're laughing at the British accents or at the ideas is unimportant—people are laughing at Monty Python's Flying Circus. Even stolid rock critics like me find themselves amused by their TV shows and movies. Britishers have always had a knack for striking the funnybones (and pocketbooks) of Americans, regardless of whether the actual comic material can be heard over the Cockney mumbling.

The question is, can Python's attack, which is highly visual, be translated well enough onto the disc and back up into our mind's eye? Fortunately the answer is yes. They've taken the most rib-tickling bits of their movies, thrown in some conceptual jokes, running commentary, and assorted oddities (which I refrain from revealing to save them for proper presentation), and packaged them all very cleverly. Python devotees will not be disappointed with this record. Be, however, forewarned that this album, like most spoken-word recordings, does not wear well with age—it's not an album you'll get more from in repeated listening. On the other hand, unlike most comedy records, this is good the first time you hear it. *Jon Tiven*

Sound: B Performance: A

Blackmore's Rainbow: Ritchie Blackmore
Polydor PD 6049, stereo, $6.98.

This is what you might call an album that became a group: Ritchie Blackmore, then lead guitarist in multi-million-dollar rock group Deep Purple, got bored with making records just as a member of Purple so in his spare time made a solo single, *Black Sheep of the Family*, with several of his friends. The results pleased both his ears and those of his peers so that Ritchie, enthused with having total control for the first time in two years, decided to turn the solo single project into a solo album project. So it was off to Switzerland and Germany to cut **Rainbow**, a debut solo LP by our guitar hero backed by Elf, a group from the Deep Purple management company superstructure. Ritchie made the record and saw that it was good, so he kissed Deep Purple goodbye and turned Elf into his band, and thus was born the latest heavy metal thunder. Voila, two bands for the price of one!

The album seems to do nothing but threaten Deep Purple's stance as the Top Guitar-based Band in the World. Because even though Blackmore's replacement (ace plectrum mover Tommy Bolin) can deliver, it is yet to be seen how his semi-jazz style will jell with Purple's, and Ritchie has definitely got his act together. His guitar playing has always been brilliant, but here he plays with more care and thought than previously. I'm certain he realizes that with all the weight on him now, he'd *better* perform. That's his name on the cover, and if he puts out a terrible record he's got no shelter to hide under.

He doesn't pull any punches—from *Temple of the King* to *Still I'm Sad* there's a maximum of excitement and a minimum of filler. It could almost pass for a Deep Purple album except the rhythm section is far simpler. Ritchie Blackmore is the focal point, and since hard rock is a guitarist's medium that is important. Singer Ronnie Dio performs far better than he ever did in Elf, spurred on by Ritchie's guitarwork, no doubt. The sound is extremely clean and precise (the pressing of the record could be better, but that's not Ritchie's fault). If they can cut it live as well as they do on record (and Lord knows Purple always exceeded their studio discs onstage) this band will be monstrous in 1976.

I'm certainly glad I'm not Tommy Bolin—I'd have a tremendous cloud hanging over my head, because that boy's got a lot to live up to. *Jon Tiven*

Sound: Performance: A

Sabotage: Black Sabbath
Warner Brothers BS 2822, stereo, $6.98

Let's have another one just like the other one—here is the new album by perhaps the least coherent/competent singers/players of all the heavy metal groups. They're all right, I guess, always entertaining and the big difference from one album to the next is in the production and the covers and not really in the music. I sort of like them, and I sort of don't, but the real impression that this group makes upon me is that they sell extraordinarily well for a group with very little to say. I can't understand why they keep it up—maybe Ozzy is just waiting for somebody to call their bluff. If so, this is it: you aren't doing anything revolutionary, creative or particularly interesting other than taking advantage of the public. Congratulations on a job well done, but that's practically all it is. *Jon Tiven*

Sound: B Performance: ?

Futurama: Be-Bop Deluxe
Harvest ST-11432, stereo, $6.98.

Bill Nelson, lead singer/songwriter/guitarist/keyboardist in this group, is an adventurous sort who has taken nothing for granted. He disputes the proposition that only self-indulgent keyboard-based groups can play around with time signatures, he trifles with territories that musicians dared not tread previously, and he is clever with words—all within the context of the three-piece hard rock band. And this band, Be-Bop Deluxe, may well be the rock 'n roll band that the world has been waiting for. For Nelson is the fusion of the rock 'n roll musician and the rock 'n roll persona and can defend either position with equal strength and grace.

On first listening, the album is stupefying, and it's very difficult to grasp the changes (although the personality is readily identifiable). Something like *Stage Whispers* or *Sound Track* is pretty mind-boggling when it first hits you, but certain things become instantly clear: the man knows how to rock and he knows how to play guitars though these things are not necessarily paired. Keith Richard sure knows how to rock and the world loves him for it, though his technical prowess on his instrument is not especially astounding while John McLaughlin is the opposite case. But at last, in Bill Nelson we come to a being who has the discipline to practice and the steady inner backbeat to issue soloes with spine-tingling freedom. Not to ignore his creative abilities—Nelson's guitar lines are perhaps

the most original heard this year, right up there with Zeppelin's Page, Queen's May, Cong's Hillage, and Beck's Beck. At last a guitar hero worth his weight in Les Pauls!

But Bill Nelson is more than a one-dimensional musician, for his songs are also outstanding. He's a bit of a ham, tending to describe in voluminous detail his experiences as a guitar player ("Well, I'm waiting in the wings with all the strings and things that help me make the music . . .") or as a macho on the go ("Life is a love affair, all the girls declare it so . . . they know I am a gigolo . . ."). Some may find it heavy-handed, but I find it illuminating. The band keeps up with him every instant, though the album's bite comes about 90% from the mouth of Nelson. Simon Fox is the drummer and Charles Tumahai is the bass player, Roy Thomas Baker is the producer, and a good one. Bill Nelson has a strong set of pipes, and, girls, he's good-looking as well. I just can't wait for the first American tour, commencing any moment now. I haven't been this excited over a band in ages.

Jon Tiven

Sound: A Performance: A++

Daryl Hall & John Oates
RCA APL1-1144, stereo, $6.98

Hall & Oates hail from somewhere in Pennsylvania, and although I'm tempted to avoid the comparisons between their music and Todd Rundgren's, it's pretty near impossible. Their last album produced by Mr. R., was an embarassment to all parties concerned—combining the worst of Todd and the worst of this duo's talents. This time around, they sound almost exactly like they're living in the music of Todd's most frequently hailed album, ***Something Anything.*** They write in that style, the arrangements and production is very Toddish, and even the vocal nuances are straight out of Toddsville.

This is not to knock the record, which I like very much (especially side two), but it's just to put things in perspective. The music is quite pleasing to the ear, the lyrics are amusing, and the whole feel of the record is a good one. Hall & Oates both sing and write well, but I find it difficult to understand how two people so obviously talented can live almost exclusively in another person's style. I suppose if it's possible for Badfinger to live within the Beatles, and the Dolls to echo the Rolling Stones, then Hall & Oates aren't exactly the first to do what they're doing. But will the critics love it?

Jon Tiven

Sound: B *Performance: B+*

Jazz & Blues

Ella Fitzgerald and the Chick Webb Orchestra
Joker SM 3613, mono, $4.98.

Jazz fans who grew up in the 30s like to talk about the legendary battle of swing that took place the night of May 11, 1937 in Harlem's Savoy Ballroom between the Benny Goodman orchestra and the resident Chick Webb band. Goodman was then just arriving at the first high peak of his national fame and popularity, while the tiny, crippled drummer was the King of the 125th Street ballroom. By all accounts, Benny's band played as powerfully as ever that night, but the Webb crew blew the Goodmanites away with blazing, white-hot sets that drove the crowd wild. Aficionados tell how Webb finished off the session with a masterful drum solo that left Goodman and his drummer Gene Krupa shaking their heads, their jaws hanging in open admiration and amazement!

For years Chick Webb's band has been revered by European jazz connoisseurs, and most Webb reissues have come from abroad. **Ella Fitzgerald and the Chick Webb Orchestra** is on the Italian label *Joker* (reminiscent of the first pirated jazz issues of the 40s on *Jolly Roger*—are they trying to tell us something?). This is a splendid collection which showcases the Webb band's punchy, aggressive drive, and the recording has lively, vivid sound (considering they were transferred from shellac, 10-in., 78-rpm discs).

Such is the present day commercial potency of Ms. Fitzgerald (in her late teens then, and an immediate headliner with her hit *A-Tisket, A-Tasket*) that now, almost 40 years later she gets top billing over Webb on he cover. Though the LP is top-heavy with Ella's vocals, the tremendous drive and collective swing of the band come through on instrumentals *Clap Hands, Here Comes Charlie, Spinnin' the Web, Harlem Congo*, and *Strictly Jive*. The Edgar Sampson (of *Stompin' at the Savoy* fame) arrangements are clean and spacious, leaving plenty of room for fiery soloists like trumpeters Taft Jordan and Bobby Stark. Hearing their surging, exuberant playing, one can almost see again those hundreds

of high-stepping Savoy dancers, Lindying until the small hours every night. Home of Happy Feet, it truly was!

John Lissner

Sound: C Performance: A

Skull Session: Oliver Nelson
Musicians: Nelson, alto saxophone; Lonnie Liston Smith, electric and acoustic pianos; Mike Wofford, arp and piano; Chuck Domanico, bass; Dennis Budimire, Lee Ritenour, electric and acoustic guitars; Billy Green, Billy Perkins, Jerome Richardson, Buddy Collette, Bud Shank, reeds; Buddy Childers, Bobby Bryant, Paul Hubinon, Oscar Brashear, trumpets and flugelhorns; Grover Mitchell, Richard Nash, Chancey Welsch, Maurice Spears, trombones; Vinny De Roas, Davis Alan Duke, French horns; Don Waldrop, tuba; Shelley Manne, Jimmy Gordon, drums; Willie Bobo, percussion.
Songs: *Skull Session, Reuben's Rondo, 125th Street and 7th Avenue, One for Duke, Dumpy Mama, Baja Bossa, In a Japanese Garden, Flight for Freedom.*
Flying Dutchman BDL 1-0825, stereo, $6.98.

Big bands have always possessed the greatest potential for harmonic, melodic, and rhythmic possibilities. When the jazz-rock group with added horn sections became popular in the late sixties, the big band moved into a new era, exploring things with results the smaller groups couldn't predict. Such was the success of Maynard Ferguson's MF Horn.

Oliver Nelson has always been an advocate of the big band concept. His achievements are omnipresent in television, movies, jazz bands, etc., and in playing the sax. The premise for **Skull Session** was to see how melodic Nelson could make the electronic instruments sound. Electronics make instruments louder, and some people confused louder with better. But with Oliver Nelson the musical quality went in before the volume went up. The result is a set of strongly involving electronic and acoustic sounds, incorporating electronics with contemporary rhythm pulsations. *Skull Session* brought just this idea to reality. Mike Wofford on arp and Lonnie Liston Smith on electric piano pitted against the brass colorations produce electrifying results.

The cut *125th and 7th Avenue* is as crowded with full punchy ensembles and ear-grabbing solowork as this bustling intersection is with people. It

has been the site of much political and musical thinking, and Oliver Nelson has captured a veritable cross-section in this very funky composition. Best is the rhythm section, especially the interplay between Shelly Manne and percussionist Willie Bobo.

There are a couple of swinging cuts which demonstrate how well balanced a set of rock electronics can be made to be. *Reuben's Rondo* is an augmented arrangement of a piece Nelson wrote in 1959. Shelley Manne is one of the most versatile drummers alive. His fills are museum pieces and his choice of cymbals is as tasty as the way he tunes his drum set. He is able to play any particular type of music and make it sound like it's the only type of music he plays. Other drummers should take a lesson from this brilliantly open-minded individual.

One for Duke captures the sound of Duke Ellington's reed section in undercoating the melody with some bass clarinet. Then it begins to sound more like a thought from Thad Jones. Jerome Richardson leads the sax section and it takes on the sound of Jones' section during Richardson's tenure in New York. This arrangement has a much more modern sound than the post-bop *Reuben's Rondo,* as Mike Wofford comps on electric piano.

Dumpy Mama is more funk. Richardson does extended time on the flute. *Baja Bossa* is a beautiful Latinesque sampler. Laurindo Almeida's acoustic guitar solo is a thoughtful introduction to *In a Japanese Garden.* It accurately reflects the serene atmosphere where ideas and feelings, as in music, are often understood more by a convincing look or quick glance than by verbal communications. Nelson's alto solo is an example of this superb articulation and phrasing.

Skull Session is a worthwhile treat for big band enthusiasts, and it is a logical introduction to different kinds of good music for listeners who want to broaden their scope of music appreciation.

Eric Henry

Sound:B Performance: A

Native Dancer: Wayne Shorter featuring Milton Nascimento
Musicians: Shorter, tenor, soprano saxes, piano; Nascimento, vocals, acoustic guitar; Herbie Hancock, piano; Airto Moreira, percussion; Dave McDaniel, bass; Roberto Siova, percussion; Wagner Tiso, electric piano, organ, bass; Jay Graydon, bass; David Amaro, acoustic guitar.

Songs: *Ponta De Areia, Beauty and the Beast, Tarde, Miracle of the Fishes, Diana, From the Lonely Afternoons, Ana Maria, Lilia, Joanna's Theme.*
Columbia PC 33418, stereo, $6.98.

Native Dancer boasts inspirational music from beginning to end. Shorter's comments accurately summarize the musical results: "... only this combination of five Americans and four Brazilians could conceive and mold such an expressive life force contained within."

Although the music is restrained and relaxed in tempo and volume, it in no way lacks vital drive and intensity. **Native Dancer** possesses the power to move mountains and cut through icebergs without having to demonstrate explosive power.

Shorter's piano playing makes a thoughtful addition to *Diana,* a composition to the daughter of Airto and Flora Purim. His playing mirrors the understatement which is the most elemental aspect of his sax work. *Lilia* is a conduit for an interesting 5/8 meter undercurrent over which Shorter's soprano sax gently flows.

Herbie Hancock's acoustic piano on *Beauty and the Beast* hints at what his repertoire may sound like in an acoustic setting. The cut is laid back but very funky. It's a catchy instrumental which you'll find yourself singing.

Milton Nascimento is a very talented Brazilian guitarist and vocalist. Shorter said that he thought it unnecessary to say who Milton Nascimento is because he thought everybody knew. Everybody who hears his unique performance will remember.

Ponta De Areia is a vocal carnival with apparent falsetto overdubbings surfacing beside Nascimento's leads. Most gratifying are Nascimento's quick and accurate range transpositions. Shorter's soprano brilliantly complements the vocals.

A more mellow showcase is the magnificent ballad *Tarde.* Shorter is on tenor and Nascimento explores his own lower vocal range. Wagner Tiso builds a lilting harmonic foundation on organ. *Tarde* means suffering extendedly without asking forgiveness. The inside sleeve also explains the other titles.

Miracle of the Fishes has an elusive melody throughout the tune which fades behind an electric piano codetta before we can grab it. Rhythmically a 6/8 Nanigo, it has quite a euphonious array of vocals. Shorter's articulations within lightning runs up and down the entire register of the saxes are flawless and his intonation is unwavering.

Native Dancer is comparable to **Chick Corea-Light as a Feather** vintage. Both concepts take a light and airy approach to making music. Their music is relaxing yet stimulating, incorporating some provocative Brazilian elements. **Light as a Feather** is a musical milestone. Time will tell if **Native Dancer** stands in the same deep waters. The music has a hypnotic effect, transporting the listener to its tropic origins. *Eric Henry*

Sound: A-/B+ Performance: A

Jazz Funeral at New Orleans: George Lewis
Olympic 7117, mono, $4.98.
Live Concert: George Lewis & His Orchestra
Saga 6921, mono, $6.95.

New Orleans jazz is never better than when it is played by men who have lived with it all their lives; when trombone, trumpet and clarinet

weave highly-charged counterpoint, and when the solos sail out of ensembles with increasing excitement. There are many moments like this in these collections, when the emotions and artistry of the New Orleans veterans communicate in an inspired manner.

Clarinetist Lewis was part of the original Bunk Johnson band. Like other Crescent City revival groups, it was a collection of aging and out-of-practice Black and Creole musicians, ex-stevedores and longshoremen, refurbished with instruments, (and, in Johnson's case, a new set of teeth) by dedicated, white, middle-class fan/entrepreneurs.

When the Johnson band hit New York in 1944 it received widespread media coverage. At its best it played with wonderful drive and spontaneity; it was jazz that got right down to the core. But at its worst, there were many embarrassing moments: grossly out-of-tune passages, botched ensembles, and defective tempos. After Johnson passed away in 1949 and George Lewis assumed leadership, things tightened up musically, and he successfully led the group until his death in the late 60s.

These recordings contain selections culled from a 1953 Lewis concert. Some of the musicians involved, including the incredible octogenarian trombonist Jim Robinson, are still with us and playing with the Preservation Hall Jazz Band. Although the two albums, the budget Olympic and the British Saga duplicate each other on three tracks (*When the Saints . . ., Panama,* and *Burgundy St. Blues*), they can be considered complementary and are both recommended.

Saints is the key track, a remarkable eight-minute joy ride with inspired, solid ensembles full of color and movement, with Robinson playing a rough, savage trombone solo with tremendous vigor. *Ice Cream,* which appears only on the Olympic, really drives, with perfect swing created by piano, trombone, and the thumping, rhythmic thud of the banjo. The strong, surging exuberance of the players will lift you right out of your chair.

Caledonia, which kicks off side two on the Saga disc, is another gem, a brassy, rollicking, boogie blues that starts off in a typically ragged manner, with trumpeter Avery "Kid" Howard barking the vocal, picking up strength on his horn, growling and blowing with the uninhibited energy of a much younger man. Lewis' expressive New Orleans clarinet is heard weaving in and out of ensembles with its liquid tone providing a fluency that is the cornerstone of the band's front line. The rhythm section is tremendous here with bassist "Slow Drag" Pavageau, drummer Joe Warkins, banjoist Lawrence Marrero, and pianist Alton Purnell playing with driving fervor that builds a rocking momentum as it rolls along furiously chorus after chorus. Both albums are well recorded, offering a crisp, monaural sound. Absolutely exhilarating music.

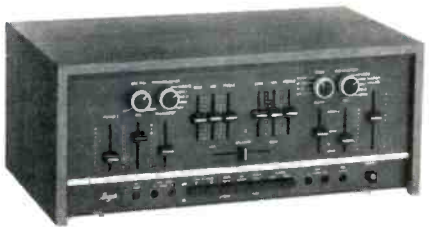
John Lissner

Sound: B+ Performance: A

Advertising Index

What's New in Audio

Bozak Model 929 Preamplifier



This Audio Signal Processing Center includes a phono input, microphone input, and choice of tuner, AUX, or either of two tape inputs. All preamplifier stages are on plug-in modules. A *Mike Pan* control permits shifting the apparent position of a microphone anywhere from extreme right to extreme left. The continuously-variable *Stereo Blend* slide control goes from mono to stereo, and may even be expanded to an "extra-wide" dimension labelled *Stereo +*. The mode selector includes *Mono, Stereo, Reverse Stereo, Stereo Blend,* and *Reverse Blend*. Two tape monitor circuits are provided. A *Cue Output Selector* permits monitoring *Phono*, either *Tape Monitor, Program,* or *Main Output*. Distortion is less than 0.1% from 20 to 20,000 Hz. at 10 V into 200 ohms.

The 929 is 7-in. H, x 17-3/4 in. W, x 10-3/4 in. D. It weighs 21 pounds and is priced, w/o optional walnut cabinet, at $797.

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Inovonics Recorder Electronics

These single-channel tape recorder electronics include play, record, and bias/erase circuitry in a rack-mount panel 3½-in. high, made to plug directly into Ampex 300, 350, and 351 transports, but can be readily adapted to other tape mechanisms. Switching is all-electronic, eliminating mechanical switching noise and permitting remote control. Reproduce circuitry is phase corrected. The regulated power supply and plug-in circuit cards are included. Record amplifier distortion measures less than 0.1% at operating level, less than 0.2% at 25 dB above operating level. The 360 circuitry is priced at $645.00. Sync reproduce optional at $60.00.

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The Hitronic electronic car aerial has a miniature amplifier built into the base of the unit, which will amplify signals up to a level double the original. There are seven click-stop aerial lengths, one of which will be suitable for any signal field strength, and an eighth or retracted position for car washes. Operating voltage is either 6 or 12 V, and current consumption is about 7 mA. The base can be mounted at any angle from horizontal to vertical through use of the template supplied. Price: $46.08.

Check No. 71 on Reader Service Card

Canby's Capsules

Edward Tatnall Canby

Judith Blegen, Frederica von Stade. (Solos and Duets for soprano). Charles Wadsworth, piano. **Columbia M 33307,** stereo, $6.98.

Two glorious all-American star voices, (despite the names) in solos and duets with piano, ranging from Scarlatti, Mozart, Schubert, through Brahms, Chausson, Saint-Saens. Only one problem: all the music is "chamber" type, close-up room music, and the recording is the same—but the ladies let loose like the Met. *TOO LOUD*!! Fine sound but very out of style. When will American pros learn to sing *softly* and well? Why so powerhouse??

Simple Gifts. The Metropolitan Opera Madrigal Singers. (Met. Opera Guild.) **Advent 50102,** stereo, $6.98. (878 Clarence Rd., Cleveland, Ohio 44121)

Six younger Met members in an unexpected operation—madrigals, songs together, even church motets. They do remarkably well, considering, and the sopranos know how to sing softly. But the ensemble, well coached, still sounds faintly like *that* Sextet in *Lucia*. No great blend. Opera lovers will be charmed, rightly, but choral and madrigal people will be unamused.

Hindustani — A Panorama of North Indian Music. Vanguard Everyman SRV 73010, stereo, $3.89.

Karnatic — A Panorama of South Indian Music. Vanguard Everyman SRV 73011, stereo, $3.89.

Far-Eastern music is rapidly making its way into Western cultures and these two BBC-derived discs, deliberately designed to bring unusual instrumental and vocal Indian music to records (radio?), are beautifully performed, superbly recorded, well annotated, evidently taken down locally in India. Exotic sounds—musical glasses, unusual strings, drums, a sort of "jews harp," plus some singing. You could well start your Oriental Collection right here, and the price is decidedly right.

Janet Baker - Mozart, Haydn, Engl. Chamber Orch., Leppard. Philips 6500 660, stereo, $7.98.
Janet Baker - Handel. Engl. Chamber Orch., Leppard. Philips 6500 523, stereo, $7.98.
The Artistry of Janet Baker (Holst, Finzi). With Wilfred Brown, ten. Engl. Chamb. Orch. Imogen Holst. **Everest 3365,** QS, $4.98.
Elgar: Sea Pictures. Mahler: Five Songs from Ruckert. Janet Baker; London Symph., New Philharmonia, Barbirolli. **Angel S 36796,** stereo, $6.98.

A great vocal musician in recent perspective—she began as a pure British-type soprano, has now turned more international and operatic, still with perfect control and accurate muscianship. The Mozart/Haydn, a brace of mostly unusual arias and songs, is top rank. Her Handel, a choice of highly florid and difficult items, is a bit heavy-voiced (and close-recorded) for Handel, but still remarkable. The Everest **Artistry** is a reissue, one side Holst, the other Britisher Finzi—Holst is massively introspective and long, for U.S. ears, Finzi is more open, straight Romantic; she shares it with tenor Brown. Best of all these (and there are others) is the Elgar/Mahler of c. 1970, when Baker still sang pure British. Lovely, un-pompous Elgar songs, plus a side of Mahler. A dedicated performance.

The Art of the Viola da Gamba, vol. 2 Marin Marais. Eva Heinitz; Malcolm Hamilton, harpsicordists. **Delos DEL 25403,** stereo, $6.98.

The grand lady of the gamba summing up her longtime art in this series. By now she sounds a trace old fashioned, playing cello-like (with some vibrato) but she's always authoritative and musical. Marin Marais, *the* gamba composer, writes somewhat didactic French Baroque suites.

Eva Nordfelt plays Swedish Baroque Harpsichord Sonatas (Roman, Agrell). Orion ORS 74157, stereo, $6.98.

This forceful Swede, not yet 30, plays in the Landowska tradition, strongly, heavily registered and dramatic. Stockholm's Baroque sounds much like other late Baroque; both Roman and Agrell are younger than Bach, edging on into early Rococco or "galant" style. Interesting.

Domenico Scarlatti Sonatas for Harpsichord, vols. 1, 2. Kenneth Cooper. **Vanguard VSD 71201/2,** stereo, $6.98 ea.

The jaunty color cover, Cooper in an outrageously ruffled and printed mod shirt with two fingers in the air, sets the tone for these amiable and generally excellent Scarlatti renderings. Get 'em by all means!

Satie for Two. Peter Kraus, Mark Bird, guitars. **Orion ORS 74163**, stereo, $6.98.

Two young classical guitarists here take on that old French music-devil, Satie, whose many small piano works slyly dug at the foundations of tottering Romanticism back in the late 19th C. Satie's satire was in the deflated titles—*Dried Embroyos, Cold Pieces,* etc.—but also in artful musical simplicity, full of titillating "mistakes." These qualities come over well on the two guitars, though the boys are perhaps a bit too earnest. (Satie was *never* earnest! A total, gadfly. Outwardly, anyhow.)

Brahms: Complete Piano Quartets. Beaux Arts Trio (Cohen, Greenhouse, Pressler) and Walter Trampler, viola. **Philips 6747 068**, 3 discs, stereo, $23.96.

If you are in a Brahms mood, here's a fine supplement to the big orchestral pieces—three big works for three strings and piano, gorgeously recorded and played by an American-based, super-pro foursome (two born in Europe), impeccably tuned to the European tradition. The polish and sheen is purely American, the styling good continental. The pianist, rightly, is the powerhouse here—Manahem Pressler, one of the best. The others play too blandly for my taste, but he keeps things moving.

Ivan Rebroff. 25 Greatest Russian Melodies. With balalaika ens. **Vanguard Twofer VSD 67/68,** 2 discs, stereo, $6.98.

Here's that *man* again—huge, cavernous Russian basso who suddenly becomes a tenor, then a torchy contralto, *and* a soprano, more or less. Assuming it really is all him. Even some male-female duets in octaves. Overdub? Can't be sure these days! Anyhow, he gets all the label credits. Russian pop/folk style, big orch. with balalaikas, some no-voice bands for contrast. Easy listening, and now all you'll need is Yma the Sumac—you'll have heard Everything. (But he's much better.)

Acoustic Research, Inc. Demonstration Record. Vol. 1: The Sound of Musical Instruments. (10 American Drive, Norwood, MA 02062) $5.00

Mostly classical excerpts, out of Spain and Discos Ensayo. This—for a demo—is musically more responsible than most. Only a few items are faded out in mid-note or mid-movement, and most are reasonably long, ranging from Bach to jazz, via Mozart, Stravinsky, Britten, Albeniz, and so on. Hi-fi annotations on each piece—how to listen and judge your equipment. Some of it mildly fatuous, some pretty good. How about: "Who would deny that the human voice is the most expressive of all instruments?" Not me!

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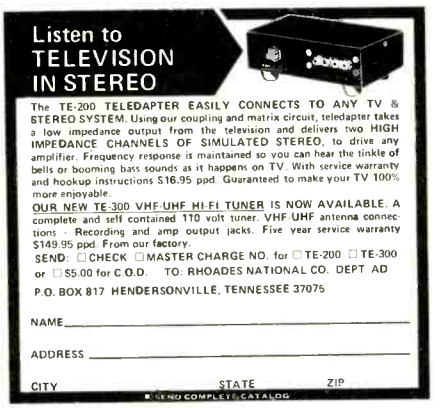

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Continued from page 107

out of the violas and celli in the Walker piece.

The second album is unabashedly contemporary in sound and method. Olly Wilson's *Akwan* (1974) uses a Fender-Rhodes electric piano and amplified strings, though it is not technically an electronic composition. Nevertheless, the interplay among the trombones near the beginning, the manner in which percussion and the Fender-Rhodes are employed, and the overall abstraction of the piece give it a distinct electronic-music flavor (particularly of the tape-with-orchestra variety). Wilson uses novel voicings (especially in the brass), displays a highly developed consciousness of rhythm/arhythm, and has a masterful sense of timing which allows him to extend an idea until just before the moment monotony would set it. *Akwan* is, to my ears, a major work, one which will be heard and discussed often in the future.

T. J. Anderson's *Squares* (1965) involves such things as symmetries of fragmented phrases, overlapping tone-color "platforms," and the like. What would seem on paper a disjointed collection of disparate ideas, sounds quite unified, thanks to the ingenuity of Anderson's systems of grouping. Though it is an atonal, essentially themeless work, it is no doubt the kind of indisputably contemporary composition that will nonetheless appeal to musical conservatives, if only because the pieces fit together into such a neat, accessible bundle.

Talib Rasul Hakim may be an unfamiliar name because the composer first attracted attention as Stephen Chambers. *Visions of Ishwara* (1970) is an esoteric and stately work, which begins and ends with an exotic alto flute line over a ceremonial-processional bass drum pulse. The trombone, tuba, and percussion parts are seemingly derived from Tibetan ritual music, with the rest of the orchestra arranged so that each group of instruments seems to seek its own level at random. The effect is not unlike a Sun Ra improvised ensemble, translated into orchestral-block terms. *Visions* is a very impressive composition, which should help the composer retain his reputation under his new name.

It's always difficult to judge the performance of a new and complex composition without access to the score (and sometimes even with the score), but all three works seem to have received tour-de-force realizations by Freeman and Richard Bunger, soloist on *Akwan*. *Tom Bingham*

Sound: A Performance: A

Annual Index

Subject Index

Author Index

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