

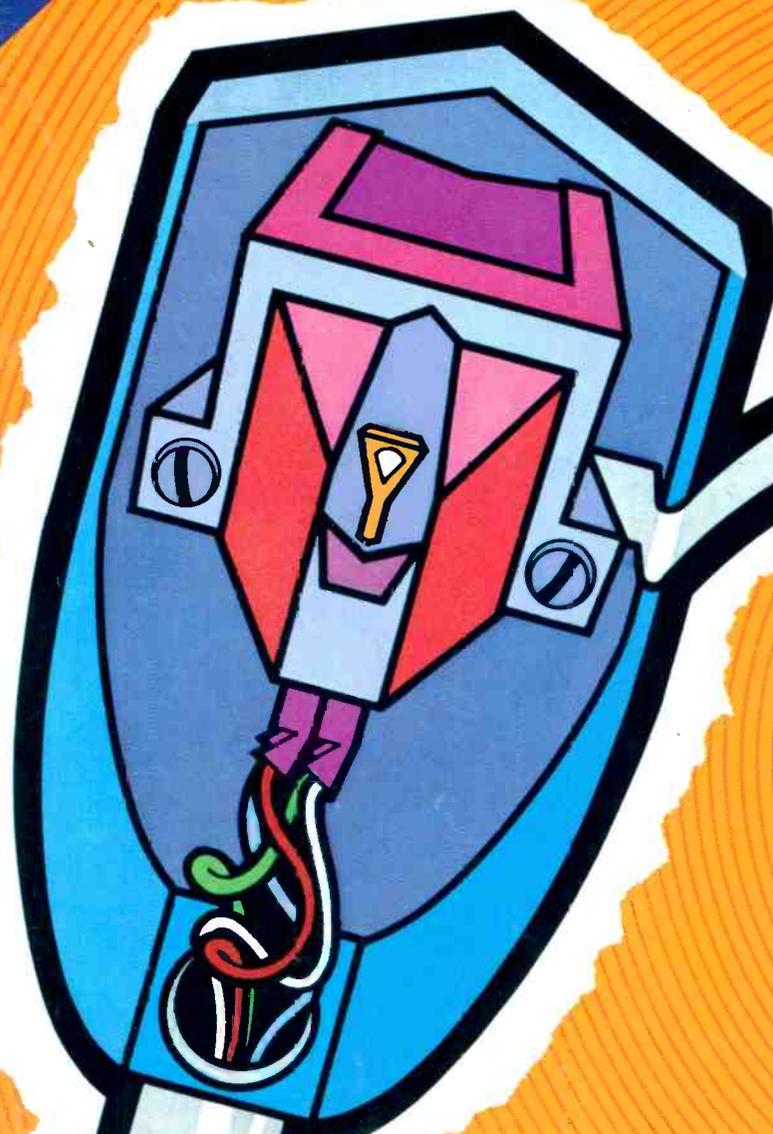
Ellen McIlwaine

WE THE PEOPLE

Audio

THE AUTHORITATIVE MAGAZINE ABOUT HIGH FIDELITY • AUGUST 1973 60¢ © A

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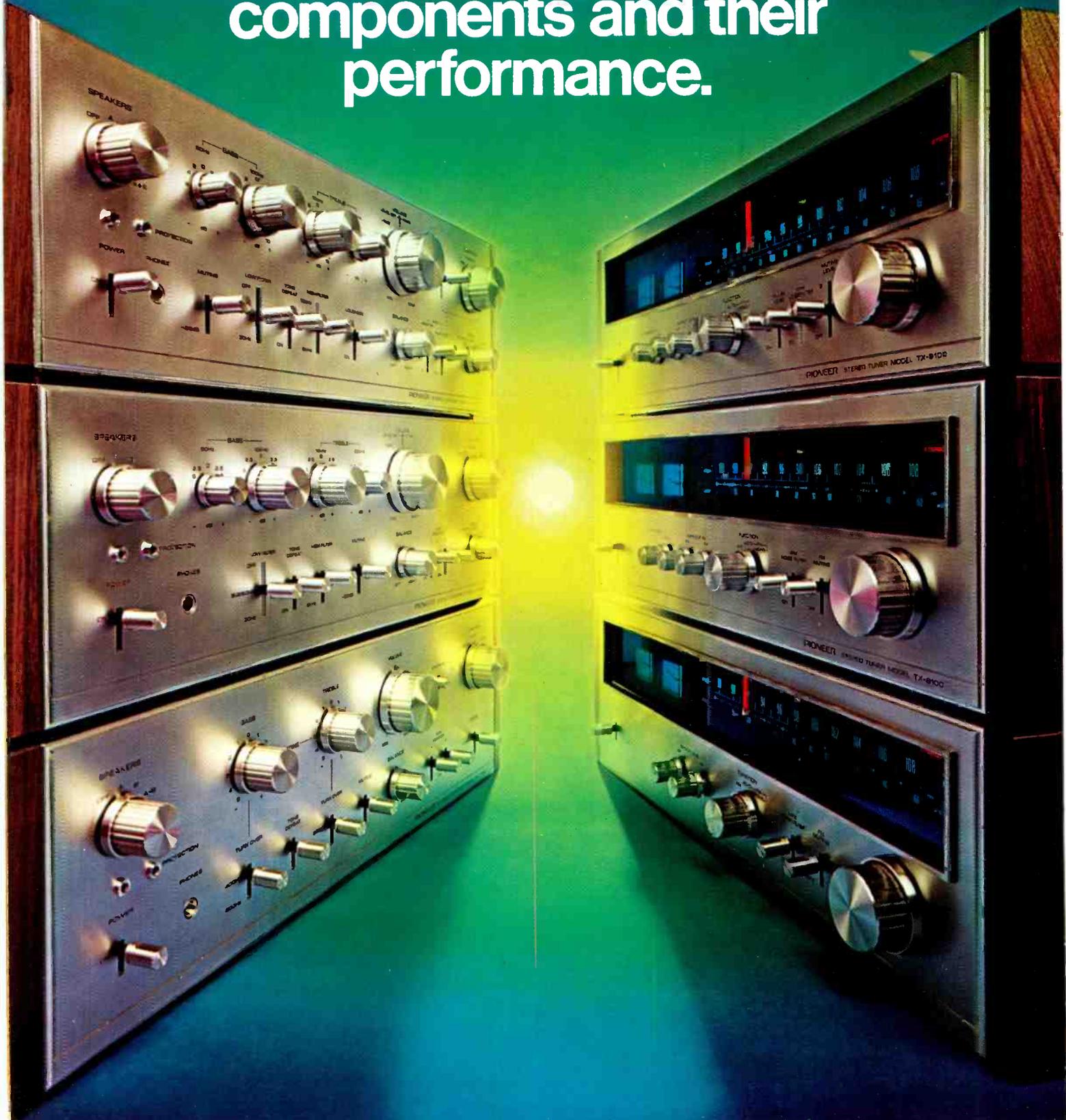


Audio
**Tests 9
Phono
Cartridges**

Trackability...1973

Seen at the CES

Announcing a major breakthrough
that will have universal impact
on all future high fidelity
components and their
performance.



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

The unique equalizer amplifier

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

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

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

The power amplifier

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

Exclusive direct-coupling in all stages

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

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

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

Successive settings of -15dB and -30dB result in lower gain. Once the desired volume is obtained, the volume control is used for fine adjustments within the given

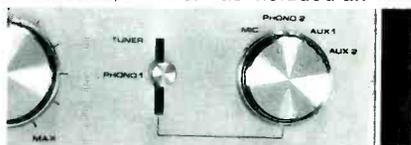
range. While the loudness contour boosts bass and treble, it may also be used with the level set control. The more advanced the position of the level set control, the lower the effective range of the loudness contour.

The original and positive speaker protector circuit

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

Maximum convenience for program source selection

While there is a multiple function rotary switch for microphone, phono 2 and two auxiliaries, Pioneer has included an



Convenient program source selection switch & control lever.

PIONEER
when you want something better

additional convenience. A separate flip type lever control for instant switching between the more widely used tuner and phono 1 and any other single program source. Incidentally, both switches are shielded to protect the input against undesirable extraneous signal pickups.

Two-way tape duplicating and monitoring

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

Level controls for phono 2, aux 2

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

Speaker B control

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

Impedance selector for phono 2

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

Two-position high & low filters

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

Maximum versatility in program sources

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

Consistent power for every requirement

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

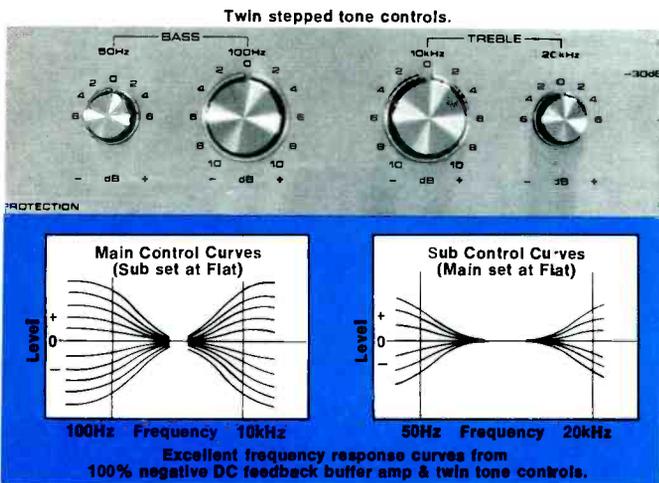
This new lineup of Pioneer tuners and amplifiers is unquestionably the most advanced available today. Yet despite this overwhelming sophistication, they're sensibly priced.

See your Pioneer dealer. He'll show you how this series of fine instruments can outperform any units in their price range. All prices include walnut cabinets. SA-9100—\$399.95; SA-8100—\$299.95; SA-7100—\$229.95. TX-9100—\$299.95; TX-8100—\$229.95; TX-7100—\$179.95.

While not discussed here, Pioneer is also introducing the SA-5200 stereo amplifier and the TX-6200 stereo tuner for high quality hi-fi on a low budget. Only \$129.95 each, with walnut cabinet.

U.S. Pioneer Electronics Corp., 178 Commerce Rd., Carlstadt, New Jersey 07072

West: 13300 S. Estrella, Los Angeles 90248 / Midwest: 1500 Greenleaf, Elk Grove Village, Ill. 60007 / Canada: S. H. Parker Co., Ont.



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

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

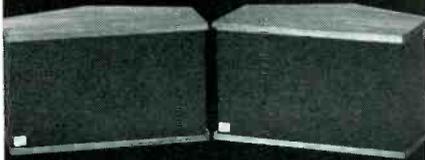
Now you can make the most critical bass and treble adjustments with supreme ease. In fact, there are 5,929 tonal combinations to suit your listening room acoustics and to compare or compensate for component frequency response.

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

New tone defeat switch

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

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same
reasons
we build
our
speakers.



Better music, wherever you listen. Real fundamental, bass, including the attack of tympani and organ. An almost tactile feeling of presence. And transparent highs, providing unusual instrumental definition.

First and foremost, we built the LDL 749A to satisfy our own desire for musical enjoyment. Including the spatial sensations: from the intimacy of small groups to the awesomeness of full orchestra.

With their precise combination of forward-radiated sound and panoramic reflection, LDL 749A are a compact, elegant way to put the concert hall in your listening room. And the price is as realistic as the sound!


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Design
Labs Inc.**

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Audio

AUGUST, 1973

Vol. 57, No. 8

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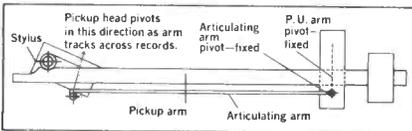
Sometimes high fidelity people lose sight of what it's all about: Sound.

The ultimate test of any piece of high fidelity equipment is what you hear.

That's why, of all the statements made by equipment reviewers about our Garrard Zero 100, the most significant were these:

"Using identical virgin records, and virgin styli in identical good cartridges, the Zero 100 on occasion sounded markedly 'crisper' than other turntables." *Rolling Stone*.

"A listening test proves to bring new life to many records, noticeably reducing distortion on the inner grooves." *Radio Electronics*.



"From about 7 in. diameter to runout, the Zero 100 delivers considerably less distortion and greater definition than with the same pickup mounted in a standard arm. The improvement in sound quality is notably impressive."

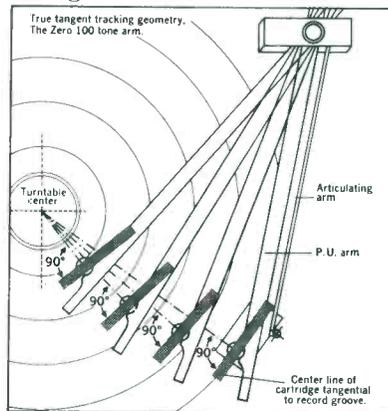
Elementary Electronics.

"The articulated arm of the Zero 100 produced less distortion, and therefore greater definition, on high-level, musically complex passages, from the inner grooves."

Hi-Fi Stereo Buyers' Guide.

That's what reviewers actually

heard when they tested the first automatic turntable with Zero Tracking Error. This is, to our knowledge, the first time a turntable has been given credit for making records sound better.



Cartridges and other components, yes. But never a turntable — until the Zero 100.

By this time you probably know how we achieve Zero Tracking Error. The principle of the articulating arm, continually adjusting the angle of the cartridge so it is always at a 90° tangent to the grooves, is a simple one. But the ingenious engineering and the development of the precision pivots to make the principle work, took several years.

But enough from us. Let's go back to what the reviewers say about the Zero 100.

"It probably is the best arm yet

offered as an integral part of an automatic player." *High Fidelity*.

"All of these features combined into one automatic turntable make news, even though some are found on other units. Only in the Zero 100 are they all put together." *Audio*.

When *Audio* talks about "all of these features" they're referring to such things as our magnetic anti-skating, variable speed control, illuminated strobe, viscous-damped cueing, 15° vertical tracking adjustment, patented Garrard Synchro-Lab synchronous motor and our exclusive two-point record support in automatic play.

But all of this gets back to our original point. It is the sound that makes the difference. After all, a \$200 record player should give you a really meaningful difference. And the high fidelity experts agree that people who own a Zero 100 will hear better than people who don't.

If you'd like to read the reviews in full detail, we'll send them to you along with a complete brochure on the Zero 100 and the Garrard line. Write to: British Industries Company, Dept. H 13 Westbury, N.Y. 11590.

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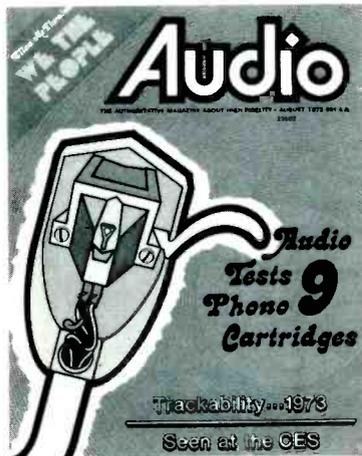
coming in September

Annual Directory Issue

Listings include •Receivers •Amplifiers •Tuners •Turntables •Changers •Phono Cartridges •Loudspeakers •Open-Reel, Cassette, and Cartridge Recorders •Headphones •Microphones •Pre-amplifiers

Special Listing of manufacturers' names and addresses

The Dolby B-Type Noise Reduction System by Robert Berkovitz and Kenneth Gundry, Dolby Laboratories



About the cover: This month we turn our attention to phono cartridges; this is represented by our cover artist's rendering of a tone arm and cartridge. The transition into an era of quadrasonics has placed stringent demands on the current crop of cartridges, and the manufacturers have responded to the challenge with new high-performance models. Even higher demands will probably be placed on cartridges in the future, though these will undoubtedly be solved with close cooperation between disc and cartridge manufacturer.

Audioclinic

Joseph Giovanelli

Definition of Terms

Q. Please define the following: 1. Output Z in ohms; 2. damping factor.—James Leone Rochester, New York.

A. 1. Z stands for the word “impedance”. Thus, output Z in ohms means output impedance in ohms.

2. Loudspeakers are not perfect devices. When signal “hits” them, it takes their cones a certain time to get moving. When this signal is removed, it takes the cones time to stop moving. We would like to have our speakers start and stop immediately upon the removal or introduction of the signal. It just so happens that, if we could short the two speaker terminals together and still feed a signal into the speaker, the speaker cone would stop moving much more quickly than it would if the terminals were not shorted. This phenomenon is called “damping”; the ability of an amplifier to perform this task is a measure of the damping factor of the amplifier. The higher the number, the better will be the damping provided by the amplifier.

Lightning Protection Revisited

I have just finished reading your reply to Mr. James Boltz in the November, 1972 issue of *AUDIO*. I think your explanation of the operation of a lightning rod is in error.

Lightning rods do not have points “because . . . lightning is attracted to high, sharp objects” as you wrote. I think the operation of a lightning rod can best be explained as follows:

The clouds become charged, either positively or negatively, by moisture activity until a region of charge is directly over an object on the earth, or the earth itself, and an opposite charge is induced in this object. Because unlike charges attract, the “desired state” of this system is to discharge. This occurs when the air dielectric breaks down and provides a conducting path for the charged particles. Thus, the lightning discharges.

The function of the lightning rod is to keep the induced charge from building up in the ground object by allowing this induced charge to leak off to

the air. This is accomplished by a pointed rod, well affixed to a ground source of charge. The point on the rod is necessary to provide the leakage. Because a charge always resides on the surface, the small surface of the point then provides a high charge density.

Lightning rods do not attract lightning as you stated. Who wants to put up lightning rods to attract lightning? I would like to distract it. Most lightning discharges would disintegrate lightning rods, cable, and probably a house.—John Rich, Whitesburg, Kentucky

High Resistance Grid Circuits

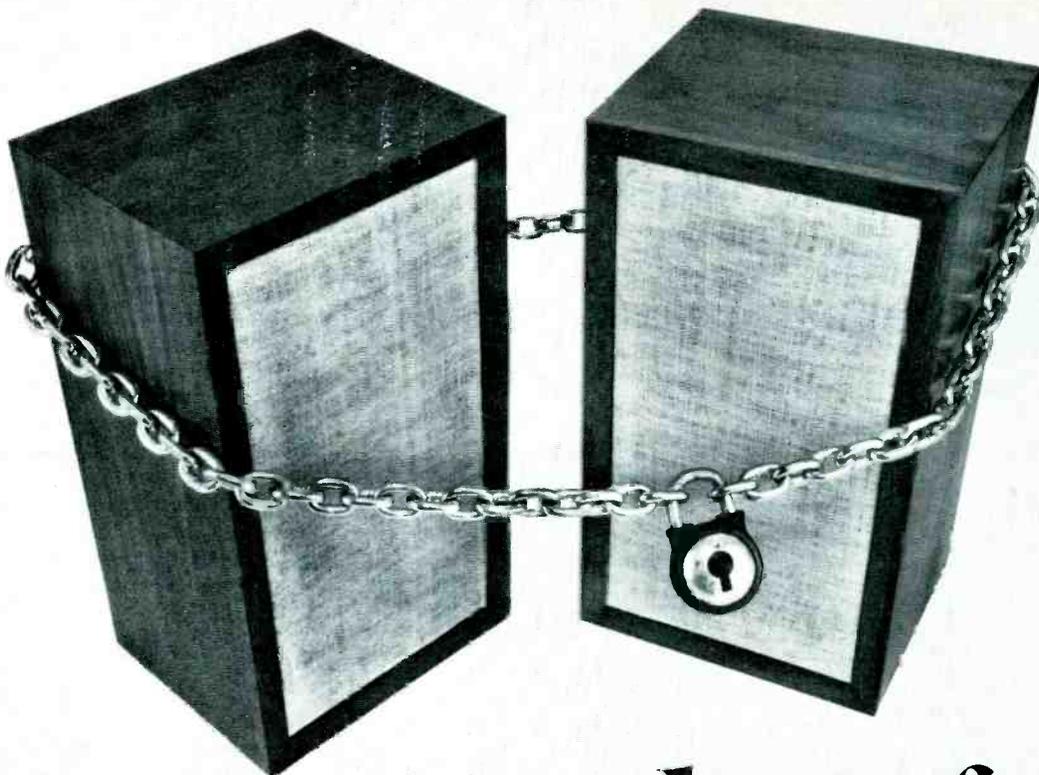
Q. I have read that it is necessary to have a high resistance between the grid and ground of the initial preamplifier tube in a vacuum tube music system. Why is this necessary?—Name withheld.

A. Any preamplifier will require some kind of return path for the grid circuit. The question here comes down to how high a resistance is needed for this return path. We see values ranging from 100 K to perhaps 10 megohms. I am assuming from your question that by “high resistance” you refer to those 10 megohm values.

The reason that some input stages do use this extremely high value is because they operate on what is known as “contact bias.” In such a circuit the cathode is grounded. The bias voltage is developed by cathode current flowing through this high grid resistance on its way to ground, thereby driving the grid negative with respect to cathode.

The advantage of such a circuit arrangement lies in its economy. There is no need for a cathode biasing resistor and a cathode bypass capacitor. However, such contact biased circuits are subject to greater distortion than either cathode biased or fixed biased circuits.

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



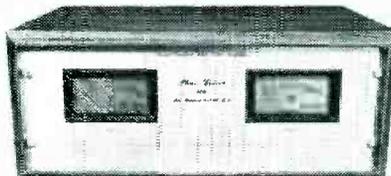
Set your speakers free!

Your amplifier is probably too weak to break the chains that bind your speakers. An under-powered amplifier will lock your stereo system into clipping during low frequency passages or on musical peaks, forcing you down to a less than realistic listening level.

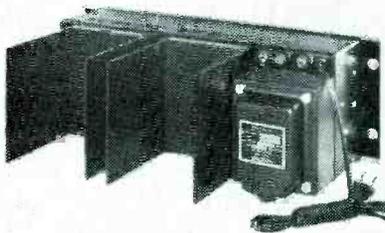


The key to the solution is a high-powered amplifier, specifically, the Phase Linear 400. Listen to Julian Hirsch of Stereo Review: "Anyone using a low efficiency speaker system with an amplifier in the 30 to 50 watt class cannot approach a realistic listening level without severe clipping."

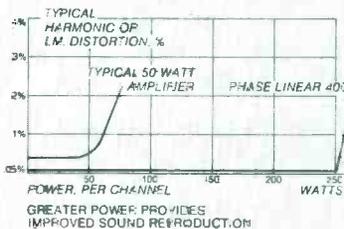
The Phase Linear 400 will unlock music you never dreamed existed in your favorite records. How long has it been since you've had a dream fulfilled? Listen to the Phase Linear 400 at your dealer's soon.



Phase Linear 400
400 watts RMS direct coupled solid state stereo power amplifier.



Advanced design heat sink provides protective cooling.



SPECIFICATIONS

POWER—Greater than 200 watts/channel RMS both channels driven into 8 ohms. Power at clipping typically 250 watts/channel into 8 ohms and 400 watts/channel RMS into 4 ohms.

HARMONIC OR I.M. DISTORTION—Less than .25%; typically less than .05%.

PROTECTION—Patented protection circuit monitors output voltage and current, shuts down amplifier instantly if safe operating levels are exceeded.

HUM AND NOISE—Better than 100 db below 200 watts.

STABILITY—Absolutely stable with all speaker loads including electrostatic units.

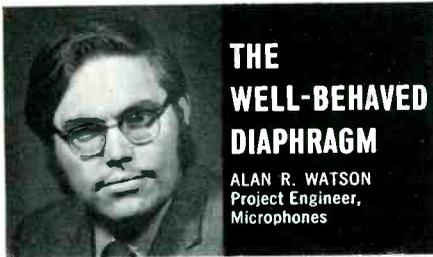
WARRANTY—Three years, parts and labor for normal use.

PRICE—\$499.00 Cabinet: \$37.00

Phase Linear 400

THE POWERFUL DIFFERENCE

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When a microphone design engineer finds discrepancies in the frequency response curve of a microphone under test, he can usually assume that any peaks and/or dips are the result of either faulty damping or that the diaphragm is departing from ideal piston operation. The big problem has been to determine which fault is being displayed.

A powerful tool in determining actual diaphragm behavior is the holographic camera. It can reveal and measure deformations of the diaphragm not visible by other means. Use of this research method led to the unusual diaphragm used in the new E-V Model DS35 Single-D microphone.

The problem was to design a diaphragm that offered high compliance at low frequencies yet maintained good rigidity at high frequencies to withstand the high accelerative forces without diaphragm breakup. The solution was to combine an Acoustalloy® diaphragm using a semi-toroidal surround plus a flat center section, to which is bonded a domed "pill" of molded polystyrene. This construction reduces piston breakup over a broad range of frequencies, and eliminates the minor resonant areas typical of more complex diaphragm designs. Mass of the moving system is also controllable within very close tolerances. The result is predictably flat response, especially at higher frequencies.

This flat response, in addition to being desirable in itself, makes possible more uniform off-axis performance since adjustments can be made to the phase-shifting networks necessary for creating a cardioid pattern, without upsetting the on-axis response.

The holograms also revealed a need to mount the voice coil more rigidly to the diaphragm to eliminate the decoupling that can take place at high frequencies. This was done by recessing the rear surface of the diaphragm to permit the coil cement to operate in shear rather than the usual compression-expansion mode typical of other designs. This improved mounting was made possible by the unique volumetric nature of the diaphragm assembly.

The net result of this design program was to create a Single-D microphone that is remarkably uniform in response both on-and off-axis, especially in the region from 3 to 10 kHz where non-linear diaphragm motion is relatively common with traditional designs. The same approach to diaphragm construction has also been applied to other E-V Single-D microphones including the 670 series.

Where the microphone is used for sound reinforcement a distinct improvement can be noted in gain-before-feedback as a direct result of the reduction of peaks in both on-and off-axis modes. In addition, elimination of peaks reduced the likelihood of input overload in critical installations.

For reprints of other discussions in this series,
or technical data on any E-V product, write:
ELECTRO-VOICE, INC., Dept. 833A
602 Cecil St., Buchanan, Michigan 49107

Electro-Voice
a GULTON subsidiary

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Tape Guide

Herman Burstein

Takeup Squeak Revisited

In the June, 1973, issue Mr. David Tishler asked how to get rid of the occasional squeak in the takeup reel of his Sony TC-255. The answer was unfortunately phrased to indicate that the problem is a peculiarity of this model or brand. It is not.

Possible solutions. Superscope informs us, include replacement of a warped reel, replacement of worn-out reel cap holders or insertion of a thin plastic, cardboard or felt shim on the reel turntable so as to keep the reel from scraping.

Matching Impedance

Q. I recently purchased an Electro-Voice 635A microphone rated at 150 ohms impedance, for use with a Sony 800B recorder having a microphone input impedance of 600 ohms. Is it necessary for me to obtain a transformer which will match the 600 ohm impedance?—Wilson Clark, Washington, D.C.

A. An output impedance of 150 ohms into an input impedance of 600 ohms is ordinarily not a serious mismatch, and should cause no problems. However, if your tape recorder has barely enough gain on its 600 ohm input, so that the 12 db voltage gain to be obtained from a correct match is important, then you would require a transformer. I suggest that you contact the microphone manufacturer, as well as audio houses, about a suitable stepup transformer.

Adjusting For Tape

Q. What adjustments must be made to a tape deck to realize the full potential of high output low-noise tapes? Would the front-panel bias adjustment on the Dokorder 9020V be of value in this respect? What functions do the high output low-noise tape selectors on the Sony TC-651 and the Akai GX-365 D perform?—T.S. Wulbrecht, APO San Francisco.

A. To realize the full potential of low-noise tape, it is necessary to increase bias somewhat above that used for conventional tape, to decrease treble boost somewhat, and to increase record

drive current somewhat. I would assume that the tape machines equipped with tape selector switches perform one or more of the above changes. And the bias adjustment on the Dokorder would be similarly useful.

Recording Matrix Quad Material

Q. Is it possible to record a matrix four-channel disc (for example, a Columbia SQ record) onto a two-channel tape deck in the conventional, two channel mode and not lose any of the code, i.e., to be able to play it back on a tape deck through the decoder, and deliver the same four-channel separation originally found on the disc?—Capt. Burton Silberstein, APO S.F., Cal.

A. You definitely can use a two-channel tape deck to make matrix recordings. You can play these recordings into your decoder with assurance of getting back all four channels without loss. This is one of the advantages of the matrixing system of producing four-channel sound.

Playback Equalization

Q. I understand that there is supposed to be no difference between 7½ and 15 ips equalization. But somehow I think that there must be some difference as there is quite a speed differential.—Richard McCleary, Jacksonville, Fla.

A. So far as playback equalization goes, there is no difference between 7½ and 15 ips according to the NAB standard. However, in recording, there are more severe treble losses at 7½ ips than at 15 ips. Hence 7½ ips entails more treble boost. The specific amount of treble boost is not stated by the NAB standard. Rather, the standard requires that equalization in recording shall be such that, in conjunction with standard playback equalization, overall record-playback response shall be flat (within given tolerances).

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

SONY® 1055 and 5055

One good Sony deserves another



Sony offers you ten individual choices in tuners, amplifiers and preamps, plus an infinite variety of combinations. For every listening requirement in every price range. We're going to tell you about two new low-priced models that offer all the traditional Sony performance and value.

The Sony TA-1055 delivers 20+20W RMS continuous power into 8 ohms per channel, from 40Hz to 20kHz. The power you pay for is the power you get, at every frequency from low, low bass (where you really need it) right up to the highest highs. And these Sony circuit features keep that power

clean and quiet—direct coupled differential output and wide range, integrated circuit phono preamp. It has all the operating features, including such luxury touches as two sets of tape output and monitor connections (use one for an SQ decoder) with direct dubbing, front panel Aux and MIC inputs and slide controls. \$169.50*

The deserving tuner for the TA-1055 is Sony's ST-5055. Its sensitivity is 2.2µV IHF, moderate by today's standards, but when you combine it with a capture ratio of 1 dB, performance is outstanding. There's a high blend switch for quiet stereo reception of

weak signals, built in AFC, signal-strength meter and switchable muting. \$169.50*

Each is the lowest priced tuner and amplifier offered by Sony. Imagine the performance and value offered by the eight other models. Sony's wide selection of deserving amplifiers and tuners goes right on up to the ultimate combination of the super-powered 3200F, deluxe 2000F preamp, and 5130 tuner. Visit your dealer and audition these Sonys. You deserve it. Sony

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Behind The Scenes

Bert Whyte

The professional audio industry is currently enjoying an almost "boom" type prosperity. This is reflected in the activities of the Audio Engineering Society, which thus far this year has held its 44th convention in Rotterdam, its 45th convention in Los Angeles, and will sponsor the 46th convention in September at the Waldorf Astoria in New York. What other industry do you know of that has 3 conventions in a year?

I've been back a few weeks from the Los Angeles convention, and my feet are still aching from tromping through the "biggest ever" exhibition of professional audio equipment. Convened as usual at the Los Angeles Hilton, there was so much equipment that additional space beyond the usual AES allocation was pressed into service.

Where to start? Always most impressive are the huge audio mixing consoles from such companies as Rupert Neve, Westlake Audio, Spectra Sonics and Quad-Eight Electronics. All of them feature 24 or more inputs and usually 16 outputs. There is every kind of equalization, echo send and return, filtering, channel switching, pan-potting, preview monitoring mix . . . even automated "memory bank" input mix and retrieval. In spite of the mad profusion of knobs and switches and meters, these consoles are functionally beautiful and it is evident that much consideration was given to human engineering in their design. For those whose mixing requirements are on a more modest scale, but who nonetheless want professional quality, the Tascam people seem to be concentrating on this market. In addition to their Model 10 console introduced last year, they now have a compact "outboard" console with 12 input modules, which hooks up with the Model 10, affording a total of 24 inputs. With their "building block" philosophy of offering various modules such as remote control, quad panner, headphone monitor, talkback, etc., the mixing console can be tailored to meet the requirements of a broad spectrum of audio people. Tascam vice president, Arne Berg,

showed me some interesting prototypes of new equipment, including power amplifiers, an 8-channel half-inch tape recorder, and a two-channel spring type reverb unit. I listened to the latter (with a chip on my shoulder, because I don't like springs) and was pleasantly surprised at the lack of that objectionable "boingggg" sound that always seems to color these devices.

At the Altec room, old friend John Eargle was showing off a new small-scaled monitor speaker with a new horn design with very wide dispersion. Standing as far off axis as 45-50 degrees, the high frequencies were still very much in evidence, and the stereo imaging was very solid. John also played his "monster monitors," a bi-amplified system employing two 15" acoustic suspension woofers, and a big multi-cellular horn. These speakers have been re-designed since last year, losing about a third in size, but gaining in sound quality from new driver units and a newly configured throat construction in the horn. John says he aims to ship me a pair about mid-July, so I can play all sorts of music and bring you a detailed report. At one end of the Altec room I was astonished to see a pair of gargantuan "C-5 bins" . . . a theatre horn speaker designed by the late Douglas Shearer, chief of the MGM sound department for many years, and brother of the glamorous Norma Shearer. I met Doug years ago, and in fact Bob Fine and I were using his "C-5 bins" to demonstrate "Perspectasound" in an old theatre in the Bronx before a distinguished group that included Sherman Fairchild, Arthur Loew, Spyros Skouras and Joe Schenck.

Big speakers . . . big sound, brings readily to mind the Cerwin-Vega room. It is never difficult to find their room . . . just cock your ears and they will guide you to the source of the awesome roar of genial Gene Czerwinski's corner horn bass speaker, powered by a mere 2000 watts. If you can stand it, when you are in the room the SPL will actually make your clothing flutter! It so happens that old friend Jim Cunningham, a stereo and quadra-

phonic pioneer, was presenting a paper at the quadraphonics seminar. Now Jim happens to be an expert in sound effects recordings, and earlier in the day he had been regaling me with the story of how he had just recorded the whistle of the "Queen Mary," now permanently berthed in Long Beach. He was told the whistle "speaks" at 26 Hertz. God help us all, if Jim and Gene Czerwinski get together at the fall AES convention and send the "Queen Mary" steaming through the corridors of the Waldorf!

The proponents of the various species of quadraphonic discs were on hand, with excellent demonstration rooms. Sansui was showing off their Vario-Matrix, which unquestionably enhances separation to a remarkable degree. The Vario-Matrix circuit is now in production in a number of Sansui receivers. To the list of Sansui supporters we can now add the catalog of French Pathe.

JVC was of course elated when the Warner/Elektra/Atlantic record group opted for their CD-4 discrete four-channel system. The first fruits of that decision will be reaching me shortly, in the way of some pop releases, and a number of classical items from the Nonesuch catalog. In their room, JVC was demonstrating CD-4, but what caught my eye was a most unique peak and VU level meter for quadraphonic sound. Designated the MM-4, this amazing device utilizes a "plasma-film," which shows visually and dynamically the simultaneous level of four signals. The signals appear as concentric circles in each of the four corners of the plasma-film. Now get this . . . the maximum signal level of each channel is displayed in a memory circuit, which will maintain it visually for one hour, while at the same time the fluctuating running signal is displayed! I hope to have one of these units before long and do some recording to put it through the mill.

Quad matrix pioneer Peter Scheiber was ensconced in a suite on the 5th floor where he was proudly showing his new variable matrix encoder and decoder, for use in the EV/SQ quadraphonic disc system. Pete had a nice set-

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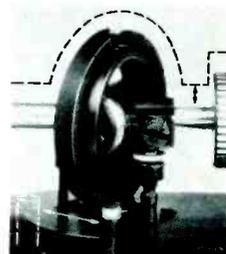


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CROWN

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up using the new Crown electrostatic speakers powered by the new Crown DC300A amplifiers. It certainly was one of the best sounding exhibits at the convention. Pete played some SQ recordings that I had heard on fairly conventional SQ decoding equipment, and the difference in separation and instrumental localization using his decoder was very pronounced. Don't know what the status of Pete's system is, but there was some talk of the possibility of consumer models of his new decoder.

Speaking of Crown, they were on hand with an exhibit of their DC300A amplifier and a shiny new tape recorder, among the first production from their new factory. Crown is recovering nicely from the disastrous fire of Thanksgiving Day 1971. The DC300A is proving extremely popular, being able to cope with virtually any speaker load. In fact as impedance goes down . . . for example around two ohms . . . power output rises to almost 500 watts. The DC300A can also be simply strapped to act as a mono amplifier with 600 watts continuous power at 8 ohms.

Ampex always has an interesting exhibit, and this one was no exception. My friend Frank Rush, the "Dean" of the regional field reps, was on hand to explain the niceties of the new servo-drive 440B recorder, which can be hooked into a gizmo to afford synchronous lock-up with the new 7900 video recorder, as well as the big studio professional video machines.

Scully was showing their tape recorder, about which they are claiming some very impressive noise specs. Will be interesting to find out what combination of tape and type of record/playback electronics is responsible for a S/N of 72dB!

Three M, after having introduced a new 16 track unit last year, has followed up with new quarter- and half-inch recorders. Impressive looking units, professionally detailed, it is obvious 3M wants to maintain a strong competitive position in the studio markets.

Ray Dolby was on hand with his always charming wife, Dagmar, showing off his masterpiece of electronic miniaturization, the M-16. It is hard to imagine that this unit contains 16 channels of A Type noise reduction in little more space than the original Dolby A-301 two-channel NR unit.

There were many more exhibits one could detail . . . the first entry of Bose into electronics, their new 1801 amplifier, an 82-pound brute with an output of 800 watts at 4 ohms, beautifully

finished with both power meters and peak indicating LED's . . . the Burwen/Schoeps microphone with exceptionally low noise circuitry . . . Rudy Bozak's new speakers combining two new design 8-inch woofers, with what is essentially the 8x2 inch tweeter array from the big Bozak "Concert Grand," which however, Rudy says is also a new design with response out to 40-kHz! One could go on and on . . . but I would be most remiss if I did not tell you about one of the most fabulous exhibits I have seen in years and without doubt, the hit of the AES convention. This was a fascinating look at audio history, prepared by Mr. Jack Mullin. Mr. Mullin brought back the original Magnetophon from Germany after the war, and with Alexander M. Poniatoff (whose initials form the first part of the name "Ampex") and the help of Bing Crosby Enterprises, the Ampex Company was formed. Mr. Mullin has collected a great deal of record and tape equipment that has been historically significant over the years and it is these fascinating artifacts, arranged chronologically, which make up his exhibit. Thus we have the first Berliner disc phonograph, record machines with actual demonstration of the same piece recorded acoustically and then electrically. There are tremendous gear-driven turntables for handling 16-inch transcriptions, which were cut vertically and are played back with an arm and cartridge exerting a mere *four ounces* of stylus pressure! There are all kinds of early microphones, including some giant German condenser mics that weighed in at 14 pounds. Wonder of wonders, you can not only see what the original Magnetophon looked like, but by God, it is actually operating at 30 ips, and using the original BASF "Luvitherm" tape! Then there is the Rangertone, an early Magnetophone derivative. The first huge Ampex 200, which handled 14-inch reels of tape is on display. So is the old Magnecord, and the Pentron, and Wilcox-Gay and . . . well it is just staggering. Happily, Mr. Mullin is bringing the same exhibit to the 46th AES convention at the Waldorf in September. If you are a recording man, this is one exhibit that is an absolute must!

So went the 45th AES convention. There were plenty of papers by dedicated people exploring the technological frontiers of our industry, the seminars were well attended, and I'm sure the interchange among the members will set brains a-spinnin', and there will be products coming along that you have never dreamed of, Horatio.

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Editor's Review

THIS YEAR the Consumer Electronics Show (more commonly known among its affectionate attendees by its initials, CES) was again held at Chicago's colossal McCormick Place. This show place is located on the shore of Lake Michigan about two miles south of The Loop, Chicago's city center. The view of the lake from the walkway along the east side of McCormick Place is, as one might expect, extraordinary. However, this view is not for those inside, as walls and curtained glass intervene. Leaving aside the question of whether the addition of such a visual attraction would be conducive to the business inside, it certainly would have been nice to have lunch outside in a "sidewalk" restaurant, looking out over the lake, despite the heat and humidity which prevailed during the first few days of the CES. A pity that the planners didn't include one.

Interest in the various quadrasonic mediums was very high on the part of most of those in attendance, and manufacturers have done a good deal of development work in the past year. There are no fantastic, startling developments to report nor is there any apparent "settling down" toward either of the two major systems—CD-4 or SQ. What seemed most in evidence, however, was a tendency on the part of receiver manufacturers to "cover their bets" by including both systems. In addition, inputs for discrete tape sources are now relatively standard, and many receivers also had jacks for quadrasonic FM decoders/adapters.

The doubling up of systems has, of course, pushed prices up and led one highly placed representative of a tape recorder manufacturer to remark that these costs would eventually be passed on to the consumer. They will indeed, since one cannot logically expect licensing and production costs to be borne by the manufacturers without remuneration.

But it should be pointed out that such "hedging" will delay the ultimate confrontation and final survival of either system. This is not so much a result of the less than decisive atmosphere created by the makers opting for both systems as it will be of the effect of the increased cost to the consumer. For John Q. Public, the receiver with both systems presents him with a third choice, at a cost greater than either of the other two, and one which must appear to him to be only an interim solution, lasting only a year or

two at best, until the confrontation is finally settled. "Why," John Q. asks himself, "should I buy something, part of which will be obsolete in a year or two. I wonder if I might not be better off waiting?"

In some ways, however, the arrival of such all-inclusive receivers is a good thing for John Q. since they allow him to do away with all the wiring detailed in Len Feldman's article last month. Additionally, there is much less shelf space taken up and switching is reduced to a single turn of a knob. (Indeed, one receiver shown at CES performed this switching internally and automatically.)

All things said and done, this year's CES pointed unequivocally towards a quadrasonic future. Just how and when the necessary developments will occur is not clear, but it is certain that they will. In the meantime, look for a rash of new four-channel products, especially receivers, on your dealer's shelves.

Nest

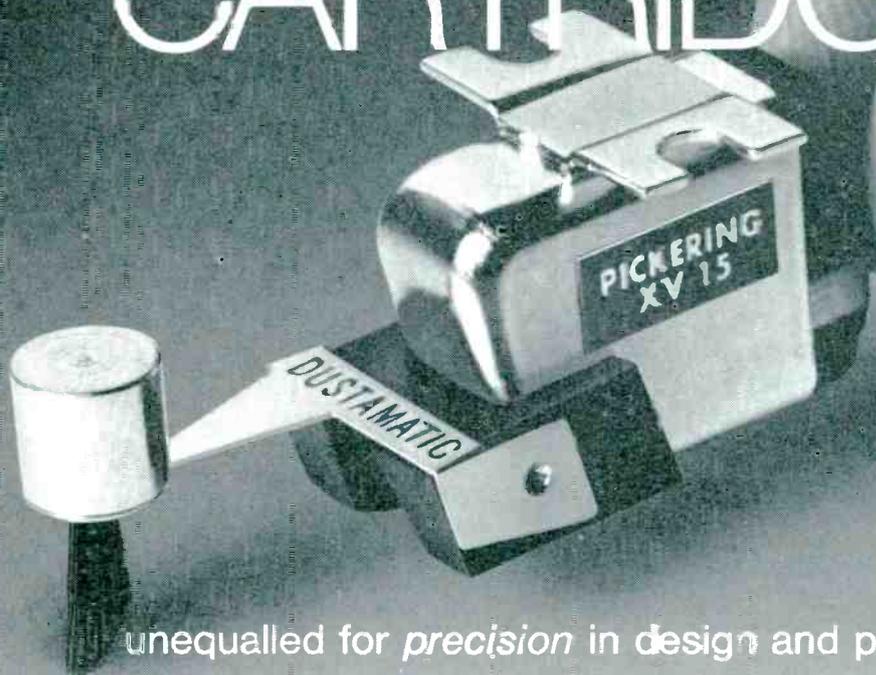
Nest is the acronym for the National Electronic-music Service on Tape, a free tape-lending service set up between contributing electronic music studios and a selected audience in the U.S. and Canada. The essential goal of this service is to establish a means of exchanging information regarding any aspect of electronic music. All "dub boxes" accepted by NEST for distribution are listed in a catalog printed in August. Each tape will circulate among a series of listeners requesting that tape. Presently tapes are composed of compositions (with brief time scopes) for electronic music; lectures and pieces for tape and traditional instrument(s) will be added.

To exchange ideas "live," a three-day conference is being organized for electronic music people. Although exact location, dates, and agenda are not yet set, initial canvassing suggests the eastern U.S. in early Spring, 1974, with an agenda made up of discussions by composers on add-on lab design, to notate or not to notate, and better utilization of computers.

NEST's mailing list is comprised of undergraduate schools with active electronic music labs. Potential listeners and/or tape composers wanting a free catalog and more information can contact: David Barnebl, Music Dept., Harpur College, SUNY, Binghamton, N.Y. 13901. *E.P.*

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Trackability - - 1973

J. Kogen, B. Jakobs, F. Karlov*

IN 1966, we wrote an article for *AUDIO* entitled "Trackability." That article described the concept of trackability as the ability of the stylus to stay in contact with the record groove at all times during the playing of the record. It was emphasized that the necessity of maintaining contact between the stylus and the record is basic to phonograph reproduction and must be considered as one of the major factors in the evaluation of a phonograph cartridge. In the ensuing years, this concept has been accepted throughout the world, and measurements of trackability are made in one form or another by almost all testing laboratories.

During the years since that presentation, a continuous research program on trackability and allied subjects has been under way in the Shure laboratories. The work has been centered about three primary areas of activity. First, a means of accurately measuring the trackability of phonograph cartridges has been developed. This was described by Anderson and Jenrick in *AUDIO* (August, 1972), and a trackability test record, TTR103, has been made available. Second, studies have been made on commercially available phonograph records to determine the trackability requirements that are imposed on the playback system. And, finally, a significant effort has been expended toward finding ways of improving the trackability of phonograph cartridges.

In this article, we will review the second and third areas of our investigative program. We will describe the results of measurements made on typical phonograph records. This, in essence, defines the tracking requirement imposed by the records, which must be accommodated by the playback system. We will then describe a design approach that satisfies these requirements.

Earlier Considerations of Trackability

The accepted definition of trackability has been: "The ability of the stylus to maintain contact with the record groove at minimum tracking force and at all frequencies within the audible spectrum."

*Shure Brothers, Inc.

This definition, which has been in use for many years, contains the term "audible spectrum." Our studies indicate that consideration must be given to frequencies outside the audible spectrum, and we will, therefore, modify the definition to: "The ability of the stylus to maintain contact with the record groove at minimum tracking force and at all frequencies found on phonograph records." The reasons for modifying the definition to include frequencies outside the audible spectrum will be discussed in detail later in this article.

In the 1966 article, reference was made to the limits of recorded modulation on records. In that reference, the audible frequency spectrum was broken down into parts and modulation limits applied as follows:

A. Low frequency, extending from 20 to about 800 Hz, with a maximum amplitude of groove modulation of 0.005 centimeters (0.002 inches).

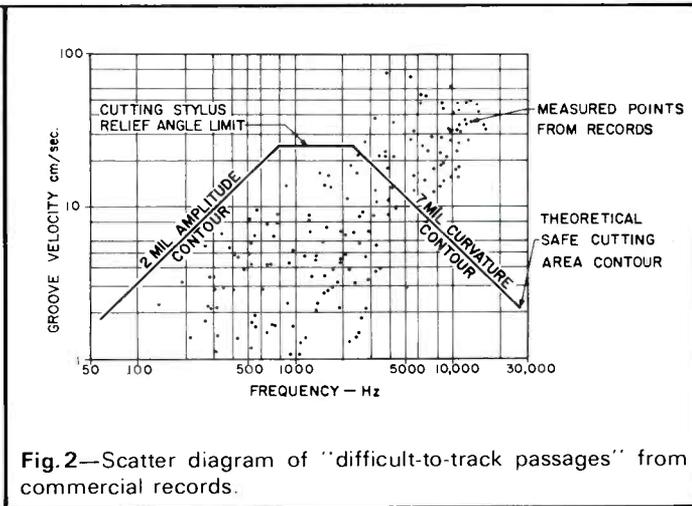
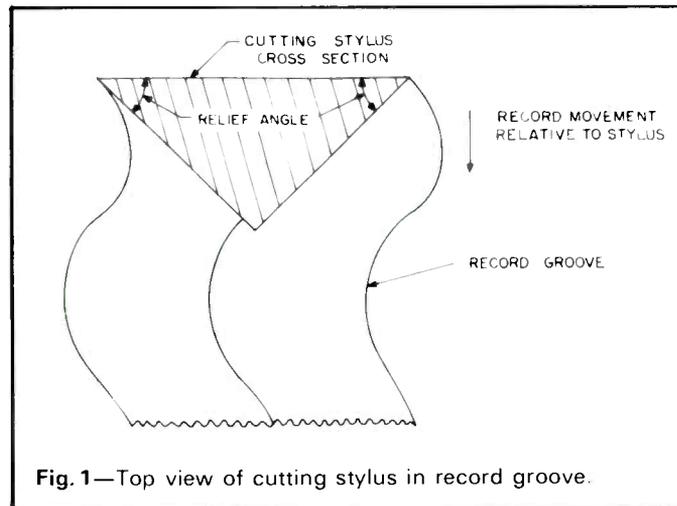
B. Mid frequency, extending from about 800 to 2500 Hz, with a maximum modulation velocity of 25 centimeters per second.

C. High frequency, above 2500 Hz, with an acceleration requirement in excess of 400 g.

These limits were determined by some theoretical considerations as well as practical limitations in cutting phonograph records.

One of the practical limitations relates to the objective of providing a maximum playing time on each side of a record. This objective imposes a limitation on the amplitude of groove modulation. If the groove modulation is too large, it will not be possible to fit enough grooves onto the record to achieve this goal. In examining hundreds of records, we found that very rarely is the practical limit of 0.005 centimeters (0.002 inches) exceeded.

Another practical restriction is determined by the shape of the cutting stylus. The stylus is wedge-shaped (Fig. 1), and the relief angle between the sides and the front of the wedge determines the maximum angle the stylus is capable of cutting. This, in turn, determines the maximum modulation velocity to be found in the record groove. Near the inner grooves, this



limit is about 25 centimeters per second. While higher velocities can be achieved with specially designed cutting styli and at larger distances from the center of the record, we have rarely found modulation velocities greater than 25 centimeters per second in the 800 to 2500 Hz frequency range.

A theoretical limitation in the high-frequency region is based on the assumption that records should not be cut with a radius of curvature of modulation less than 0.7 mils (0.0007 inches). The reasoning for this is that such modulation would cause excessive distortion when the record is played with a stylus having a tip radius of 0.7 mils. In 1966, we stated that many records had been found to exceed this theoretical limit. In the next section, we will review our most recent findings on this subject.

Tracking Requirements Imposed by Commercially Available Records in the Audible Frequency Range

A study was made of a large collection of "difficult-to-track" records in order to update our information on trackability requirements in the audible frequency range. The results of this study are shown in Fig. 2.

Many of the records included in this study were suggested to us by critics and customers, while others were discovered by our engineers. These records contain some of the most difficult-to-track passages found in phonograph records. The records are all of good quality, worth having in one's collection, but with characteristics that for one reason or another make them difficult to play. It was felt that this collection would constitute a reasonable sampling of problem records that a top-quality phonograph system should be able to reproduce with minimum distortion.

On each of these records, difficult-to-track passages were identified, and the modulation velocity and frequency for each passage were measured. Each of these measurements was then plotted as a point in Fig. 2. The envelope of the points presents a picture of the maximum recorded velocities found in this sampling of phonograph records illustrated as a function of frequency.

One point of information that should be interjected here is that some of the points in Fig. 2 would not appear to be difficult to track in terms of modulation velocity and frequency. The measurements we have made assume single-frequency signals. Many of these passages actually contained a number of signals at different frequencies, the dominant one being present in Fig. 2. The total trackability requirement is actually the sum of those imposed by all of the frequencies acting simultaneously. It is also probable that the existence of warps in some of these records aggravated the tracking problem.

Superimposed on the scatter diagram of points in Fig. 2 are the "quasi" theoretical maximum velocity limits one would expect for recorded modulation velocity. Note that in the low-frequency region, from 20 to 800 Hz, and in the mid-frequency region, from 800 to 2500 Hz, none of the measured points exceeds this curve. This is in agreement with the statements made previously regarding the 0.005-centimeter (0.002-inch) amplitude limit and the 25 centimeters-per-second velocity limit in the low- and mid-frequency regions. The theoretical high-frequency limit is exceeded by many points, however, and it seems reasonable to assume that records have been and will continue to be cut with very high modulation velocities in the high-frequency region.

There are several reasons for the existence of high-velocity program material in the high-frequency region of phonograph records. High-frequency, high-level signals provide a means of broadening the dynamic range and producing impressive high-frequency sounds from records. Also, no significant mechanical or electrical restriction is placed on the cutting equipment in this region. It is obvious from the points on Fig. 2 that cutters

are capable of achieving very high modulation acceleration. The only major restriction that the recording engineer apparently considers is the ability of the cutter to inscribe this high-level, high-frequency program material without "burning out" the equipment!

The conclusion reached from the reexamination of trackability requirements in the audible frequency region is that the major problem area still lies in the high-frequency region. The theoretical limits in the low- and mid-frequency regions are reasonably well defined and held. In the high-frequency region, at this point in time, our objective appears to be one of maximizing trackability with no clear limit as to the maximum that must be achieved.

Evaluation of Commercially-Available Records—Subaudible Frequencies

The tracking requirements imposed by the record can be significantly affected by the existence of warps and thickness variations in the record. Consider, for example, one of the difficult-to-track records we measured. The trackability requirement of the modulation in the record groove may be sufficient to drive the phonograph cartridge to the limit of its ability to play that modulation on a perfectly flat record. In such a case, all the available stylus force is used up just to play the groove modulation. Now, think of what will happen if the record is warped. In addition to being required to play the high-modulation velocity in the record, the cartridge must also follow the warp undulation. This will cause additional stylus force to be used up. The addition of the warp, therefore, could be enough to cause mistracking because of a lack of available stylus force. Since high modulation velocity and warp can and do happen simultaneously, it is very important for us to learn more about warp of commercially-available records.

Warp appears on records primarily in the form of subaudible frequencies—that is, below 20 Hz. A study was performed to determine the amplitude as well as the frequency band in which warps occur. The method involved was to examine a significant number of randomly-chosen records by making measurements of the surface contour variations. These contour measurements were then analyzed to determine the amplitude and approximate frequencies of the warps.

A measuring technique was developed that provided a profile of the record surface as a function of angular position around the circumference of the record. Figure 3 presents a series of typical profiles. The vertical axis shows amplitude of the warps in thousandths of an inch; the horizontal axis shows angular position in degrees for 360 degrees around the record i.e., a full revolution. Figure 3 also shows several examples of

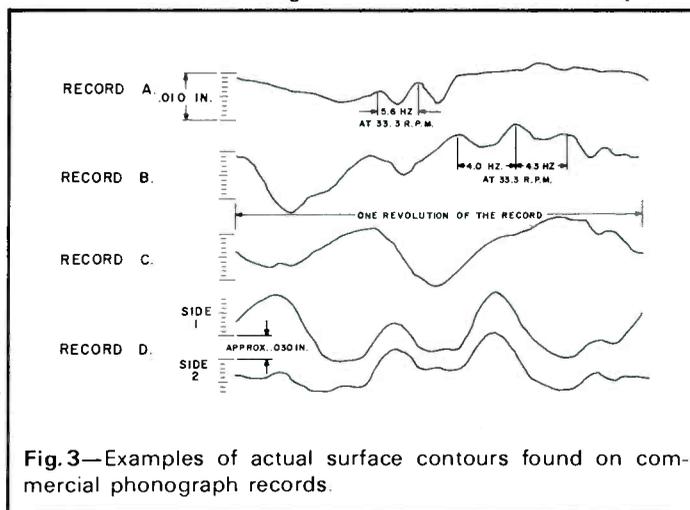


Fig. 3—Examples of actual surface contours found on commercial phonograph records.

frequency approximations, such as the section in record "A" around the 180-degree point, where an amplitude of about 0.005 inches and a frequency of 5.6 Hz are indicated.

Some of the records were measured on both sides, so that with proper alignment, thickness variation could also be determined. An example of this is shown in part "d" of Figure 3, in which the distance between the two curves indicates record thickness. In this particular record, there is a fairly significant variation in thickness. While it was found that thickness variations can be significant, their effect on disturbing the record surface profile is indistinguishable from warps as far as the playback problem is concerned. We will not, therefore, consider thickness variations as phenomena separate from warps.

In the study, 67 randomly-selected records were measured and 210 warp conditions were identified. Figure 4 is a scatter diagram that shows each of these points plotted at the appropriate amplitude and frequency. The dashed line across the bottom of the diagram represents the maximum recorded groove modulation amplitude limit—that is, 0.005 centimeters (0.002 inches). The solid curve lying above all the points represents the maximum expected warp amplitude based upon this random selection of records. The solid curve will be assumed

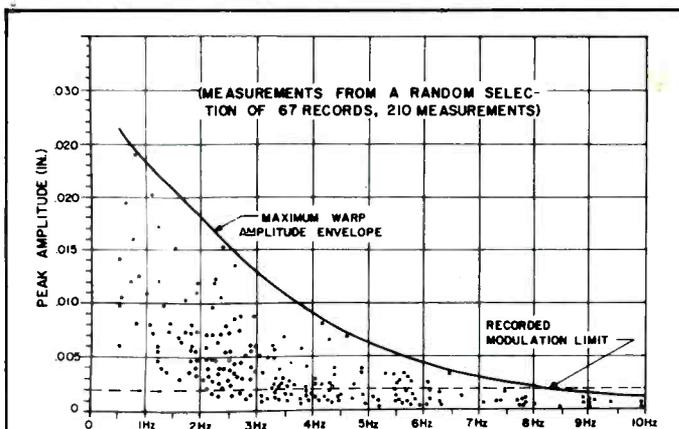


Fig. 4—Scatter diagram of warp amplitude and frequency found on commercial records.

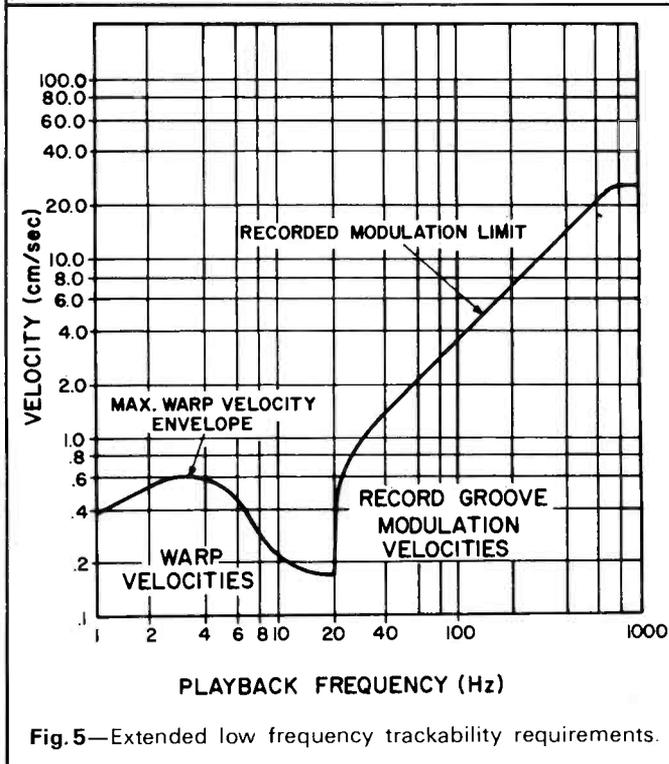


Fig. 5—Extended low frequency trackability requirements.

to represent the worst warp conditions the playback system will be required to cope with in the range below 20 Hz.

The figure indicates that the warp amplitude increases as the frequency decreases. While we will not attempt to discuss this in detail here, another consideration is that of the probability that such warps will occur. In our study, we found that a large number of serious warps occur at frequencies around 4 Hz. This would indicate that although the maximum amplitude of warp occurs at the lowest frequency—that is, one-half Hz—the problem is really most significant in the region of approximately three to five Hz, where one must combine the problem posed by the amplitude of the warp along with the probability that such a warp will occur more frequently.

We should also state that the 67 records randomly chosen for this study were pressed within the past few years and include samples from most of the large record companies throughout the world. They should, therefore, be representative of the typical audiophile's record collection. The maximum warp curve of Fig. 4 could be subject to modification in the future if means should be developed for improving the flatness of records. We feel that for the present, however, this study gives us a reasonable, practical perspective of record warps and the challenge they present to the playback systems.

Trackability Requirements in the 0.5- to 20,000-Hz Range

The data shown in Fig. 4 can be used to present an extended low-frequency trackability requirement for phonograph cartridges. Figure 5 shows the trackability requirements extended into the subaudible region to encompass the warp frequencies. The objective in the design of a phonograph cartridge must be to provide trackability that exceeds the limits shown in Fig. 5. Several factors should be considered in attempting to meet this objective and also to provide the required high-frequency trackability.

In the very low-frequency region below approximately 100 Hz, trackability is determined by the tone arm and the phonograph cartridge operating as a system. In this region, trackability is not controlled solely by the cartridge as it is in the audible spectrum above approximately 100 Hz. We cannot specify trackability for the phonograph cartridge alone but must consider the cartridge in combination with the tone arm.

Above approximately 100 Hz, trackability is determined solely by the phonograph cartridge. In phonograph cartridge designs, it is possible to "trade off" trackability in the low-frequency region in order to increase trackability in the high-frequency region. It is possible to provide only enough low-frequency trackability to satisfy the low-frequency requirements and to place the major emphasis in the high-frequency region. The design is wasteful, to say the least, if excessive low-frequency trackability margin is provided with a resulting reduction in high-frequency trackability.

Since recorded modulation at all frequencies and warps can occur simultaneously, it is necessary that the cartridge-arm system be able to track properly throughout the total significant frequency band. It is not sufficient for the cartridge-arm system to be capable of tracking audio frequencies and yet be incapable of properly coping with the warp modulation. The objective in the design of the phonograph cartridge must be to resolve both of these problems at the same time.

Optimizing for Low-Frequency Trackability

In the low-frequency region, the amplitude of the record groove excursion caused both by the recorded groove modulation and by the warp of the record is the major factor to be considered. In order to track in the low-frequency region, it is necessary for the stylus to be capable of deflecting to

the maximum amplitude with the available tracking force. At low frequencies, this ability is determined primarily by a parameter that we call the dynamic compliance of the stylus. The compliance figure normally specified for phono cartridges in "10⁻⁶ centimeters per dyne" is the static compliance; that is, the compliance that would be measured under static conditions. Dynamic compliance is measured while the stylus is in motion and is normally smaller than the static compliance.

At some low frequency, the tone arm-cartridge system will exhibit a resonance determined primarily by the interaction of the dynamic compliance of the stylus and the effective mass of the tone arm-phono cartridge combination. At and near the resonance frequency, the motion of the stylus relative to the tone arm will be many times that of the exciting signal. This will then significantly reduce the ability of the pickup to track the groove modulation. It is essential, therefore, that we minimize as far as is practical the probability of exciting this resonance.

To further examine the effect of tone arm-cartridge resonance, let us consider an experiment as depicted in Fig. 6. Here we have a tone arm and cartridge mounted with a device that can drive the stylus at a constant amplitude with varying frequency. Such a device could be the coil-magnet assembly of a loudspeaker. We will measure the output of the phonograph cartridge as the frequency is varied from a very low frequency up to 100 Hz. We will assume for the purpose of this example that this particular system resonates at 10 Hz.

At one-half Hz, the tone arm and cartridge move up and down together as a unit. There is little relative motion between the stylus and the tone arm. Since the stylus moves only slightly with respect to the tone arm, little electrical signal is generated and we can plot point 1 of Fig. 7.

As the frequency of the input signal is raised, we begin to discern more relative motion between the stylus and the tone arm. Keep in mind at this time that the total system is moving up and down with the driving device, and we are now obtaining an additional motion of the stylus relative to the tone arm. This produces some output, as shown at point 2 of Fig. 7.

As the system approaches resonance, the tone arm moves in ever-increasing amplitude, reaching a violent motion at 10 Hz. There is considerable relative motion between the stylus and the tone arm, and considerable electrical output from the cartridge (point 3, Fig. 7). This is the resonance frequency.

As the frequency is raised above 10 Hz, the relative amplitude of motion between stylus and tone arm decreases, and at about 40 Hz becomes constant with increasing frequency. At this point, the tone arm is standing still and all of the motion is taking place in the stylus. This is the condition under which the phonograph system is supposed to operate in the recorded frequency range. At these frequencies, one cannot see movement of the stylus with the naked eye.

There are two very important observations to be made from this experiment. First, the movement of the cartridge-tone arm system at and around resonance can cause considerable difficulty in tracking, and the frequency at which this resonance occurs must be determined with great care. Second, motion of the cartridge-tone arm below, say, 20 Hz is an indication that the system is having some difficulty. It is important to minimize the possibility and probability of generating such motion.

Optimizing the Resonance Frequency of the Cartridge-Tone Arm System

The optimum resonance frequency for the cartridge-tone arm system can be deduced from Fig. 5. The figure shows that the minimum amplitude for warp and recorded groove modulation is in the region around 10 Hz. By measuring the cartridge-tone

arm system at low frequencies in a manner similar to that just described, we can determine the low-frequency trackability of the system. A typical low-frequency cartridge-tone arm trackability curve is shown in Fig. 8, which also repeats the warp and recorded groove modulation velocity requirements of Fig. 5. In order to optimize the system, we should place the point of minimum trackability (the resonance frequency of the tone arm-cartridge system) in the region of minimum warp and record modulation velocity; that is, around 10 Hz.

The two major factors that affect the resonance frequency are the mass of the tone arm-cartridge system and the dynamic compliance of the stylus. Increasing the mass of the system will lower the resonance frequency and tend to raise the amplitude of the resonance, or, conversely, decrease the trackability. Increasing the dynamic compliance will also decrease the resonance frequency. By adjusting these two parameters, one can find an optimum frequency for the minimum point of the trackability curve. This optimum frequency is in the range between 7 and 15 Hz where there is a minimum of groove modulation and warp input to excite system resonance.

From the standpoint of phonograph cartridge design, it is necessary that the cartridge be made to operate with available good quality tone arms. A survey of tone arms indicates that the effective mass can be expected to fall in the range of 13 to 30 grams. (This includes typical cartridge mass.) This, then, sets a definite restriction on the dynamic compliance of the cartridge. Using the information obtained as to the optimum resonance frequency and the range of effective tone arm masses, we can calculate the optimum dynamic compliance for a phonograph cartridge to be in the range of 20 to 25 microcentimeters per dyne (10⁻⁶ cm/dyne).

The conclusion we have reached is most significant with regard to optimizing the design of a phonograph cartridge. We

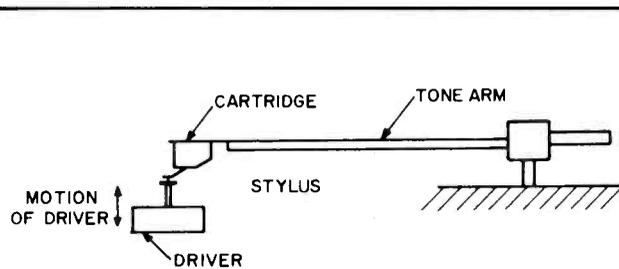


Fig. 6—Method for measuring tone arm-cartridge resonance.

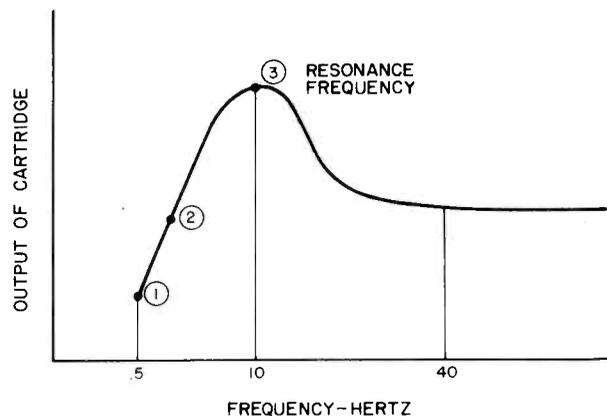


Fig. 7—Output of cartridge as drive frequency is changed near tone arm-cartridge resonance.

have found that there is actually an optimum compliance, and that either too much or too little compliance can lead to difficulty.

If the compliance is too high, the resonance frequency of the tone arm-cartridge system will be too low; and severe problems will result when the system is used with warped records. Aggravated wow and groove jumping are typical in this case. In addition, large amplitude, subaudible electrical signals will be

generated. The signals can easily overload an amplifier or cause excessive stress and possible distortion in the loudspeaker.

If the stylus compliance is too low, causing the resonance frequency to be too high, several other problems can occur. Very low audio frequencies may be over-emphasized because of the rise in response near resonance. One might also expect increased mechanical and acoustical feedback problems. And, finally, problems may occur because of insufficient low-frequency trackability in the audio region.

The seriousness of the low-frequency resonance problem should not be underestimated. We have found that the sensitivity to record warp resulting in mistracking and wow can differ by as much as a factor of ten between properly and improperly designed tone arm-cartridge systems.

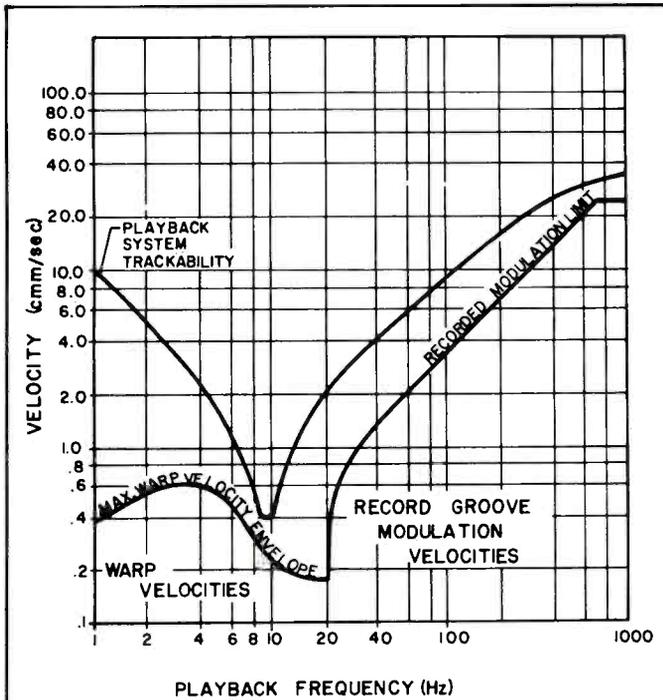


Fig. 8—Typical tone arm-cartridge trackability curve.

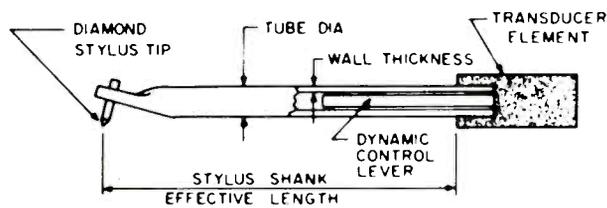


Fig. 9—Stylus of Shure phonograph cartridge.

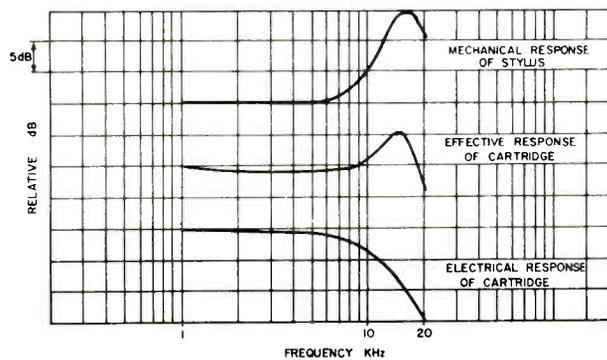


Fig. 10—Mechanical, electrical, and effective frequency characteristics of V15-I.

Optimizing for High-Frequency Trackability

The need for maximizing high-frequency trackability has been established (Fig. 2). Our objective in the high-frequency region is to obtain all the trackability possible, provided that we have allowed sufficient tracking capability in the subaudible, low-, and mid-frequency regions. The studies that yielded the data illustrated in Fig. 2 give information as to the required trackability for the cartridge. Other studies relating to evaluating cartridges, as reported by Anderson and Jenrick in *AUDIO* (August, 1972), resulted in the TTR103 Test Record, which is now commercially available. This record allows measurement of trackability in the low-, mid-, and high-frequency regions. The remaining and most critical objective is to determine how to design a cartridge that will satisfy the known trackability requirements.

The major factor in maximizing high-frequency trackability of the cartridge is the design of the stylus. When studied in detail, the stylus is a complex mechanical structure. In previous papers, this subject was discussed in some detail, and we will not repeat that information here. Suffice it to say that development and design engineers must pursue a task of considerable complexity, using both analog and digital computational techniques, along with arduous and painstaking development and evaluation of prototypes. Parameters that must be optimized include many stylus dimensions; stylus shank, wall size and thickness; tip shape and size; magnet geometry; different materials; and—in the case of the Shure cartridge—dimensions and positioning of the dynamic control lever (Fig. 9). The general direction in which the engineer moves is that of decreasing the effective stylus mass. However, there are many limitations on this objective, not the least of which is ruggedness and reliability. Output level and clearance between the cartridge and the record surface are other factors that must be considered when reducing the stylus mass.

While one primary objective is to maximize high-frequency trackability, we must not forget other very important characteristics of the phonograph cartridge. It is possible to improve trackability, but at the same time deteriorate the frequency response. There is a point beyond which this is not acceptable. A brief historical review will be useful to explain this point.

The frequency response of a phonograph cartridge results from the combination of two frequency characteristics: the mechanical characteristic of the stylus and the electrical characteristic of the cartridge. Figure 10 shows these characteristics for the original Shure V-15 I phonograph cartridge, which was introduced in 1964. In the figure, we show the effective frequency response, as well as the relative responses of both the stylus and the cartridge alone. Addition of the mechanical and electrical curves results in the effective response. Since trackability is generally poor at resonance, it

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When *Audio Magazine* reviewed the Model 50, it recorded a response that "extended from 45 to 16,000 Hz ± 3 db, and dispersion was excellent." When *Audio* tested 14 small speakers for dispersion, our Model 50 beat the pack of them.

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is clear that the V-15 I would have difficulty tracking material in the 15 kHz region.

Trackability of the Shure V-15 II cartridge was substantially improved by moving the mechanical resonance frequency to 20 kHz while many other parameters of the cartridge were idealized. In the design of the V-15 II, the decision was made to accept a small droop in the frequency response in exchange for the vastly improved trackability. This is shown in Fig. 11.

In the development of the newly introduced Shure V-15 III (Fig. 13), one primary objective was to further improve the high-frequency trackability. In the process of making this improvement, the stylus resonance was moved out to 23,000 Hz, well above the audible spectrum. It was clear, however, that with this additional raising of the resonance frequency, a considerable droop in the frequency response curve would

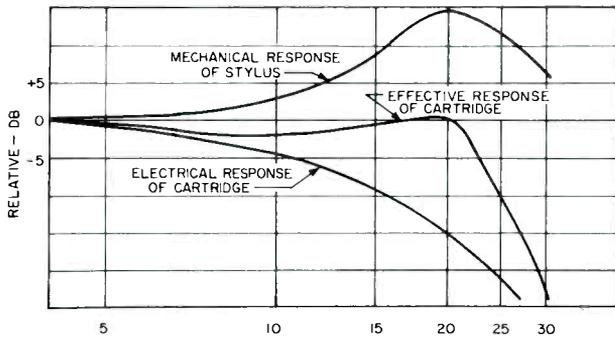


Fig. 11—V15-II frequency response characteristics.

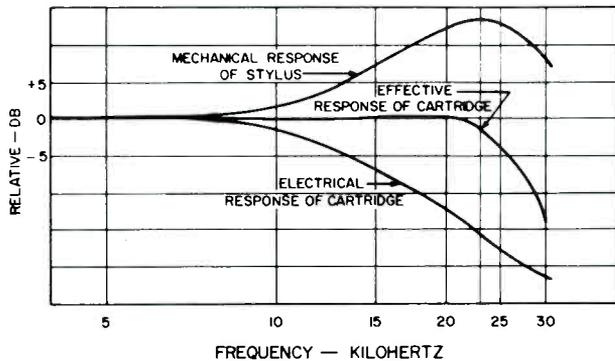


Fig. 12—V15-III frequency response characteristics.



Fig. 13—V15-III

occur if the cartridge body of the V-15 II were retained. It was thus necessary to design a completely new cartridge body structure to match the higher trackability stylus of the V-15 III.

The cartridge structure of the V-15 III incorporates an assembly of precise miniature laminations. These laminations reduce electrical losses in a manner similar to the laminations of an electrical transformer. Through the use of these laminations and several other design features, it is possible to provide an electrical frequency response that almost perfectly complements the mechanical frequency response of the stylus. This results in an overall frequency response that is essentially flat (Fig. 12). Through the use of this new structure, it is possible, therefore, to achieve a significant improvement in high-frequency trackability and, at the same time, to provide an improvement in frequency response over that of the previous design—the V-15 II.

The trackability curve of the V-15 III as compared to the V-15 II is shown in Fig. 14.

Conclusion

New product development must always be a matter of continuous progress. In many instances, however, we must retrace our steps, reexamine our previous results, and provide improvements before moving ahead. While such factors as record warp and thickness variations, and high-velocity groove modulation have been known to us for many years, we have found it valuable to learn more about them. We have learned about them by developing measuring techniques and by performing extensive studies, both on discs and on cartridges.

Our measurements show that warp is a significant problem in current phonograph records and that it is essential to optimize the dynamic compliance of a phonograph cartridge so that records may be played properly. Since warp exists on practically all phonograph records to one degree or another, it is an important characteristic that cannot be ignored. Fortunately, we know how to minimize the effects of warp without compromising the low-frequency response. Only severely warped records need cause significant problems.

We have also learned that through careful optimization, it is possible to design a phonograph cartridge that satisfies the high-frequency tracking requirements of practically all phonograph records and, at the same time, offers an almost perfect, flat frequency response. The art and technology of making records has progressed significantly since the report we presented in AUDIO in 1966. We believe that the design of phonograph cartridges and their ability to play the records has kept pace with that progress.

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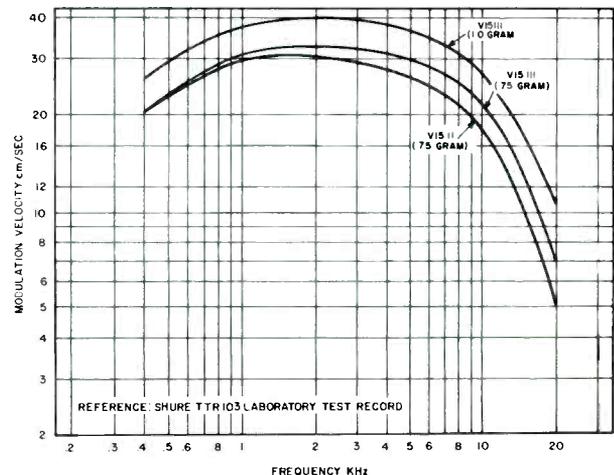
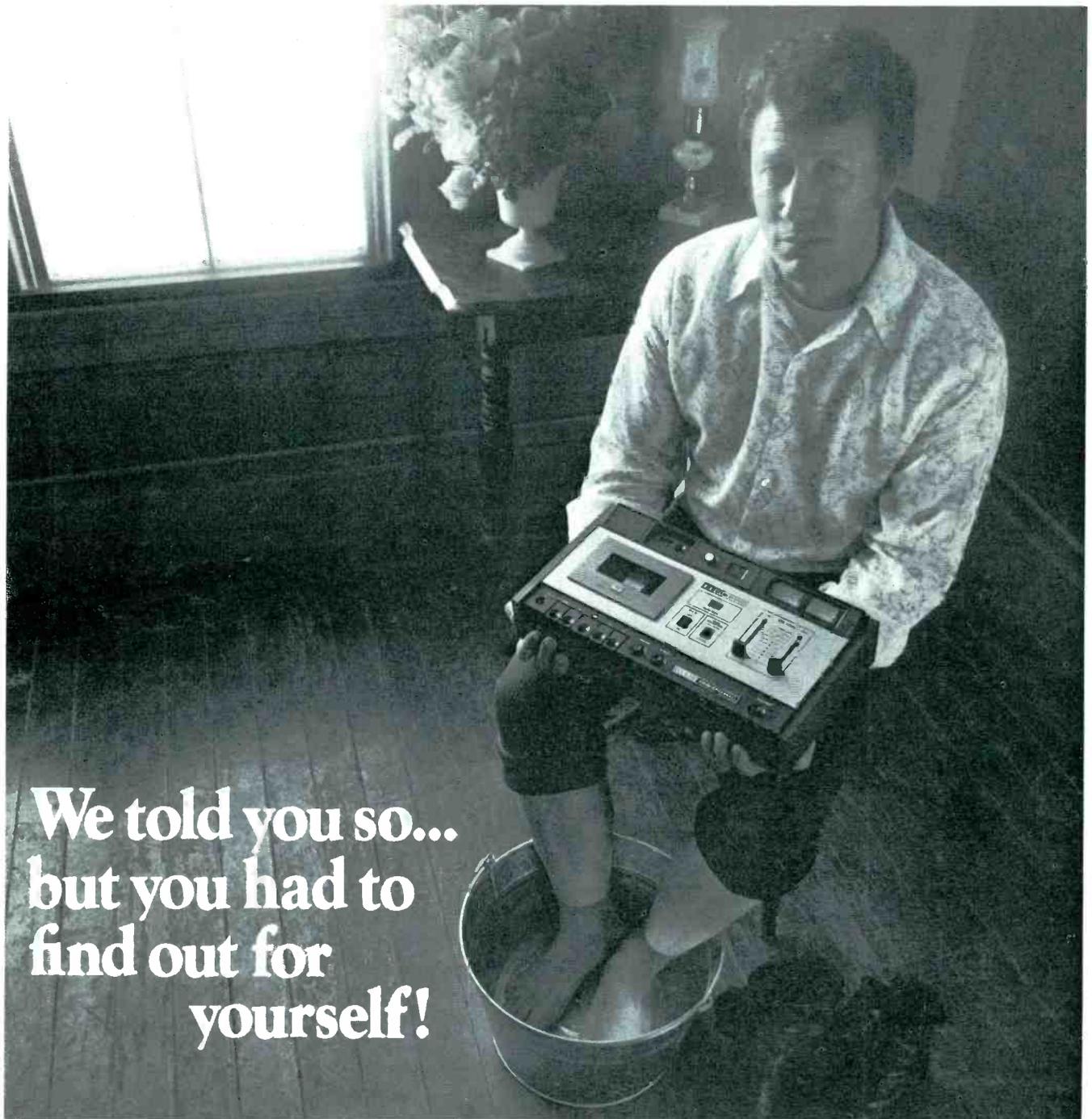


Fig. 14—Trackability of V15-II and V15-III.



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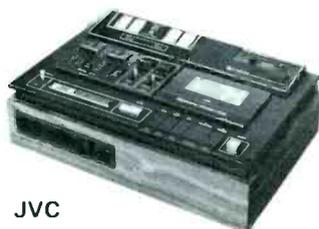
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Seen At CES



Dual 701



JVC
4CD-1680



Kenwood KR-9340

THE CONSUMER ELECTRONICS SHOW, which introduces the product lines for the coming year to hi-fi dealers and sales reps. was held again this year at Chicago's McCormick Place. More than 370 firms exhibited at the convention center June 10 to 14, with some (especially speaker manufacturers) taking suites in various hotels for more intimate and undisturbed demonstrations.

Far too great a variety of new products was shown to permit coverage of them all, but the following are some of those about which we had details at press time.

Dual turntable

The Model 701 is a direct-drive unit which uses electronically-regulated, overlapping coil assemblies. Speed is controlled via feedback, and the record spindle is actually the top of the motor shaft. There are two separate mechanical resonance-cancelling filters, one tuned to the resonant range of the tonearm-cartridge system, the other to the chassis. Other features include gimbal tonearm suspension, anti-skating for either conical or elliptical styli, 8% pitch control, and built-in illuminated strobe. Price: \$350.00.

Dynaco amplifier

The Stereo 400 amplifier offers 200 watts rms/chan. at 8 ohms with less than 0.1% IM and 0.18% THD from 20 to 20,000 Hz. Hum and noise is stated as 95 dB below rated output, response as 20 to 20,000 Hz \pm 0.5 dB at 200 watts, and power at clipping (single channel, 2500 Hz) is 235 watts

at 8 ohms. Prices: \$449.00, kit; \$599.00, factory wired; meter assembly kit, \$75.00; factory wired with meters, \$669.00.

ESS speaker

The Heil amt 2 prototype, shown by ESS, is a two-way system using the air motion transformer (amt) found in the amt 1 for the middle and high frequencies. A twin-stacked amt diaphragm, driven by a central motor, is used for the lower frequencies. The latter unit has an effective radiating area equivalent to an 18½-in. piston and will reproduce 25 Hz fundamentals, says the firm. Price: N.A.

Fairfax speaker

The FE-8B is a refined version of the FE-8A and features two isolated, vented chambers, each with a 10-in. woofer, for extended bass response. The four-speaker, three-way system also has a 3½-in. mid-range cone and a 1-in. dome tweeter. The enclosure is made of 1-in. walnut and has a foam grille. Price: \$249.95.

Harmon-Kardon receiver

The 900+ AM/FM two/four channel receiver offers 4x32 watts, 8 ohms, 20-20,000 Hz with less than 0.5% THD, all channels driven, or 2x90 watts in two-channel mode. The tuner section is rated at 1.8 μ V sensitivity, 1.6 dB capture ratio, 70 dB S/N, 60 dB selectivity, and 37 dB separation. Features include CD-4 and SQ circuitry, "joy-stick" balance control, split treble, mid-range, and bass tone controls, main and remote speaker facilities with individual front and back switch-

ing, and two each tape and phono inputs. Price: \$749.00.

JVC receiver, cassette deck

New products from JVC include the top-of-the-line two/four-channel receiver. Model 4VR-5456, which boasts 4x25 watts rms, 8 ohms, 20-20,000 Hz. THD at rated power is 0.5%, while IM is 0.8%. Price: \$699.95. Also shown was a prototype tape deck, Model 4CD-1680, a two/four channel, eight-track cassette unit incorporating ANRS and CrO₂ capability. S/N, using chrome tape, is claimed as 55 dB, while crosstalk is specified at 25 dB. Special circuitry uses phase shift and feedback to help eliminate crosstalk. Discussions are proceeding with Philips, says JVC, and availability is "mid-1974," though this is tentative. Price will be in the \$500 to \$600 range.

Kenwood receiver

Kenwood introduced the KR-9340, a top-of-the-line receiver with 4x50 watts rms. It will handle all four-channel sources with built-in CD-4 demodulator, SQ, and RM decoders, and discrete facilities. Other features include four VU meters, separate bass and treble controls for front and rear, push button controls for two speaker systems, inputs for two four-channel tape systems, and direct coupling between speakers and amplifier. Specs are 1.8 μ V sensitivity, 75 dB S/N, 1 dB capture ratio, and 40 dB separation at 1 kHz, while the amp specs are 0.5% THD and IM, 10 to 60 kHz power bandwidth, and 60 dB hum and noise (phono). Price: N.A.

This is "one powerful set!"

"It was in the area of audio amplification, however, that we got our biggest surprise. The S-7200 is one powerful set."

This quote from Audio Magazine, May 1973, evaluating the Sherwood S-7200 AM/FM stereo receiver, surprised us.

Not that the reviewers found it to be such a powerful set. But that they found it so surprising.

The fact is, most people who are into Hi-Fidelity components, are discovering that Sherwood delivers on its claims. And then some.

Or, to quote further from the review:

"The 40 dB mid-band separation figure is exceeded by 3 dB."

"With a signal as little as 5 μ v, quieting had already reached an impressive 52 dB."

"THD in mono exceeded

published claims, reaching a low figure of just 0.2% at mid-audio frequencies."

"Our power amplifier tests were confined to 8-ohm loads, but at that, the Sherwood S-7200 exceeded its claims and pumped nearly 43 watts into each load, with both channels driven."

"Based upon a 40-watt rated output per channel, power bandwidth extended from 10 Hz to 40 kHz, quite a bit better than claimed. At the audio limits of 20 Hz and 20 kHz, 1% THD was reached at 36 watts per channel and 40.5 watts respectively, while at all power levels below 40 watts, THD remained well under 0.5% for all audible frequencies."

"The loudness-volume control of the S-7200 deserves special mention. The tracking of the two sections of this control was excellent—with no more than 1 dB

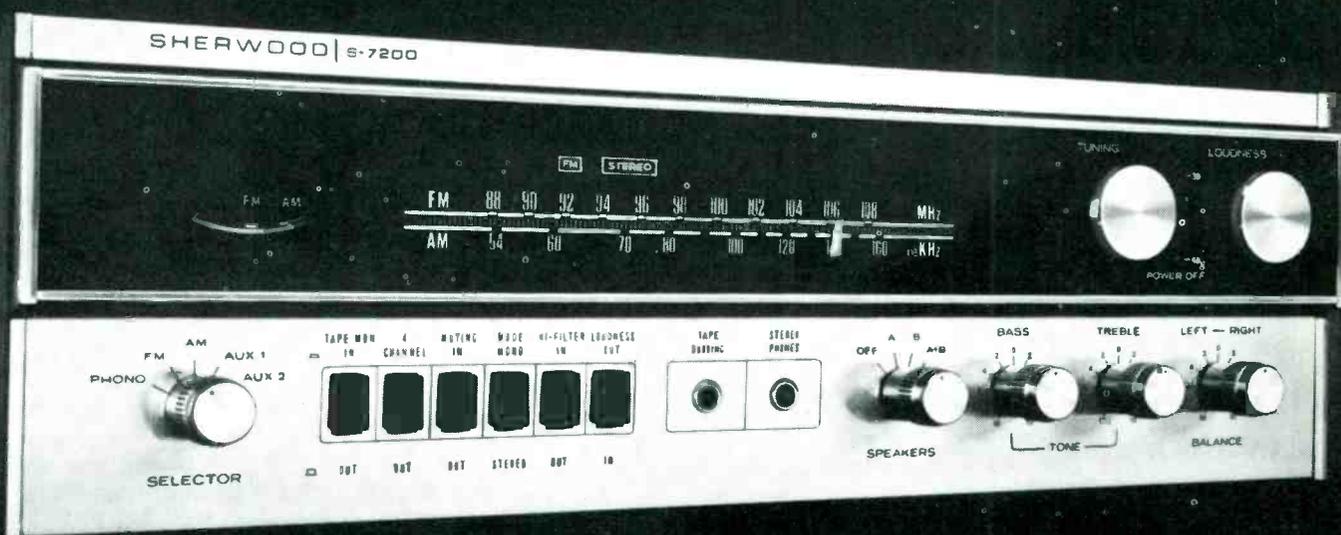
variation all the way down to 60 dB from the full clockwise position—which means that high quality potentiometers are used in this all important control."

But in the end, it is the power of Sherwood receivers that normally turns people on.

"Using low efficiency speaker systems in our main listening area, we just could not overdrive the amplifier portion at any desired listening level—and we mean all the way up to over 100 dB sound-pressure levels."

Which perhaps brings us to this point. If there is one impressive factor about Sherwood receivers, it is that they often not only outperform their specs: they almost always out-spec competition.

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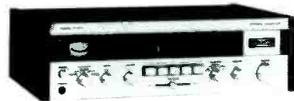
Sansui
SC-737



TEAC 850



Nikko STA-9090



Superscope R-350



Technics by Panasonic
SA-8000X

Nikko receiver

The 9090 AM/FM receiver offers 65 watts rms/chan. and incorporates such features as five circuit breakers for speaker protection, phase-lock-loop multiplex decoding, FET front-end, and ceramic filter. A new addition for Nikko is a high blend filter, which gives flat high frequency response to help eliminate beats and other spurious signals. Price: N.A.

Phase Linear preamplifier

The Model 4000 preamp is designed for use with a quadraphonic system, incorporating individual left and right bass and treble controls, built-in SQ circuitry, and provision for external CD-4 or SQ adaptors. Other circuits include a peak limiter, designed to compensate for peak compression during recording; a downward expander, which compensates for gain riding during recording, and a noise reduction system called an Auto-correlator, which operates above 2 kHz and below 200 Hz. There is also an active equalizer to boost lows below 50 Hz and, more moderately, above 7 kHz. Price: \$599.00.

Pioneer receiver

Among several new products from Pioneer is the QX-949 AM/FM two/four-channel receiver with CD-4, SQ, and regular matrix circuitry. Power is specified as 4x40 watts rms, four channels driven at 8 ohms, 20-20,000 Hz. Power in two-channel mode is 2x60 watts rms. Other features include four-channel level indicator, facilities for two four-channel speaker systems, three tape decks, two turntables, and an auxiliary source. Tuner specs are

1.8 μ V sensitivity, 1 dB capture ratio, 80 dB selectivity, 70 dB S/N, and greater than 30 dB separation 50-10,000 Hz. Price: \$699.95.

SAE amplifier

The Mark IIIC amp is rated at 200 watts/chan., 8 ohms, 20-20,000 Hz \pm 0.25 dB. THD is rated as 0.05% and IM at 0.025%, both at full power. S/N is specified at 100 dB below 200 watts rms, and the damping factor at better than 150. There is protection circuitry against d.c., low frequency, and thermal problems. The Mark IIICM has power meters reading directly in watts, a voltage scale, and a dB scale. Prices: Mark IIIC, \$750.00; Mark IIICM, \$850.00.

Sansui cassette deck

The SC-737 cassette deck is one of several new products from Sansui. It incorporates a Dolby noise reduction system, MCF ferrite head, and synchronous motor. Specified performance is S/N of 56 dB with Dolby engaged, response of 30-13,000 Hz, and wow and flutter of 0.12% rms. Features include soft-touch, push-button operation, pause control, and CrO₂ tape select. Price: \$299.95.

Superscope receiver

The R-350 AM/FM receiver offers two-four channel compatibility with the ability to achieve a four-channel effect from both two-channel and matrix encoded sources using Quadraphase[®] circuitry. Power output is rated at 60 watts IHF. Other features include a four-channel FM output jack, mono mode selector, and graphic balance control. Price: \$279.95, with cabinet.

TEAC tape recorders

Some 16 new cassette and open-reel tape recorders were shown by TEAC at CES, including the Model 160 cassette unit, which is priced at \$229.50 and includes a Dolby noise reduction system, bias and equalization for CrO₂, high energy, or standard tapes. The Model 850X is a three-head, three-motor cassette deck with dual-process Dolby for simultaneous Dolbyized recording and decoded tape monitoring, slow wind cue control, and memory rewind counter. Price: \$579.50.

Technics by Panasonic

Heading up this line aimed at the audiophile is the SA-8000X AM/FM receiver, a two/four-channel unit with built-in CD-4 demodulator and AFD matrix circuitry for demodulating or decoding all four-channel sources. The unit offers 4x64 watts rms or 2x84 watts rms, plug-in adaptability for discrete four-channel FM broadcasts, facilities for discrete four-channel tape equipment, separate level controls for each channel, four-channel/two channel speaker outputs, and multiple tape monitor and dubbing facilities. Price: \$499.95.

3M/Wollensak tape deck

Several new cassette and cartridge decks were shown by 3M/Wollensak. Top-of-the-line in cassettes was the Model 4765, which boasts Dolby noise reduction circuitry, sound-on-sound mixing, sound-on-sound or independent channel monitoring, and beltless direct drive. Response is said to be 35-15,000 Hz \pm 2 dB with high performance tape. S/N is specified as better than 50 dB without Dolby, and wow and flutter at less than 0.15% DIN weighted. Price: \$329.95.



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AU7500



AU6500

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Among the many exciting features of the AU9500 are a wide variety of conveniences, such as a 4-channel adaptor switch, for QS, SQ, or CD-4 add-on units, the ability to handle up to four tape decks, and provision for tape-to-tape dubbing. Triple tone controls allow even the fussiest listener to adjust the AU9500's response to his taste.

As eye-catching as it is functional, the AU9500's elegant front-panel styling is a standout in any audio display. And it has two counterparts, the AU7500 and AU6500, which offer many of the same features, the same quality engineering and manufacturing, but slightly less power. All three are powerful, quality units that are unequalled for fine high fidelity reproduction.



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the new dynamic world of



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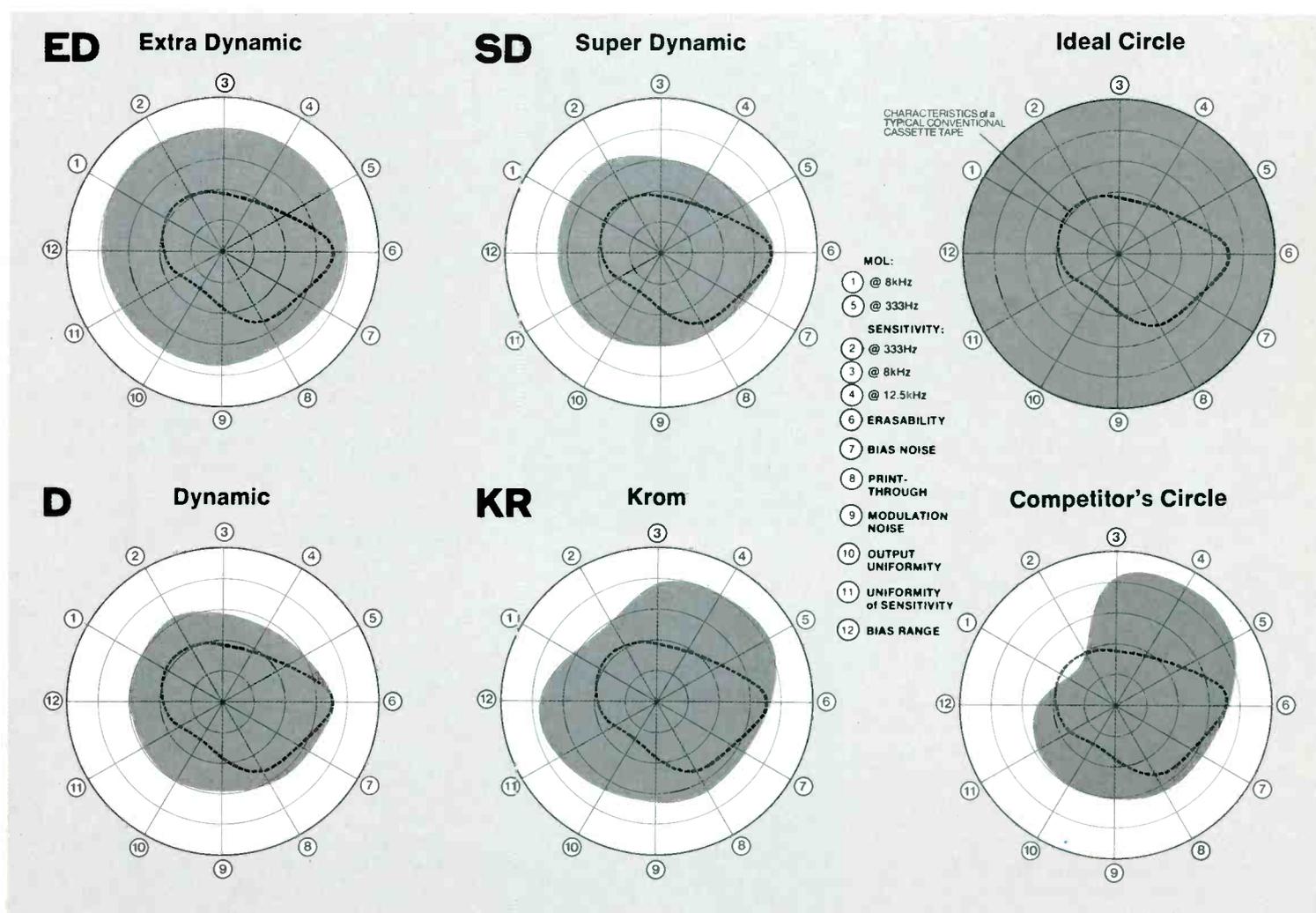
ED EXTRA DYNAMIC offers an entirely new dimension in cassette recording fidelity for the discriminating audiophile. Recording characteristics are vastly superior to any other cassette on the market, for unmatched performance on any cassette deck. Incomparably fresh, sharp and rich sound. Available in 45, 60 and 90 minute lengths.

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Shown below are CIRCLE OF TAPE PERFORMANCE characteristics of TDK's ED, SD, D and KR-series cassettes; on the right are the properties of two leading "premium-quality" competitive cassettes. Judge for yourself which cassettes provide the best balanced hi-fi performance.



SD SUPER DYNAMIC, the tape that turned the cassette into a high-fidelity medium. Very high maximum output levels (MOL) and very broad dynamic range assure outstanding reproduction of the complex characteristics of "real life" sound. Clear, crisp, delicate sound reproduction. Available in 45, 60, 90 and 120 minute lengths.

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KR KROM cassettes, available in 60 and 90 minute lengths, are the "more than equal" chromium dioxide cassettes for those who prefer its brilliant, crisp, sharp sound. For use only on decks equipped with a bias or tape type selector switch, KROM cassettes offer unequalled response and outstanding linearity at high frequencies.

From The Lab

George W. Tillett

I HADN'T been back to England for over four years but I have kept in close touch with many friends there. Even so, I must admit I was really staggered by the inflation: prices have risen enormously, especially property values which are five times higher in two years! Curiously enough, one result of this situation is a boom in hi-fi. People feel it is not worth saving money because of the depreciation so they just up and spend it! This buying spree is not just confined to compact systems, cassette recorders and "medium-fi" equipment, but top quality items are also much in demand. And so the hi-fi stores are filled with products from Marantz, Crown, Phase Linear and H-K Citation, which are all quite expensive by the time they have crossed the Atlantic.

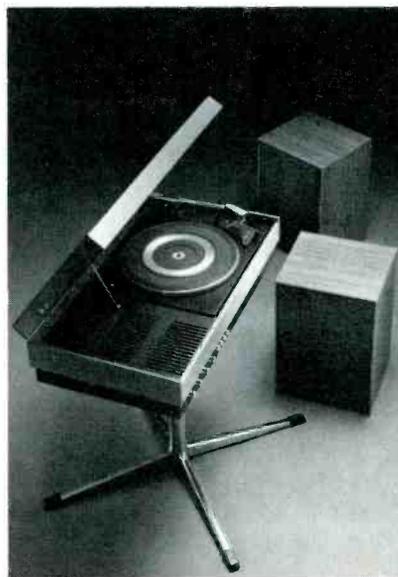
Years ago, the British Radio and Television industry had a regular exhibition called RadiOlympia which was a kind of family affair with music, personal appearances by various celebrities, and all kinds of spectacular promotions. Attendances used to be around the 250,000 mark and a good time was had by all—or so it seemed. But what happened? First, the hi-fi manufacturers dropped out to organize their own show where they could demonstrate in peace, then a few other companies decided to save money and hold extra-mural shows in local hotels. As costs rose, still more dropped out (some had booked most of their orders before the show anyway). So, the main exhibition got smaller and smaller until there was none—everyone was outside. This was the situation this year and some 20 or 30 manufacturers had organized a trade exhibition dispersed in hotels in West and Central London. The unfortunate dealers found



B&O 2200



Typical compact units



it a tiring exercise although I fancy they were well-nourished at every port of call. Some of the exhibits, like the Rank-Wharfedale-Bush group, B & O, and Decca occupied a great deal of space, others were hidden away in small rooms. All, or most of them, featured compact systems with power outputs in the 5 to 20 watt range. In general, styling followed the low profile trend with some receivers less than three inches high! This meant a return to the flat toroidal power transformers and some cunning layouts—as can be imagined. The exhibition—if it can be called that—was not restricted to British-made equipment and there were items from France, Germany, Italy and Yugoslavia.

Russian Hi-Fi

At least two Russian manufacturers were represented—*Vega* were showing a range of portable radio receivers—one model with a built-in timer and *Rigonda* had several compacts and an elaborate radio-phonograph called the "Bolshoi." Styling was quite good—being nearer the Japanese concept rather than following the East German trend as in previous years.

There were several quadraphonic demonstrations and I found three or four demonstrators using SQ records for two-channel stereo. They all said it gave better results than ordinary records! I am not certain why this should be so but it certainly says something for the compatibility! B & O had a large suite of rooms and among the new products was a cassette recorder. This was model 2200, a Dolby unit with a claimed signal-to-noise of 61 dB. Styling is typical B & O slimline, but the predominant black finish

with just a touch of silver is a little unusual.

A visit to a number of Hi-Fi dealers confirmed the growing interest in quadraphonic sound and I was particularly impressed with a store called "Lind-Air," claimed to have the largest display of Hi-Fi equipment in Europe. Could be true, too: they occupied four floors of a large building near the center of London with separate demonstration rooms for JBL, Marantz, Pioneer, Harman-Kardon and many others, plus another room for quadraphonic sound. The room was a little too large for best results but the overall sound quality was good.

The week was rounded off, so to speak, with a visit to the Dolby plant in South London. After the Grand Tour given by Bob Berkovitz (late of AR), I had a discussion with Ray Dolby on the "B" system adapted for FM broadcasting. It has long been known that the present pre-emphasis boost (50 μ s in Europe, 75 μ s here) can cause overmodulation problems. The boost at 10 kHz is 10 and 14 dB respectively and the problem is often "solved" by some kind of limiting. Alternatively, overall modulation is reduced resulting in inefficient operation (see Fig. 1).

As it happens, a 25 μ s pre-emphasis is compatible with the spectral distribution of program energy and so it can allow full modulation of the carrier under all program conditions. A larger constant does not permit full modulation, a smaller one permits no further increase in level. Ray Dolby's idea is to combine the "B" system with a 25 μ s pre-emphasis to get maximum efficiency with optimum signal-to-noise. With such a system there is no

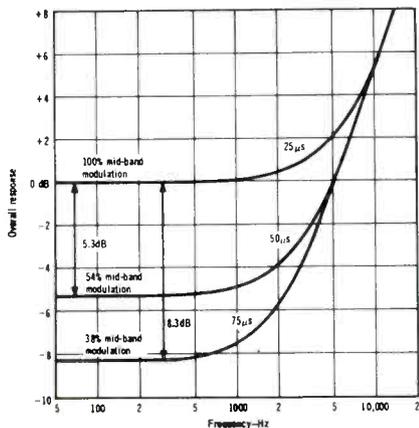


Fig. 1—FM pre-emphasis curves arranged to show maximum permissible mid-band modulation levels with 75 μ s, 50 μ s, and 25 μ s time-constants assuming same net boost (resulting in approximately full modulation) at 10 kHz in all cases.

need for high frequency limiters. Now it only remains to convince the FCC. . .

Incidentally, Ray Dolby and Dagmar Dolby will have a new product in November. Ray hopes it is a boy; one thing is certain—neither an "A" or "B" unit can help to increase the signal-to-noise from this amplifier!

* * * * *

I have been taken to task by two readers who believe I am biased

against AM. They do not contest my criticism of poor quality from AM stations but *put the blame on the manufacturers for not making top quality AM receivers!* This is putting the cart before the horse and no mistake; how can you expect a manufacturer to increase the price of a receiver by putting in a sensitive, low distortion AM unit if there is no demand for it? If there was such a demand, I am quite certain that manufacturers would waste no time in filling it. **AE**

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AUDIO TESTS

NINE PHONO

CARTRIDGES

EVERY FEW MONTHS, a new crop of phono cartridges hits the market, and every serious audio hobbyist is understandably curious about their characteristics. Is such-and-such model appreciably (or even a little bit) better than the one I am now using? Will it improve my reproduction? Will it perform properly with my present equipment? These are the kinds of questions that the enthusiast asks—of himself or of his favorite dealer. Here are some of the answers, particularly as pertain to nine different models—most new, but with an old standby for comparison purposes, the Stanton 681EE.

To begin with, the potential buyer may want to consider the possibility of changing over to discrete four-channel reproduction. For any type of matrix four-channel reproduction, any good cartridge will suffice, but for CD-4 or discrete records, a different breed is required, since response must be extended out to at least 45,000 Hz. This is because the CD-4 system operates on a principle similar to the familiar FM-stereo multiplexing, and the “sub-carrier” in the record system is at 30,000 Hz. To reproduce sidebands adequately, the response must be wide enough to permit sidebands up to the usual 15,000 Hz, which means that the sub-channel operates in the range from 15,000 to 45,000 Hz.

This treatise was not intended to evaluate cartridges solely for their ability to reproduce discrete four-channel records, but since there has been considerable speculation about cartridges usable for reproducing them, we will try to clarify some of the requirements. To that end, all of the cartridges reported on in this profile were tested out to 50,000 Hz, although only one made any claims to CD-4 readiness.

In making the frequency-response measurements, a Bruel & Kjaer frequency-sweep record, QR-2009, with a range from 20 to 20,000 Hz, was used, and with the response recorded automatically on Justi-Meter III, the graphic audio recorder designed by this reviewer. To cover the range from 1,000 to 50,000 Hz, a newly available record from JVC was used. Not much can be told about this record, since the information on the jacket was in Japanese, a language with which this reviewer is only slightly familiar, such knowledge including such words as *arigato* and *sayonara*, both learned from movies. However, the information on the record label tells us that it is a “High Frequency Response Test Sweep, No. TRS-1005,” of JVC’s Technical Record Series, and that there is a spot or reference tone, of 1000 Hz, followed by a period of no modulation, then a sweep starting at 1000 Hz and continuing up to 50,000, with nine pairs of left and right sweeps on each side. The time of the sweep is such that it matches the B & K QR-2009, assuming that the 1000-Hz reference tone is started at the 50-Hz mark on the chart. The reference tone continues for a few seconds, then stops (which starts the chart motor), and then the sweep commences at the 100-Hz line on the chart, so that the plotting is just 10 times the indicated frequency.

The response from 20 to 20,000 Hz was recorded for both left and right channels from both outputs from the cartridge, to give both frequency response and separation. Only the left channel was recorded for the range from 1000 to 50,000 on the JVC record. Output was measured from the left-channel cut on CBS STR-100 at a stylus velocity of 3.54 cm/sec, and corrected mathematically to indicate the output (in mV) per centimeter/sec of stylus velocity. Square wave

photos were made using CBS STR-111 for the source, again using only the left-channel cut since both were nearly identical in all cases. In two cases—the Decca models—both the vertical and lateral sweeps of the QR-2009 were measured just out of curiosity, and were found to be quite close over the range—enough so that their responses are not included. The Decca cartridges are, of course, built with vertical and lateral transducers, with the matrixing done internally, presumably, so that the outputs are left and right, and thus compatible with most other cartridges in which the signals are developed directly from the 45/45 aspects of the grooves.

It should be noted in advance that these cartridges represent the latest outputs of the various manufacturers, and that most are not specifically intended for CD-4 reproduction. The only exception to the “latest output” designation is the Stanton 681EE, which is about two years old, but still a creditable cartridge.

High-Frequency Measurement Problems

We have long noted the variations in response caused by different capacitances in the leads from the cartridge to the measuring instrument. In some cases, the manufacturer specifies the recommended value of capacitance, and unless used with that much capacitance, response is likely to show a peak somewhere around 19,000 Hz, and a broad droop in the 6000 to 9000 range. With proper load capacitance, the droop is flattened out, and the peak is reduced, so that response is flatter over the entire range. Measurements of a number of turntables with their supplied connecting leads indicates that an average value of capacitance is around 300 pF. Consequently,

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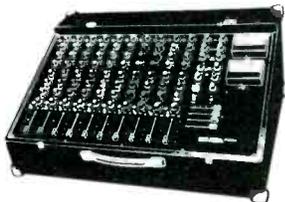
by Panasonic

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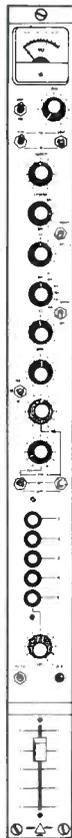
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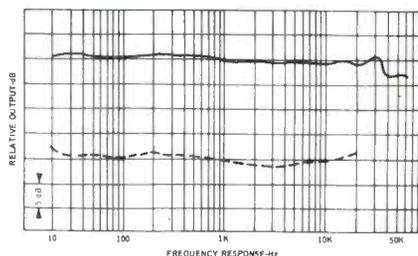
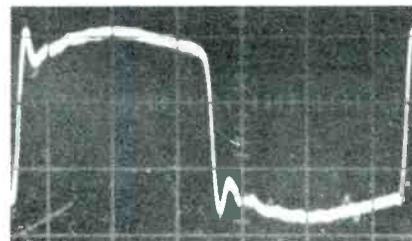
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responses were measured at this value, and also with added capacitances of 100 and 200 pF, so that where is a significant difference in response between 300, 400, and 500 pF, it is noted. In all cases, the high-frequency ranges were measured with lead capacitances of 105 pF.

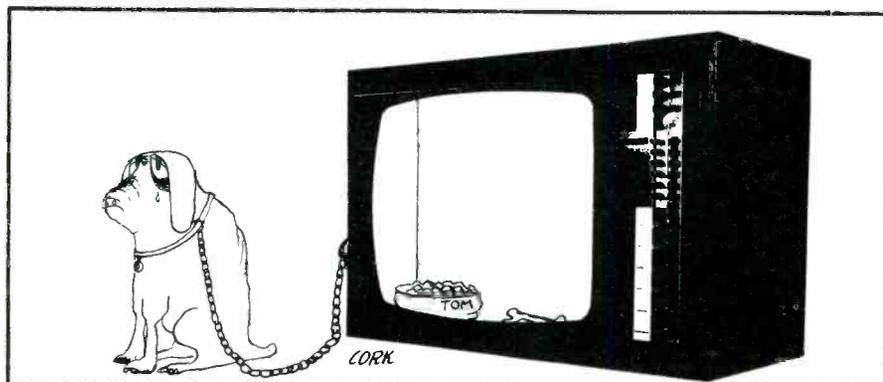
In trying to duplicate the published responses of the Audio-Technica AT-15S cartridge, it was found necessary to reduce the lead capacitance appreciably. In fact, the load resistance in the CD-4 demodulator unit is said to be 100k ohms instead of the usual 47,000 in phono inputs of conventional receivers and amplifiers. Furthermore, it seems that the leads from the cartridge to the demodulator are described as "large, fat cables." Since it was found that there was a great difference in response with a standard 300-pF connecting cable, another cable was made up using two 3-foot lengths of RG-58/U, resulting in a total capacitance of 105 pF from the stereo plug to the cartridge clips. (Input to the recorder is by means of a standard stereo jack.) With this pair of leads, it was possible to come within 2 dB of the published response of the cartridge at 50,000 Hz.

What we are trying to tell you in all this dissertation is that if you plan to convert to CD-4, don't expect to get good results with the cables supplied with your turntable—replace them with leads made from cables with lower capacitances in the vicinity of 40 pF/ft, and that's not counting the small leads, also shielded, within the turntable itself. It is suggested that you make a new set of leads—not RG58/U, since that is with a solid conductor, but with a good 75-ohm video cable, flexible, such as Belden 8279, with 21 pF/ft., or Dearborn 195/U, with 15.2 pF/ft. RG58/U has a capacitance of 17 pF/ft., but with its solid conductor is difficult to handle. It is likely that with the decoder you would get new leads, but don't forget the extra capacitance within the turntable itself.

Audio-Technica-15S



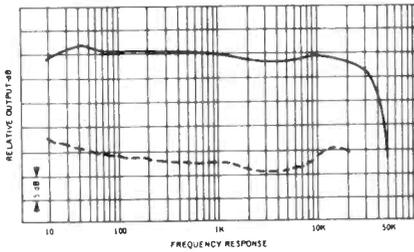
Next to the top of the line (the top is AT-20S) is this model which is claimed to be usable for CD-4 reproduction. From the standpoint of frequency response it certainly could, since it is down only 3 dB at 50 kHz. In this company's line, two separate magnets are mounted on the stylus "arm" near the fulcrum. These magnets are less than half a millimeter in diameter and only about two millimeters in length, and are mounted at right angles to the stylus "bar," which is actually a conical tube of minute dimensions. The stylus is a nude diamond mounted directly onto the end of the tube, and it has the Shibata shape, which is designed to contact a larger



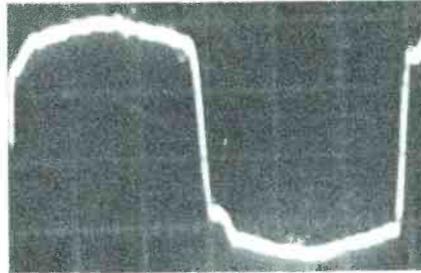
area of the groove, thus reducing stylus pressure at the same stylus force, which is recommended at 1.5 to 2 grams.

Resistance measured 485 ohms per coil, and inductance 410 mH. Output measured 1.02 mV/cm/sec.

Audio-Technica AT-13E



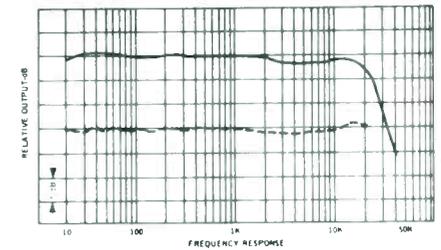
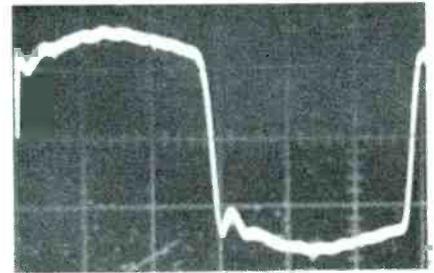
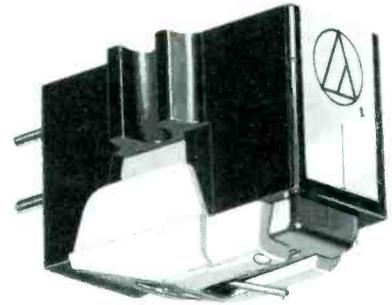
Slightly lower in performance, and somewhat lower in price is the AT-13E, which is fitted with an elliptical



stylus. Coil resistance is higher, measuring 1240 ohms per coil, and inductance is also higher, at 870 mH per coil. Output measured 1.10 mV/cm/sec. This unit is similar in construction, but with higher resistance and inductance has a less extended range, being within ± 2 dB from 20 to 20,000 Hz, and dropping off rapidly after that. Separation still excellent, ranging about 20 dB up to 20 kHz.

Audio-Technica AT-10

This is the lowest in price of the Audio-Technica line, and performance is satisfactory by 1973 standards, with response within ± 3 dB from 20 to 20,000 Hz and very rapidly dropping off after that. Separation was 15 dB



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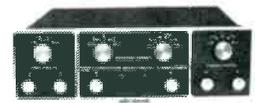
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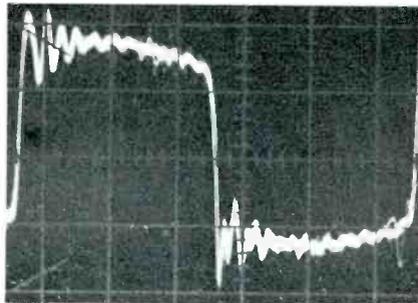
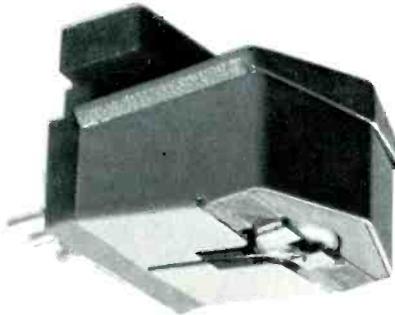
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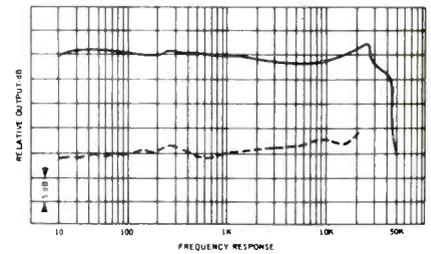
clear out to 15,000 Hz, dropping to 10 dB at 20 kHz. This model had coil resistances of 1200 ohms and inductances of 850 mH, and with its conical stylus with a radius of 0.7 mils could hardly be expected to have an extended response. However, its output—1.72 mV/cm/sec—might prove an advantage where the additional 5 dB was needed.

Decca London Export



To our knowledge, Decca is the only current manufacturer whose products operate on the vertical and lateral principle. That is, there is one coil which translates the vertical motion of the stylus, and another which translates the lateral motion. Actually, what was probably the first such pickup was the famous Western Electric 9A, which used two coils to move with the stylus motion. When connected in series opposition, they reproduced only the lateral motion; connected in series aiding, they reproduced only the vertical motion. The two coils came out to the terminals separately, and one was reversed by means of an external switch. In its patent application, the idea of matrixing these coils was described for the possibility of stereo reproduction of 45/45 records—and this was in the early '30's. It was a great pickup in its day, but massive. It followed the D-spec vertical 'hill and dale' cartridge, and was long used in broadcast stations until about the middle '40's when better cartridges—probably first was the Pickering—came onto the scene.

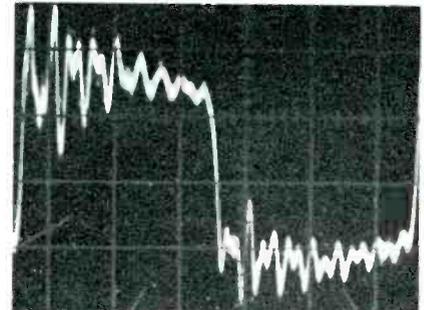
Decca claims some special advantages in its construction, and while we have



little "inside" information about it, it is likely that the matrixing is done internally. The unit is small—11/16" wide and 15/16" long—and light—4 grams. It fits onto a plastic bracket which is mounted in the head and provides the terminals for external connections. Only three terminals are provided, within the common terminal serving for both right and left channels. The stylus proper is mounted on the tip of a tiny "arm" which is shaped to transmit the motion to the two coils' pole pieces. What appears to be the stylus arm is actually a nylon tie-back cord to hold the stylus in place. The stylus is not replaceable by the user, a disadvantage in the amount of time it would be out of service while sent back for replacement, but an advantage in that its placement is factory-perfect, and when so replaced it is in effect a new cartridge.

Resistance of each channel measured 4320 ohms, and inductance was 75 mH. Output was 1.16 mV/cm/sec, and there was no noticeable difference in the response with the three values of capacitance over the 20-20,000 Hz range. Note that response is within ± 3 dB from 20 to 30,000 Hz, unusually good for normal stereo use. Reproduction excellent, with particularly smooth highs, apparently limited only by the records themselves.

Decca London

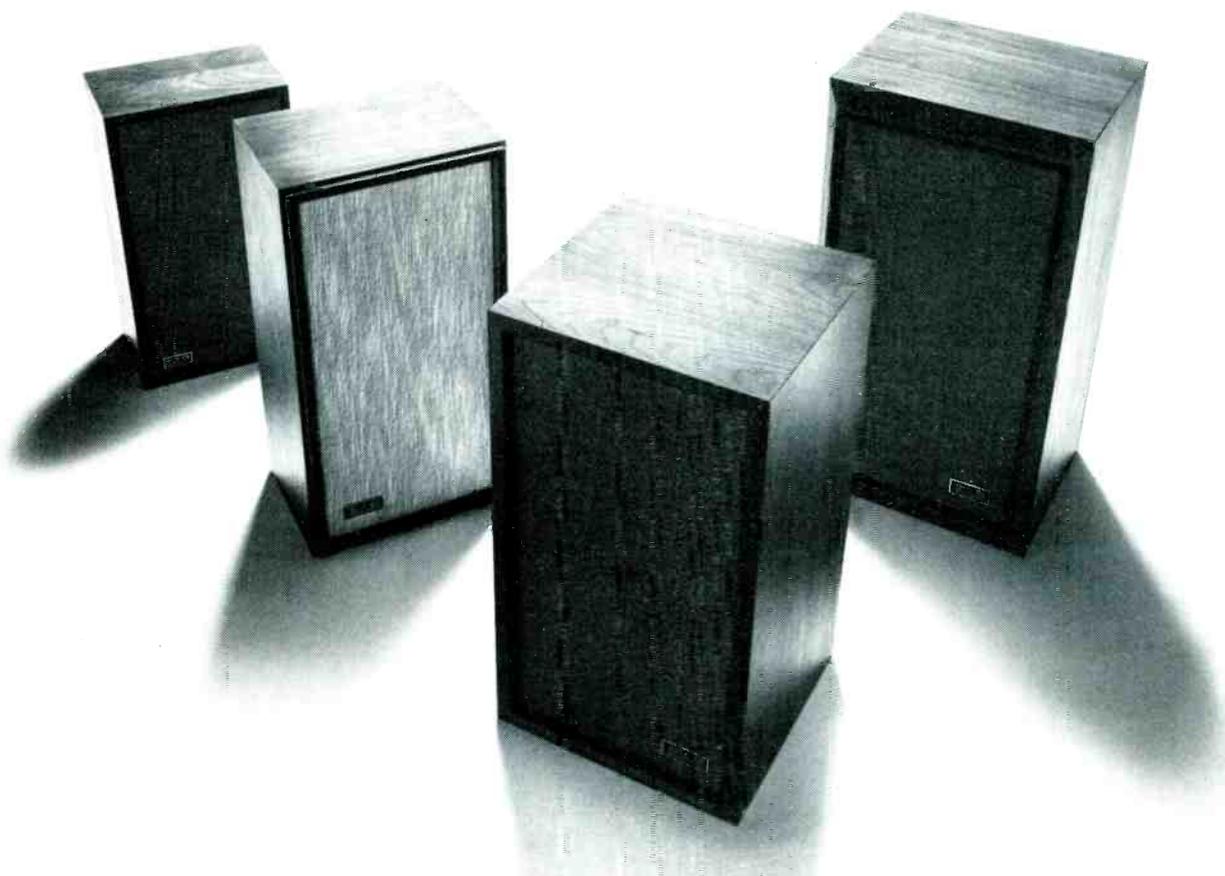


Identical in appearance to the London Export (except for the body color, which is light gray in the Export and blue in the London). Also identical in construction, although the Export is said to be made of slightly better materials and undergoes additional quality control checks. Performance differ-

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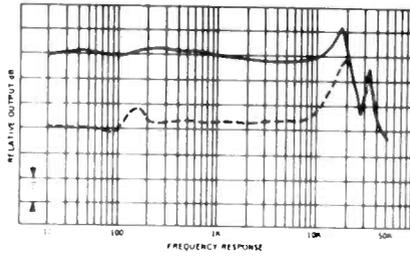
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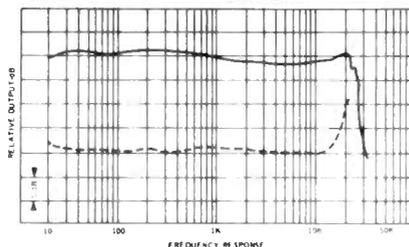
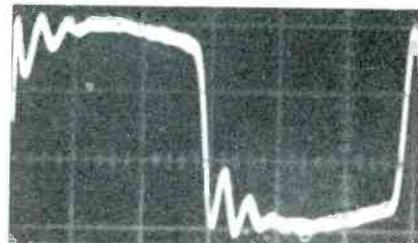
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ences are slight—output of the London is 2.51 mV/cm/sec, and the response curve is much more peaked at about 18 kHz, while above that it is erratic. Separation is somewhat less, as noted on the response curve.

It would seem desirable for the critical user to have a London Export for his principal cartridge, with a London as a spare he could use if the Export were sent off for stylus replacement. The difference in prices would make that a reasonable suggestion. Recommended tracking force on both models is three grams.

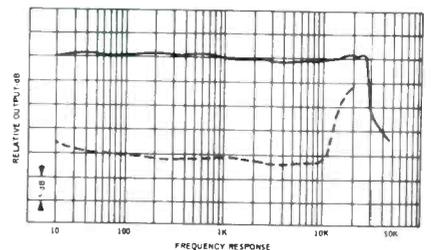
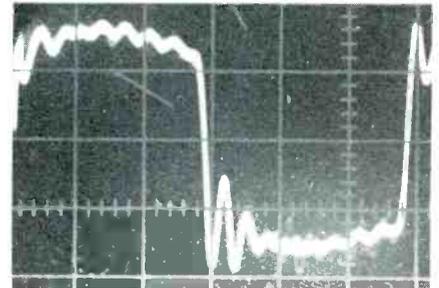
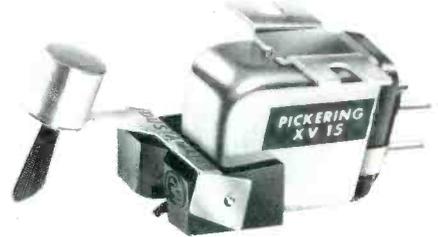
Ortofon M15E Super



This is a more conventional cartridge than previous models of this company's product line. The stylus is interchangeable, with a slip-in plastic structure which is exceptionally well guided by the plastic, not depending on the stylus housing for location. The unit is slightly longer than usual, and

weighs 5 grams. Recommended tracking force is one gram, which demands a high-quality turntable. Resistance per coil is 1205 ohms, and inductance is 980 mH. Output is 1.30 mV/cm/sec. Absolutely no effect was noted with load capacitances from 300 to 500 pF. Response is within ± 1.5 dB from 20 to 21,000 Hz, and separation is approximately 20 dB to 12 kHz, decreasing above that to 10 dB at 20 kHz. Unit is packed in a neat plastic-covered metal box, with a tiny stylus brush.

Pickering XV15/1200E

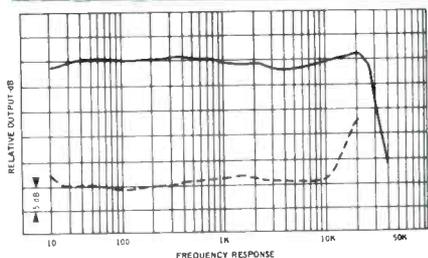
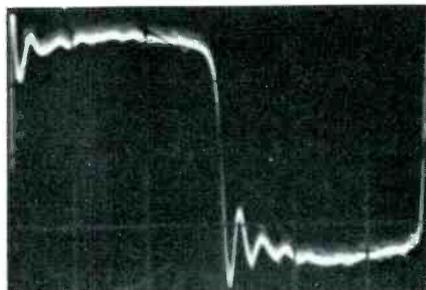


The top-quality model of this long established line, the XV15/1200E does what would be expected—frequency response exceptionally flat to about 27,000 Hz and with no peaks whatever. Separation is over 20 dB throughout most of the range, decreasing above 11,000 Hz to about 5 dB at 20,000 Hz. Among the features of this cartridge are the snap-in mounts—a group of four plastic moldings which can be fitted to the tonearms of four popular turntables to permit the instant change of cartridges without the tedious fitting of screws. You will have to attach the leads, however. A wide variety of interchangeable styli is available, but with the elliptical stylus with which this model is equipped, tracking force is specified as 0.75 grams ± 0.5 , -0.25 —that is, from $\frac{1}{2}$ gram to $\frac{1}{4}$ grams. That

is possible only with the highest quality turntables and/or arms, of course.

Resistance per coil was measured as 1240 ohms, with inductances of 810 mH per coil. Output measured at 0.93 mV/cm/sec, which is about average.

Shure V-15 Type III



Nothing ever stands still. The V-15 Type II Improved was better than the V-15 Type II, which was better than the original V-15. Any one of these was excellent in its time, but improved materials and improved designs permit continual improvements in the ultimate product—in most any category. Basically, Shure engineers have developed a laminated core structure and have decreased effective stylus mass by 25 per cent. These improvements have made possible better trackability at still lower stylus forces.

The V-15 Type III has a resistance of 1450 ohms per coil and inductance of 500 mH per coil. For whatever reason, no noticeable difference was found with the three capacitance load values of 300, 400, and 500 pF, although Shure recommends between 400 and 500 pF, as they also did for the V-15 Type II, but in the latter case there was a considerable difference in frequency responses. Output measured 1.27 mV/cm/sec. In appearance, the Type III is almost identical with the Type II, with one noticeable improvement in the molding of the housing which provides a "hole" rather than a "slot" into which the mounting

What do you think of a guy who bought a \$150 turntable to go with a \$75 amplifier and a pair of \$40 speakers?

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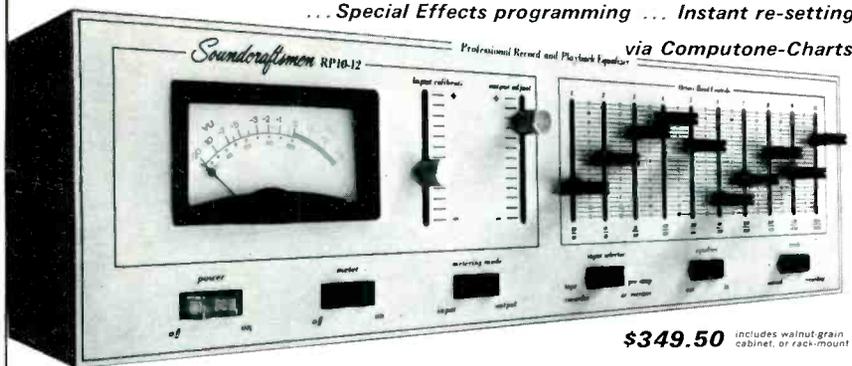
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HARMONIC DISTORTION: Less than .08% @ 2V, .05% @ 1V, Typ: .01% @ 1V.
IM DISTORTION: Less than .08% @ 2V, .05% @ 1V, Typ: .01% @ 1V.
SIGNAL-TO-NOISE RATIO: Better than 90 dB below 2V output Typ: 95 dB
INPUT IMPEDANCE: 100K ohms - (Operable from any source up to 100K ohms; any Mixer, Hi-Fi Preamp, Receiver or Tape Recorder)
OUTPUT IMPEDANCE: 600 ohms - (Operable into any Mixer, Hi-Fi Amp, Receiver or Tape Recorder)
INSERTION LOSS: Zero (slide controls centered, and "OUTPUT ADJUST" control set so that "input" equals "Output")
MAXIMUM OUTPUT: 7 V into hi-impedance, 3.5 V into 600 ohms - (13 dBm).

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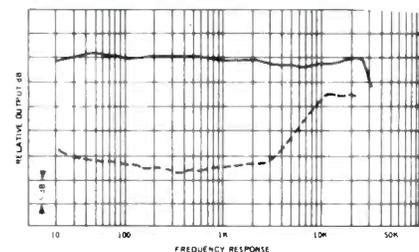
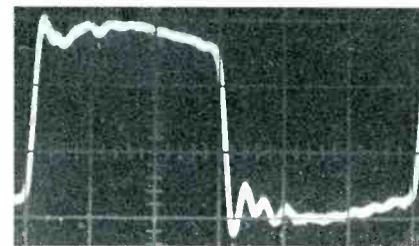
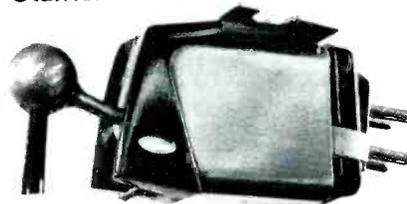
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screws fit, thereby making it much easier to mount.

Frequency response was within ± 1.5 dB from 20 to about 26,000 Hz, and separation was close to 25 dB up to 10 kHz, decreasing above that.

Stanton 681EE



This cartridge is some two years old, and has long been used by this reviewer as a measuring standard. It is not, therefore, representative of the latest output of this manufacturer. Resistance, 1430 ohms/coil; inductance 800 mH/coil; output, 1.16 mV/cm/sec. Response is within ± 1.0 dB from 20 to 25,000 Hz, and separation is 24 dB at midrange, 19 at 20 Hz, and decreases starting at 3500 Hz to a minimum of about 5 dB at 10 to 20 kHz. Not bad for an old cartridge, which was simply included for comparison purposes.

Conclusions

With the exception of the two AT models, there would be very little to choose from in this group of top-quality cartridges. A wide variety of records was listened to extensively, including the latest version of Shure's "Audio Obstacle Course," the "era III." This observer would be satisfied with any one of the group excluding the Decca London and the last two Audio-Technics-AT-13E and AT-10. Any of the others seemed to be comparable to the best, and it would be difficult-nay, impossible-to say which was really the "best."

C. G. McProud

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Equipment Profiles

KLH Model 52 AM/FM Stereo Receiver	42	Rectilinear Model X1a Loudspeaker System	49
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KLH Model Fifty-Two Stereo Receiver



MANUFACTURER'S SPECIFICATIONS

FM TUNER SECTION. IHF Sensitivity: 2.0 μ V. S/N Ratio: 65 db. Capture Ratio: 2.5 dB. Selectivity: 46 dB. Image Rejection: 60 dB. I.F. Rejection: 70 dB. Spurious Response Rejection: 80 dB. AM Suppression: 40 dB. THD: Mono, 0.5%; Stereo, 0.8%. Stereo Separation: 1 kHz, 35 dB; 10 kHz, 25 dB. 19 kHz and 38 kHz suppression: 55 dB.

AM TUNER SECTION. Usable Sensitivity (internal antenna): 300 μ V/Meter. S/N Ratio: 50 dB. Image Rejection: Greater than 50 dB. I.F. Rejection: Greater than 40 dB. Selectivity: Greater than 30 dB. Harmonic Distortion (at 80% modulation) 1.0%.

AMPLIFIER SECTION. Power Output: 30 watts per channel, 8 ohm loads, both channels operating. Rated THD: 1.0%. Rated IM: 1.0%. Power Bandwidth: 15-30,000 Hz. Frequency Response: 15-22,500 Hz. Damping Factor: Greater than 20. Stability: Unconditional. Hum and Noise Below Rated Output: Phono, -63 dB; Aux, -70 dB; Tape Monitor, -70 dB. Sensitivity for Rated Output: Phono, 3.5 mV; Aux, 500 mV; Tape Monitor, 500 mV.

GENERAL SPECIFICATIONS. Power Requirements: 120 V, 50/60 Hz, 180 watts maximum. Dimensions: (including knobs and extended antenna) 18 in. W. x 5 1/4 in. H. x 18 1/8 in. D. (11 1/2 in. D. excluding knobs and extended antenna). Weight: 22 1/2 lbs. Retail Price (including walnut grain enclosure): \$289.00.

The trend towards overlapping of product types continues amongst the component high-fidelity manufacturing fraternity. Recently, we reviewed the first receiver product of a well known and respected tape-recorder manufacturer, and now

KLH comes up with a receiver line to complement its famous loudspeaker system products. We had an opportunity to examine both the KLH 52 (reviewed here) and their lower-powered Model 55 which resembles this higher powered receiver in outward appearance but contains several circuit differences other than just the lower power rating.

The Model Fifty-Two, pictured above, is equipped with a good looking gold and blacked-out panel, end-framed to produce a very massive-looking three-dimensional effect. The upper portion of the panel includes a pair of illuminated meters (signal strength and center-of-channel tuning), well calibrated FM and AM dial scales, a linearly calibrated logging scale, and a good-sized tuning knob coupled to an effective flywheel. Just below the dial scales are a series of program source designations which become illuminated when the particular program source is selected. The now indispensable "stereo indicator" light also forms part of this word grouping.

Along the gold colored lower portion of the panel are a stereophone jack, a four-position program source selector switch, dual concentric (clutch type) bass and treble controls for each channel, a balance control, and a master volume control which, in its farthest counterclockwise position, turns off power to the receiver. A row of seven push buttons are used for such secondary functions as LOUDNESS CONTOUR activation, MONO/STEREO MODE selection, TAPE MONITOR, FM interstation MUTING, HIGH FREQUENCY FILTER, and MAIN and REMOTE speaker selection. KLH engineers may just have saved some needless service calls by having the speaker switches operate just opposite to the way we've seen them on most other "push button" selectable speaker switch arrangements. Instead of having to push either the MAIN or REMOTE speaker switches IN to hear sound, the normal out position of either switch connects the appropriate speakers. You have to push the buttons in to DISconnect speakers—a nice touch for non-

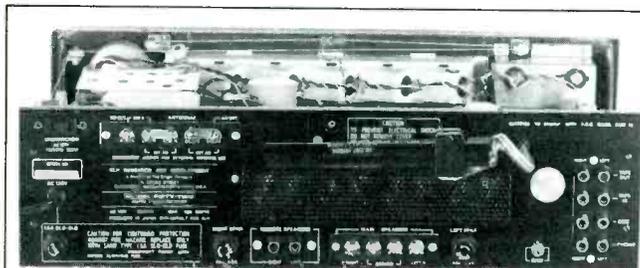


Fig. 1—Rear panel

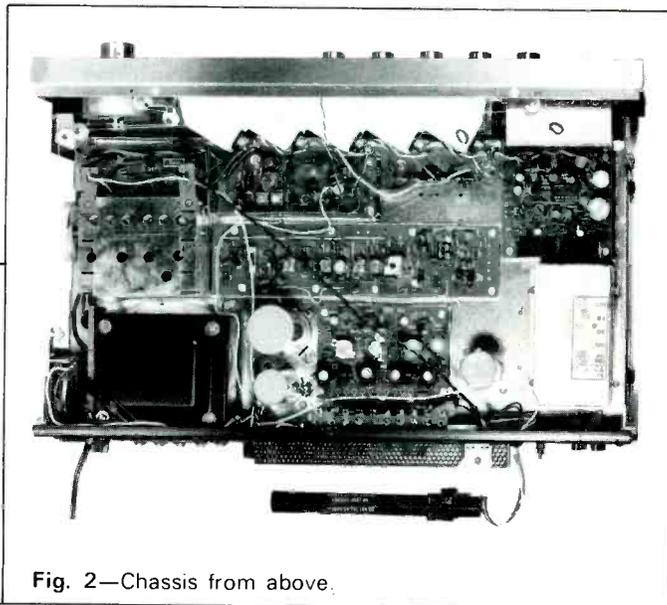


Fig. 2—Chassis from above.

instruction-book readers (most of us) who might panic if they turned on the new receiver and heard *nothing*.

The logically laid out back panel is shown in Fig. 1. Included are antenna terminals for 300 ohm FM antenna inputs (a link must be swung away to disconnect the "built in" line cord coupled antenna) and a similar arrangement for connection of an outdoor AM antenna. Main speaker systems are connected to well separated screw terminals, while provision for remote speaker systems is made by phono-tip jack connectors. Tape out and in, phono input, and aux input jacks are all located at the right of the rear panel, and there are line fuse and individual left and right speaker fuses along the lower edge of the back panel. An unswitched a.c. convenience outlet plus the usual pivotable AM bar antenna complete the rear panel layout.

The photo in Fig. 2 is an overall view of the internal wiring and layout of the Model Fifty-Two Receiver. The shielded front-end uses a four-gang capacitor and features an FET in the r.f. stage. The i.f. module uses a total of five stages, with two IC limiters and a ceramic filter. The multiplex demodulator circuit employs a single integrated circuit, and there are internal adjustments for varying muting threshold and mono/stereo threshold. The AM circuitry includes a two-i.f. system and also uses a ceramic filter. Preamplifier and voltage amplifier circuitry is fairly conventional, with an FET being used in the tone control circuitry. A quasi-complementary-symmetry output circuit is used in the power amplifier section and includes short circuit protection in addition to the speaker fuses already noted.

Performance Measurements

Conservation in "spec writing" on the part of the KLH people became apparent as we began to measure this receiver. Almost every FM parameter turned out to be better than claimed. For example, as shown in Fig. 3, IHF sensitivity for our sample was measured as $1.6 \mu\text{V}$. Before all the theoreticians send letters explaining that $1.6 \mu\text{V}$ of IHF sensitivity is "impossible" to achieve in the light of the natural laws of physics (the theoretical limit across 300 ohm input impedance has been calculated to be something just short of $1.7 \mu\text{V}$ for an S/N ratio of 30 dB), it must be noted that figures of $1.6 \mu\text{V}$ are attainable for IHF sensitivity, albeit at the expense of adequate bandwidth. In the case of the KLH receiver, this means that at $1.6 \mu\text{V}$ input, bandwidth is a bit restricted, but it quickly broadens out above a signal input level of $2.0 \mu\text{V}$, which is all KLH claimed for the receiver in the first place. Ultimate S/N measured 71 dB, well above the 65 dB claimed, and the 50 dB S/N point was reached with an input of only $2.4 \mu\text{V}$. Mono THD reached a low figure of 0.36% (again, better than the 0.5% claimed) and even with signal inputs as

low as about $20 \mu\text{V}$, THD at 100% modulation was under 1.0%, as shown in the curves of Fig. 3.

Stereo FM separation was also better than claimed, as shown in Fig. 4. Mid-band separation was just over 40 dB and remained greater than 35 dB all the way down to 50 Hz. At 10 kHz, separation was exactly 30 dB, reducing to 25 dB at the end of the FM audio spectrum, at 15 kHz. A plot of THD versus frequency is also shown in Fig. 4 and, in the case of mono performance, total THD was under 1% even at 15 kHz, with considerably lower figures obtained for more significant mid-band and low frequencies. THD in stereo hovered around the published specification of 0.8% for most frequencies, rising to 2.5% at 10 kHz, largely as a result of "beat" frequencies rather than actual harmonic distortion. Other results obtained through actual measurement (but not displayed graphically) included capture ratio readings of 2.0 dB (against 2.5 dB claimed), selectivity of 53 dB (we would have been critical had the results been limited to only the 46 dB claimed), AM suppression of better than 50 dB, and spurious response rejection of well over the 80 dB claimed.

As received, the stereo/mono switching threshold was adjusted to about 4 microvolts and, in view of the S/N performance of the Fifty-Two, this seemed to be a perfect setting. Not so with the muting threshold setting, however, since its action is not as instantaneous and complete as we have seen on some competitive products. Depending on when you want to call the mute circuit "defeated" by a signal, this setting ranged from 7 to 12 microvolts. A lower setting seems called for (say, 4 to 7 microvolts) in view of the excellent quieting characteristic discussed earlier. We feel, however, that the action of the mute circuit during transition from "off" to "on" could be more positive as its present range might result in

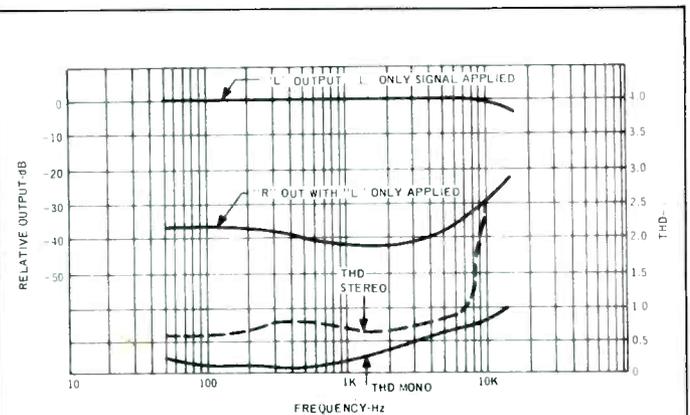


Fig. 4—FM stereo separation and THD performance characteristics versus frequency.

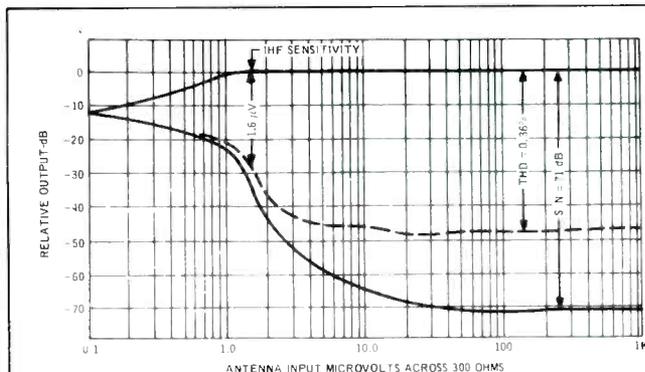


Fig. 3—Monophonic FM performance characteristics.

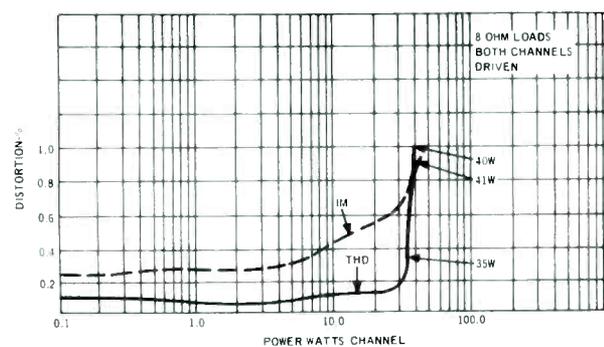


Fig. 5—Distortion characteristics at 1 kHz.

marginal situations where the signal "partially" opens the circuit, resulting in varying audio level and varying distortion percentages. In the course of our listening tests, however, we did not run into that type of situation, since most of our signals received were well above the 12 microvolt level, as they would be in most situations.

Figure 5 is a plot of THD and IM versus power output per channel, and in both cases rated distortion was reached at power output levels considerably in excess of the 30 watts claimed. In fact, at 35 watts per channel output, THD measured only 0.35% while at rated output, THD was a mere 0.15%. If we were rating this receiver's power capability, we'd definitely call it 35 watts per channel, for 8 ohm loads, both channels driven.

Even at this 35 watt reference level, THD remains well below the rated 1.0% for all audio frequencies, as shown in the graphic plot of Fig. 6. At nominal 1 watt levels, THD is essentially down to the distortion levels of our signal generator—well below 0.1%—for all frequencies of interest.

Power bandwidth, plotted in Fig. 7, extends from 12 Hz to 35 kHz. It should be pointed out that we have arbitrarily assumed a "0 dB" reference of 35 watts per channel, rather than 30 watts, as claimed by the manufacturer, and still the power bandwidth exceeds the end points specified by KLH.

Figure 8 discloses the range of some of the controls of the KLH Model Fifty-Two. Loudness-contour action for the -30 dB (from maximum volume) setting was a bit excessive, but then the whole question of loudness settings is rather arbitrary since proper Fletcher-Munson compensation depends more upon program source and speaker efficiency than it does on the components selected for use with the loudness control. The high frequency filter has a 6 dB per octave slope, but its

turnover point is optimally located at about 3500 Hz, making it somewhat more effective as a filter than the treble control might be.

Listening Tests

The KLH Model Fifty-Two certainly sounds and behaves more like a higher powered receiver than its "specs" would indicate. We had no trouble driving some of the low-efficiency book-shelf systems manufactured by the very same KLH (how embarrassing, otherwise!). FM calibration was excellent, and there was no evidence of drift.

During the measurement phase of our tests, we had noted that while the zero-center meter was "right on" the zero mark for minimum distortion tuning, it did not quite correspond to "maximum stereo separation" in stereo FM. Few listeners realize that proper center-of-channel tuning is as vital for stereo FM separation as it is for lowest distortion. Despite this slight discrepancy (which we feel sure could be "aligned out" of the receiver), there was plenty of audible separation even if we simply tuned for meter center.

While the KLH Model Fifty-Two does not offer some of the frills of more expensive receivers (low filter, multiple phono inputs, etc.) it *does* present very honest performance and is well worth its "just under \$300" price. All other specs noted by the manufacturer and not specifically mentioned in this report were met or exceeded, with the exception of phono input sensitivity, which we measured at 6 mV instead of the 3.5 mV claimed. It is possible that KLH might be measuring this figure at 400 Hz (part way up the bass equalization curve), whereas we measure this parameter at 1000 Hz, and that could account for the difference. Some of the lower output magnetic cartridges may, therefore, not be able to push the amplifier to rated output when playing dynamically restricted discs and we would have liked to see a bit more gain in the preamp circuitry. Volume control tracking was excellent all the way down to -60 dB from maximum setting, and hum and noise were all but inaudible at the listening levels we used.

A special word should be added about the owner's instruction manual which KLH packs along with each unit. Aside from giving a complete description of controls and specifications, the manual covers a good many items ordinarily found only in complete books about hi-fi installations. These include selection, stripping, and tinning of speaker wires, a discussion of the merits of indoor and outdoor antennae, care of records, and connection of electrostatic headphones. While some of the other topics are regularly covered in manufacturer's instruction manuals, KLH is to be congratulated for treating them in greater than usual depth.

Leonard Feldman

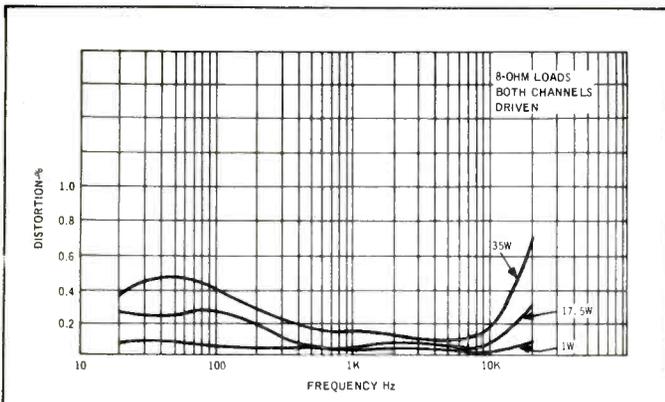


Fig. 6—Distortion versus frequency at various power levels.

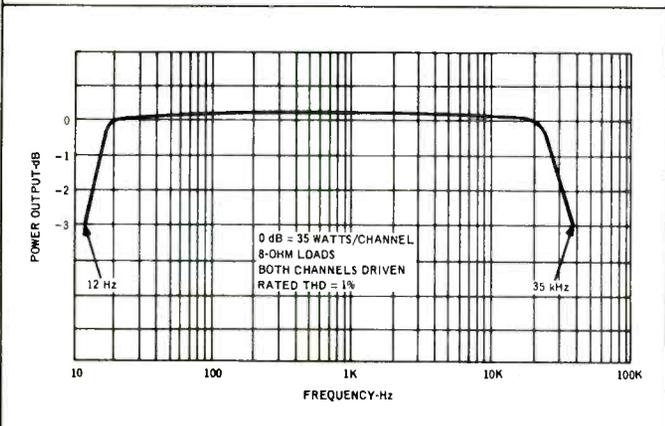


Fig. 7—Power bandwidth.

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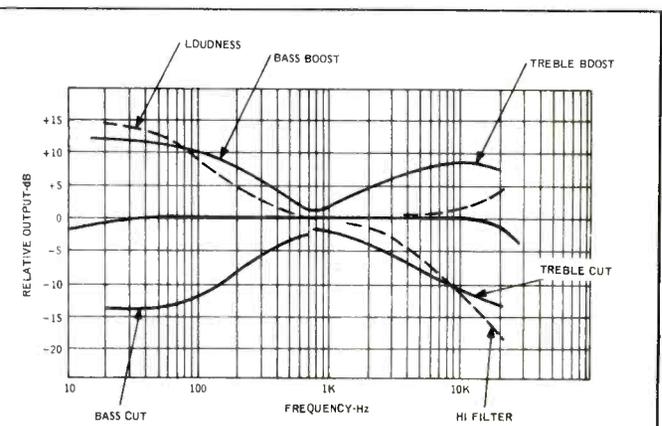


Fig. 8—Tone, filter, and loudness (-30 dB) characteristics.

The ADC-XLM "...in a class by itself."



That's the way Stereo Review described our XLM. High Fidelity headlined their review, "Superb new pickup from ADC" and went on to say, "...must be counted among the state of the art contenders." And Audio echoed them with, "The ADC-XLM appears to be state of the art."

With the critics so lavish in their praise of the XLM, there's hardly any necessity to add anything. Far better to let the experts continue to speak for us.

Frequency response The CBS STR-100 test record showed less than ± 1.5 dB variation up to 20,000Hz. *Stereo Review*
...response is within ± 2 dB over the entire range. *Audio*
Frequency response is exceptionally flat. *High Fidelity*

Tracking This is the only cartridge we have seen that is really capable of tracking almost all stereo discs at 0.4 grams. *Stereo Review*
The XLM went through the usual torture test at 0.4 grams (some top models require more than a gram). *High Fidelity*
The XLM is capable of reproducing anything found on a phonograph record. *Audio*

Distortion Distortion readings...are almost without exception better than those for any other model we've tested. *High Fidelity*

The XLM has remarkably low distortion in comparison with others. *Audio*
At 0.6 grams the distortion was low (under 1.5 per cent). *Stereo Review*

Hum and noise The XLM could be instrumental in lowering the input noise from the first stage of a modern transistor amplifier. *Audio*
The cartridge had very good shielding against induced hum. *Stereo Review*

Price This would be a very hard cartridge to surpass at any price. *Stereo Review*
We found it impossible to attribute superior sound to costlier competing models. *High Fidelity*
Priced as it is, it is a real bargain in cartridges. *Audio*

**The Pritchard High Definition
ADC-XLM \$50.**

 **AUDIO DYNAMICS CORPORATION**
Pickett District Road, New Milford, Connecticut 06776

Check No. 3 on Reader Service Card

Pioneer Model TX-9100 AM/FM Stereo Tuner



MANUFACTURER'S SPECIFICATIONS

FM SECTION

IHF Sensitivity: 1.5 μ V. **S/N Ratio:** 75 dB. **Selectivity:** 90 dB. **THD:** Mono, less than 0.2%; stereo, less than 0.3%. **Capture Ratio:** 1 dB. **Image Rejection:** More than 110 dB. **I.F. Rejection:** More than 110 dB. **Spurious Response Rejection:** Better than 110 dB. **AM Suppression:** 65 dB. **Frequency Response:** 20 Hz to 15 kHz +0.2, -2.0 dB mono; 50 Hz to 10 kHz +0.2 dB, -0.5 dB stereo. **Stereo Separation:** At 1 kHz, better than 40 dB; from 50 Hz to 10 kHz, better than 30 dB. **Sub-carrier Suppression:** 65 dB.

AM SECTION

IHF Sensitivity: Internal antenna, 300 μ V/meter; external antenna: 15 μ V. **Selectivity:** 40 dB. **S/N Ratio:** 50 dB. **Image Rejection:** More than 65 dB. **I.F. Rejection:** More than 85 dB.

AUDIO SECTION

Fixed Output Level: 650 mV. **Variable Output Level:** From 70 mV to 2 V. **Headphone Output:** 150 mV into 8-ohm load.

GENERAL SPECIFICATIONS

Power Consumption: 30 watts. **Dimensions:** 17 in. W. x 5½ in. H. x 13½ in. D. **Net Weight:** 19 lbs., 10 oz. **Retail Price:** \$299.95 (including cabinet).

Every once in a while we have the pleasure of testing and reporting on a product which is the "best" in its category, regardless of price. The reason why we can call a product "best" every couple of years is because technological developments in this ever improving industry we call high fidelity come so rapidly that last year's "best tuner" is often superseded by this year's design and production achievements. Such is the case with Pioneer's new TX-9100 tuner. Our laboratory measurements proved performance capabilities for this product which are beyond *anything* we have ever measured.

The front panel is made of cast gold-anodized aluminum, and there is an elegantly framed blackout dial area which runs almost the full width of the panel. With power applied, soft blue illumination discloses a long, linear FM dial scale, separate meters for signal-strength and center-of-channel tuning, and a zero-to-100 logging scale. This is the first tuner we've seen which has an AM dial scale which is almost linear (equal spacing between every 100 kHz) as well. Above the dial scale are illuminated designations for AM, FM and Stereo, the latter lighting when a stereo station is received. With the function switch set to AM, the center-channel tuning meter blacks out and only the peak-reading signal strength meter is visible.

The lower portion of the panel contains a lever type power switch, level control for headphones, and separate level controls for AM and FM outputs. The function switch has positions for AM, AUTO-FM (automatically switches from mono to stereo under appropriate signal conditions), and MONO. There are three more lever-type switches which control such circuit features as PULSE NOISE CUT, MPX NOISE FILTER and MUTING. The muting lever switch has three positions—one in which the muting is defeated and the other two for different thresholds of the muting action. A massive tuning knob coupled to an extremely effective flywheel completes the front panel layout.

The rear panel, pictured in Fig. 1, contains terminals for AM and 300 ohm balanced FM antenna connections. In addition, a clever clamp and terminal arrangement is provided for 75-ohm transmission line input. The clamp serves to ground the outer conductor of this kind of transmission line and acts as a strain relief clamp as well. The AM ferrite-bar antenna is pivotable over a 180-degree arc thanks to a ball-joint swivel arrangement which we have not seen in this application until now. There are outputs for fixed-level and variable-level audio (the latter controlled by the individual front panel level controls previously mentioned), outputs for horizontal and vertical inputs to an oscilloscope (for tuning and multipath visual indications), a line fuse holder, and an unswitched convenience a.c. outlet for connection of other equipment.

Normally, when we remove a wood cabinet from a component we expect to see components all over the chassis staring up at us. In the case of the Pioneer TX-9100, every single modular section is neatly covered by a metal shield, with adjustment holes clearly labelled. We removed these covers for Fig. 2, replaced them, and then "went below" and removed the overall bottom cover, disclosing the undersides of various of the logically arranged p.c. modules, as shown in Fig. 3. There are seven modules in all, not counting the front-end which contains three low-noise dual-gate MOS-FET's used in two r.f. stages and the mixer. Local oscillator voltage is injected via a special buffer amplifier. The largest single p.c. module contains six i.f. limiter stages (IC's are used throughout) and i.f. bandpass characteristics are determined by ceramic filters. This same module contains a large-scale integrated circuit (which just about handles all the AM reception circuitry), and the FM muting and pulse noise control circuits, about which more later.



Fig. 1—Rear panel.

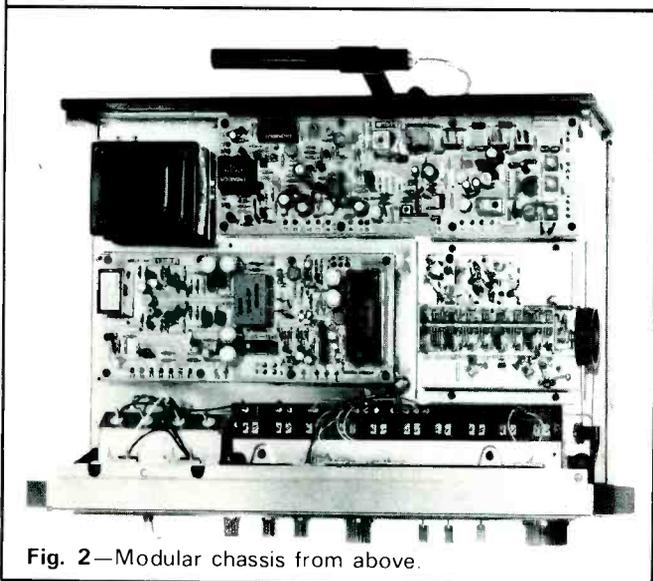


Fig. 2—Modular chassis from above.

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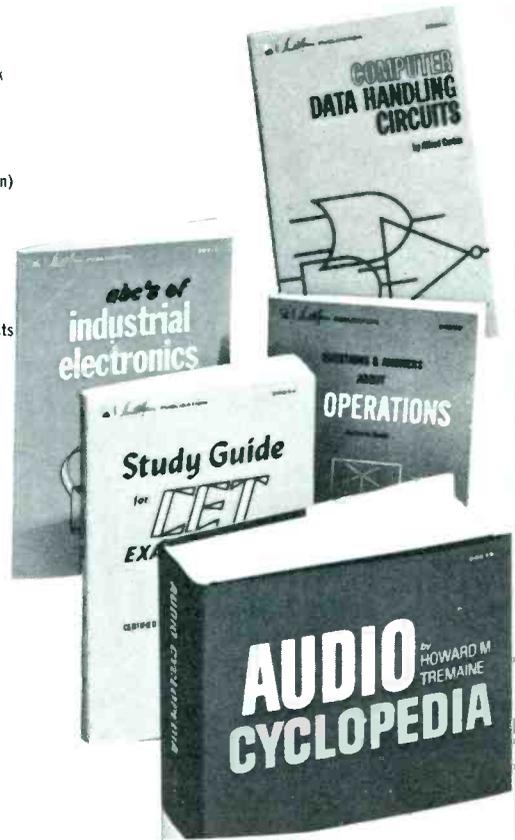
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Basic multiplex decoding has been reduced to a single IC—but what an IC it is. Motorola's PA-1310P utilizes the phase-lock-loop principle to insure rock-stable 19 kHz and 38 kHz frequency and phase. There are no coils or capacitors or "tuned circuits" as we would normally refer to them and, in addition, this circuit reduces residual 38 kHz carrier leakage and its harmonics to undetectable levels. The headphone amplifier module is really a low-power audio amplifier that provides enough power to drive low impedance phones directly, so that you could start listening to this tuner without even hooking up an amplifier and speakers.

Semiconductor complement of the Pioneer TX-9100 includes 6 FET's, 9 IC's, 35 bi-polar transistors, and 27 diodes. Some of those IC's (especially the multiplex phase-lock-loop decoder) contain so many active devices that we gave up counting the "equivalent" number of transistors altogether!

FM Measurements

Our measurements of the performance of the Pioneer TX-9100 took just about twice as long as normal. That's because we had to repeat each measurement to see if the results were really as good as we measured the first time. They were! Consider, for example, the ultimate S/N ratio, as

graphed in Fig. 4. The S/N above input signal levels of 100 μ V is an incredible 79 dB. We were delighted to learn that our generator was that good. Its manufacturer, like Pioneer, claims only a 75 dB capability and evidently *both* ratings are conservative. As for mono THD, it read 0.13% at any signal level above 20 μ V, while stereo THD was 0.19%. IHF sensitivity was 1.6 μ V and at that level, who's going to argue about one tenth of a microvolt (Pioneer claims 1.5 μ V)? Note, too, that the 50 dB S/N ratio was reached with a signal input of just over 2 microvolts. What's more, the low THD figures apply not only at the IHF test point of 400 Hz, but over just about the entire audio band as well, as shown in Fig. 5. THD in mono stays well under Pioneer's claimed 0.2% from 50 Hz to over 5 kHz, rising to 0.8% at the 15 kHz extreme. Stereo THD is under 0.3% over the same range, increasing to 0.8% at 10 kHz. It should be noted that these readings do not differentiate between actual distortion and the presence of "beats" or other extraneous signals. If you have been reading our reviews of tuner products over the past several months you will recall that less than 2% content of extraneous material (THD, beats, sub-carrier residual products, etc.) at 10 kHz is considered something of a miracle. Here we're faced with a product that is more than 6 dB better in this respect than anything we've ever tested!

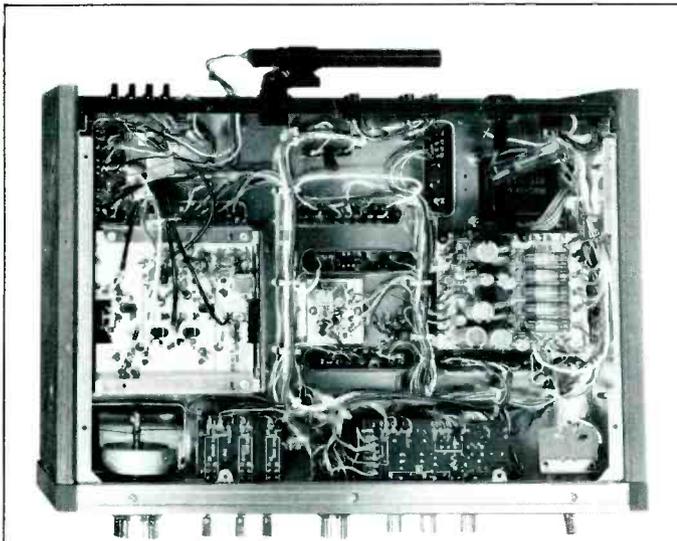


Fig. 3—Chassis from beneath.

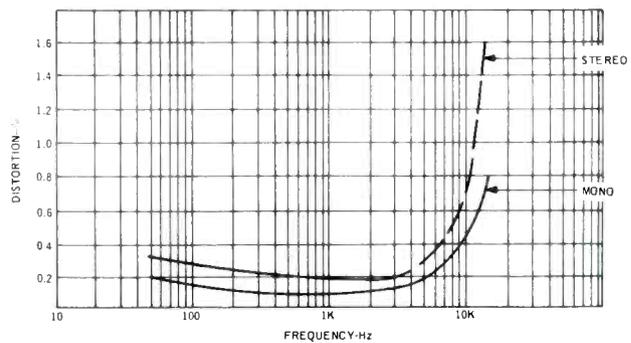


Fig. 5—Distortion vs. frequency.

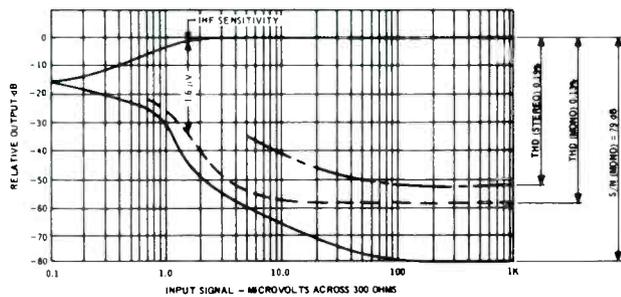


Fig. 4—FM performance characteristics.

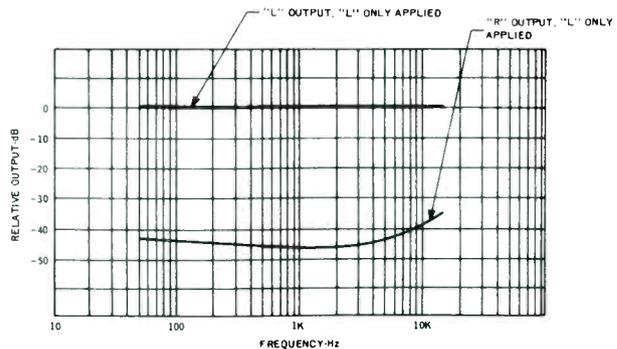


Fig. 6—FM stereo separation characteristics.

We have never faulted an FM stereo product that tends to have decreased separation at high audio frequencies, since we feel that anything above 20 dB of separation at the treble extremes is about all most quality cartridges can maintain anyway. Nevertheless, as an exercise in outstanding engineering accomplishment, it's interesting to see what Pioneer was able to do with their phase-lock-loop circuitry in this connection. Separation characteristics are plotted in Fig. 6 and are actually better than claimed by the manufacturer. Some 40 dB separation or better is maintained from 50 Hz to 10 kHz, and even at 15 kHz, it measured 35 dB! Fantastic!

As for those 110 dB figures quoted for image, i.f., and spurious response rejection, we're just going to have to take Pioneer's word for it—our equipment can't read more than 100 dB for these parameters. As near as we were able to judge, however, their capture ratio spec of 1 dB is a bit of an understatement—we measured more like 0.7 or 0.8 dB, though admittedly this is a bit difficult to measure when you start talking about this level of performance. AM suppression did measure exactly 65 dB, as claimed, and again this represents the best we have ever measured for an FM tuner. Selectivity, as measured using standard IHF techniques, turned out to be 95 dB rather than the 90 dB claimed, and frequency response from 50 to 15 kHz was well within 0.5 dB. Interestingly, Pioneer provides an internal switch (accessible once you remove the walnut cabinet) which enables the user to select 50 microsecond de-emphasis rather than the standard 75 microseconds used in the U.S. The smaller time constant is generally used throughout Europe and the Far East. If you happen to accidentally throw the switch to the 50 μ sec position, you'll get a bit more treble brilliance in your reproduced music since the highs will be slightly overemphasized.

Listening Tests

While "station counting" really doesn't have too much significance to readers around the country, we could not resist the temptation. In this case, we not only used our outdoor multi-element directional antenna but decided to use our

rotator as well—just to see the absolute total we could come up with. Would you believe 67 usable signals? Admittedly, some duplicated the frequency of others (as we rotated the antenna towards different points on the compass), but that proves the importance of a low capture-ratio figure, doesn't it? With the mute switch in the number 1 position (a muting threshold of about 6 μ V), that number was reduced to 46. All of which means we were getting some 21 stations at signal strengths of *less than* 6 microvolts but they were "listenable"! With the muting switch set to the number 2 position, the number of stations logged dropped to 38. The second position has a threshold value of about 20 μ V. Muting, by the way, is absolutely positive, since it is relay-controlled. The signal is either there or it isn't—and you have to be tuned to dead center of channel (where you'll get minimum distortion) for the muting to be overcome when it is in operation. In order to check the effectiveness of the pulse-noise cancelling circuit, we retrieved an old electric razor and used it as a pulse noise generator. (Don't laugh! That was the official "noise generator" used in the FCC field trials held in 1960 to establish stereo FM standards!) In the normal position of the noise-cancelling switch, those "ignition noise" pulses came through (though with admittedly less severity than on most tuners). When we threw the switch the interference was reduced to "whisper level" though it did not, of course, disappear completely. Judging by the severity of the initial interference, this noise cancelling circuit is very effective, and if you are bothered by nearby ignition noises that have not been cured by the use of 75-ohm transmission lines and other "external" cures—this may well be the answer. It works!

In fact, everything about this tuner "works"—and works magnificently. You can pay more than \$300.00 for some excellent tuners that have additional external convenience features (digital readout of frequency, push button tuning through varactors, etc.) but you can't buy better audible performance than is achievable with Pioneer's new TX-9100 at *any price*.

Leonard Feldman

Check No. 102 on Reader Service Card

Rectilinear XIa Loudspeaker System



MANUFACTURER'S SPECIFICATIONS

Drivers: 10-in. bass, 3½-in. tweeter. **Crossover Frequency:** 1,000 Hz. **Nominal Impedance:** 8 ohms. **Maximum Power Handling Capacity:** 50 watts rms. **Frequency Response:** 45 to 20,000 Hz \pm 4 dB. **Cabinet:** Oiled walnut. **Shipping Weight:** 31 lbs. **Dimensions:** 23 x 12 x 10½ in. deep. **Price:** \$79.50; optional fretwork grille kit, \$10.00.

The majority of the smaller bookshelf loudspeaker systems are of the infinite baffle (IB) or totally enclosed type, and the few exceptions use a damped reflex arrangement. The Rectilinear XIa is one of the latter type, and it employs a tube vent which is filled with fiberglass to give the necessary acoustic resistance. The theoretical advantages, as compared with the IB system, are a slightly higher sensitivity and an extended bass response. The 10-in. bass speaker in the XIa has a 1½-in. voice coil and its response falls off above 1000 Hz, so a simple 6-dB-per-octave LC network is sufficient to crossover to the HF unit. This is a 3½-in. cone speaker having a closed back. The cone itself is very shallow as a deep cone this size would tend to have poor dispersion. Enclosure resonance is about 63 Hz, and this impedance at this point measured just under 18 ohms, which indicates a fairly low "Q."

The cabinet is finished in oiled walnut, and the grille cloth is detachable. At the rear is a level control for the treble unit, and we were pleased to note the large input terminals were spaced well apart. No chance of a "short" here.

Measurements

Figure 1 shows the response with one-third octave pink noise. Curve A was measured on axis and B at 45 degrees off axis. The treble control was set for the most linear response. Figure 2 shows the large variation possible with this speaker's control—the maximum position having a rise of over 10 dB at 10 kHz. The impedance curve is shown in Fig. 3, and it should be noted that the average is not very much lower than 10 ohms. Thus, the Rectilinear XIa's can be used as extension speakers without any fear of overload damage to the amplifier. Figure 4 gives the low frequency distortion

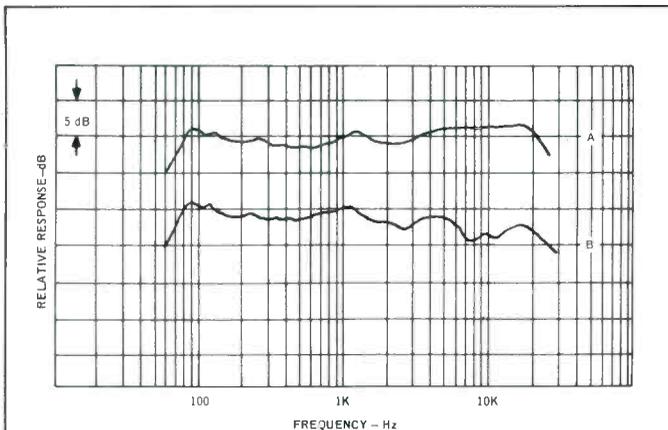


Fig. 1—Response with one-third octave pink noise. Curve A was measured on axis and B was a 45 degrees off axis.

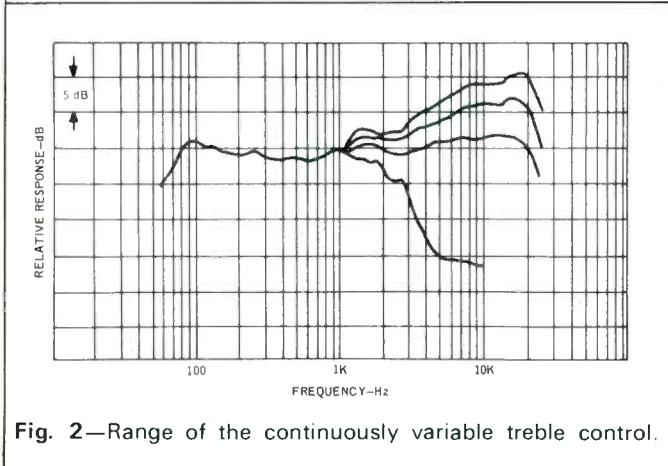


Fig. 2—Range of the continuously variable treble control.

CLARIFICATION

In our review of Lafayette's Model LR-4000 4-Channel Receiver (AUDIO, June '73 pp 56-60), we criticized the wording used by that company to describe their phase-lock circuitry. We felt that their wording implied the use of this circuit in the "front-end" (RF or IF) section of the receiver, which is not the case. Our criticism may have been interpreted by readers to suggest that there is NO phase-lock loop circuit in the receiver. Actually, the very excellent multiplex (stereo FM) decoder section of the LR-4000 DOES employ an advanced Phase-Lock Loop Integrated Circuit, which accounts in part for the excellent separation and low distortion reported in the original review. Our quarrel with Lafayette was basically one of semantics, rather than any implication of misstatements on their part. *Leonard Feldman*

together with some SPL figures at 5 and 10 watt inputs, and the toneburst performance is shown in Fig. 5, where A was taken at 100 Hz, B at 500 Hz, and C at 5 kHz. The system would handle 16 watts continuous power at 40 Hz, 17 watts at 70 Hz, and 84 watts at 100 Hz without distress. Note that this is *continuous sine wave power*, a rather severe test. White noise tests showed some coloration in the midrange with the level control advanced above the half-way mark.

Listening Tests

Efficiency of the Rectilinear XIa is above average (the manufacturers recommend a minimum of 10 watts) and a 15-plus-15 watt amplifier will give sufficient power for most rooms. Our tests were made with the Pioneer SX-424 and a Marantz 2010—both of which gave excellent results. With the treble control set for optimum balance, the sound had a slightly forward quality—not that associated with the West Coast but nearer the neutral New England sound. Bass was full and well maintained, and the high efficiency of the treble speaker will allow the systems to be angled inwards slightly to achieve a good stereo image in a large room. All-in-all, a superb sounding system for such a modest price. *T.A.*

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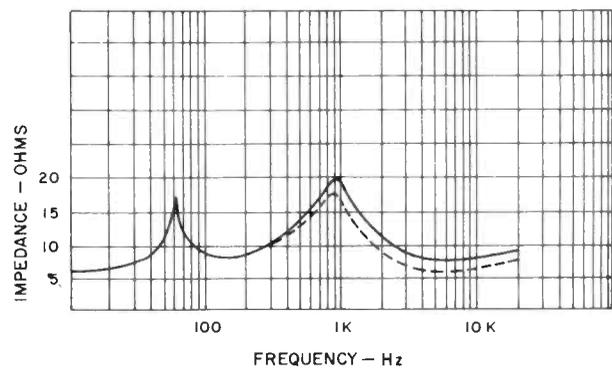


Fig. 3—Impedance characteristics.

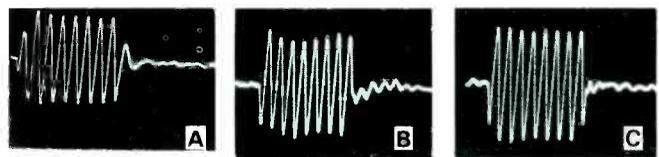


Fig. 4—Toneburst response at A, 100 Hz; B, 500 Hz, and C, 5000 Hz.

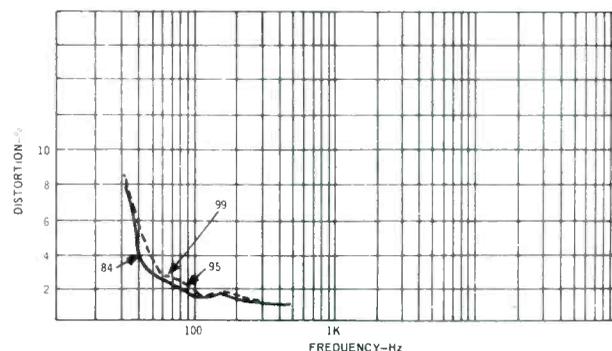


Fig. 5—Low frequency distortion and SPL figures.

Weingarten: Off The Record

Sherwood L. Weingarten

The Brothers Gibb, three of them, believe in simplicity. We should all be grateful, for the result is a soft-rock sound always pleasant to the ear. Collectively they are the Bee-Gees, and their latest *tour de force* is **TO WHOM IT MAY CONCERN** (Atco, SD7012).

Despite the occasional difficulty of understanding the lyrics, due to the threesome's down-under accents and a now-and-then overwhelming orchestral ornamentation, the album is an oasis in a time replete with musical sandstorms.

Best of the 13 cuts, all of which the Gibbs penned (some individually, some as a pair, some as a trio), is the slow and non-complex hit single, *Run to Me*. But enjoyment also can be obtained through *We Lost the Road*, a bouncy, unfast winner; *Never Been Alone*, featuring a solo, melancholy warble; *Bad Bad Dreams*, a well-put-together rocker that's definitely in an up vein; *Road to Alaska*, an amalgamation of blues, boogie and rock, and *You Know It's for You*, a moving piece with alternate slow and fast segments and fantastically incisive lyrics.

The smoothness of their harmony can't help but put the listener in harmony with the positive things around him. And, as George Gobel used to say, you can't hardly get that no more.

Carole King is a downer.

Her latest LP, Ode's **RHYMES & REASONS** (SP7016), is all about loneliness, momentary touching, the difficulties of taking each day as it comes. It nearly sounds suicidal.

And her music has become almost totally redundant, leaning so heavily on past successes that it often becomes difficult to differentiate between the new and the old.

The A&M-distributed disc, with a dozen King originals, almost manages to please via the hit single *Come Down Easy* and *My My She Cries*, but even

those are so negative in word-tone that the audiophile wonders if the pain of listening is worth it.

If, as the sage said, the first 40 years are text, the remainder commentary, then perhaps it should be said of the young tunesmith-singer that her first two dozen songs are verse, the rest chorus.

Its a shame.

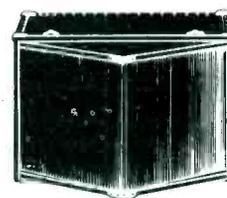
—**ALONE TOGETHER** (Kolub-MGM, SE-4886) is another lackluster outing by teen idol Donny Osmond. If a summation is needed, *typical bubble-gum junk* will do. Included are *The Twelfth of Never* and *Young Love*, chartbusters both. If you're 11 or under, or wish you were, you'll like this one; if not, take your Geritol and find something else.

—**PEOPLE AND LOVE** (Milestone, MSP 9043) spotlights exquisite jazz by Johnny Lytle on swinging vibes, beautifully backed by half a dozen other musicians. The album, distributed by Fantasy, features heavy flute work and vibrant piano modes. Result: a merged sound not unlike the Modern Jazz Quartet having come of age in the rock era. Highlight of the five cuts is *Family*, a pretty, moving, minor gem penned by Lytle.

—**EVER SENSE THE DAWN** (Threshold, THS 9) presents Providence, a sextet that doesn't quite live up to promise of the musical explorations in which it engages. The LP, distributed by London, offers a dozen tracks, three of them extremely brief, combining chamber music instrumentation and rock themes. The use of violin, viola, cello, acoustic guitar, piano or harpsichord, and bass is interesting, certainly, but somehow misses its intended mark.

—**SHARON CASH** (Playboy, PB-114) provides good soul from a 23-year-old thrush. She's basically a screamer, a la Aretha Franklin, although there too are flashes of Billie

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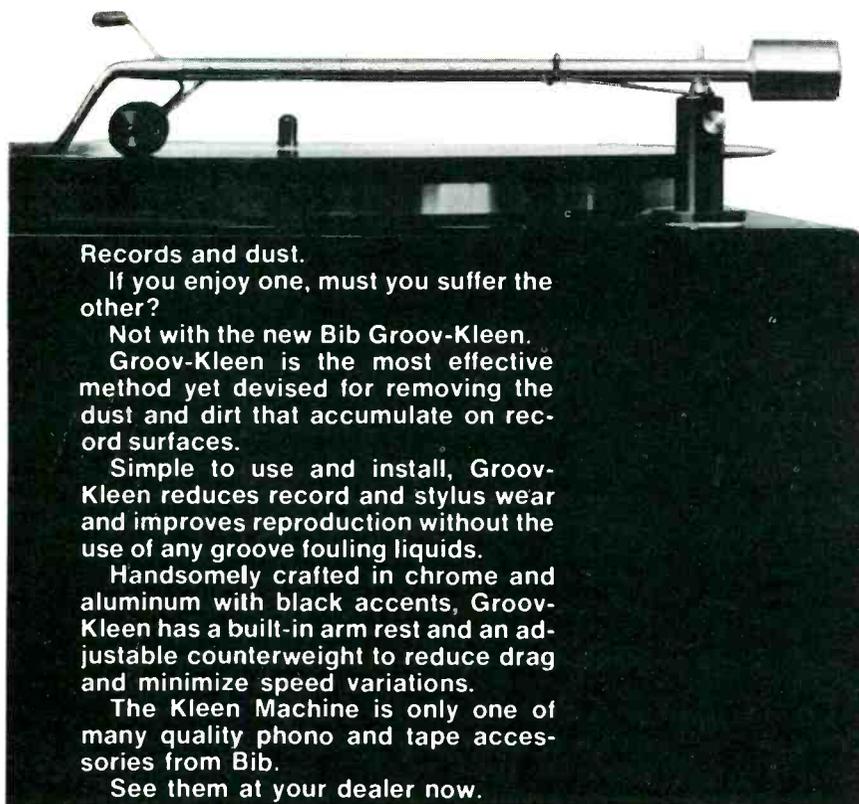
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Holiday (on *Gentleness*, for instance). Each of the 10 cuts contains more than a little excitement musically, however.

—**COMPARTMENTS** (RCA Quadra-Disc, APD1-0141) is a Jose Feliciano extravaganza in soul singing. The artist, whose vocal performance is softer than usual, is backed by a star-studded cast that includes Jim Horn, Jackie Kelso, Leon Russell, Seals & Crofts, Bill Withers and Steve Cropper. Best of the 11 cuts is *Sea Cruise*.

—**SOMETHING FOR EVERYONE** (MGM, SE-4874) finds Brook Benton singing slow stuff—for lovers and dancers who enjoy holding each other. Highlights of the 10 tracks include a medley of *For the Good Times* and *It's Just a Matter of Time*, with the lyrics of the two songs intermingled; *Sunset Memories* and *For All We Know*.

—**MONTY PYTHON'S PREVIOUS RECORD** (Charisma, CAS 1063) points up the difference in senses of humor between those on this side of the pond and those in Britain. It just isn't funny, by American standards, despite moments of high hilarity. The "comedy" disc, distributed by Buddah, is of interest more to scholars of the genre than to listeners.

—**THE VELVET GUITAR OF BRYAN DALY** (London "Phase 4 Stereo," SP 44171) is a sure winner for the Muzak crowd. Daly's mood music is supported by the London Festival Orchestra. Both perform admirably on a dozen cuts, best of which are *It's Impossible*, *Romeo and Juliet*, *Amazing Grace*, *Love Story* and *Bridge Over Troubled Water*.

—**THE GOLDEN AGE OF ROCK 'N' ROLL** (Kama Sutra, KSBS 2073-2) is a two-disc package with 29 cuts by Sha Na Na, a 12-man group that spoofs the sound of the '50s and does it well. The album, distributed by Buddah, is almost a catalogue of the top hits of that decade. Included are *Lover's Question*, *Chantilly Lace*, *Why Do Fools Fall in Love*, *Little Darlin'*, *Heartbreak Hotel*, *Get a Job*, *Rock Around the Clock*, *Yakety Yak*, *Blue Moon*, *Teenager in Love*, *16 Candles*, *Whole Lotta Shakin' Going On*, *Shake, Rattle 'N' Roll*, *At the Hop*, *Hound Dog* and *Great Balls of Fire*. Nostalgia for those under 40!

—**IMAGES 1966-1967** (London, BP 628/9) is a cash-in of David Bowie's popularity, reprising a bunch of stuff that was overlooked with good reason. Bowie, whose theatrical nature is hailed on the liner notes, apparently was big on copycat phrasing and stylistics of Anthony Newley at the time. Blah!!! The 21 cuts that cover two discs in-



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clude a dozen that filled an earlier Deram LP, seven more that were electronically reprocessed to simulate stereo (and you know what *that* means sound-wise). There *are*, for collectors of the beauty-beast, five previously unreleased tracks.

SON OF SCHMILSSON (RCA Victor, LSP-4717) is a unique, weird pastiche by singer-songwriter Harry Nilsson, a bizarre combination of Bing Crosby, Rod Stewart and Groucho Marx. There's electronic gimmickry and lots of satire, word-plays and touches of real honesty. Of the 11 cuts, all but one were penned by Nilsson, and highlights include *Take 54*, a fast-paced ditty about desertion, of sorts; *You're Breaking My Heart*, which contains a four-letter Anglo-Saxon favorite sure to offend those who haven't climbed aboard the mind-rockets of the '70s, and *Joy*, a spoof of Western ballads, replete with insipid lyrics a la Johnny Cash specialties.

SQUAWK (Kapp, KS-3669) features a trio, Budgie, with raw rock that's unimpressive unless you enjoy being blasted out of your armchair. The eardrum-breakers, a Welsh group, offer nine tracks on which volume, not quality, is the key. The underwhelming LP, Budgie's second, took four days to record. Ah, well, we all blow a week now and then.

THE LADY'S NOT FOR SALE (A&M, SP4370) is a slick, easy-to-listen-to album, professional in every sense. Rita Coolidge, a thrush whose bag is soft, sweet white soul, slows almost everything to a walk, giving her own character to each piece. Supported by a truly all-star cast (including Marc Benno, Mike Utley, Booker T. Jones, Al Kooper, John Sebastian and Kris Kristofferson), the singer slides her way through pieces by Bob Dylan, Tom Ghent, Kristofferson and others in such a way her climb to the top shouldn't take long.

HEADS (Decca, DL7-5368) spotlights Osibisa, a seven-man outfit heavily into native black sounds. This, the group's third LP, provides nine cuts that add more rock than earlier outings, to the disc's detriment—for the results seem not as innovative, not as individual as previous efforts. Highlight is *Ye Tie Wo*, a catchy thing almost impossible for a white Westerner to duplicate.

BUSTED (United Artists, UAS-5595) shows two sides of Murray Roman, the new and the old. The fresh face of the underground comic appears on Side One, a monologue about the 18 months he spent in prison. The material's too bitter to be really funny, not unlike Lenny Bruce's

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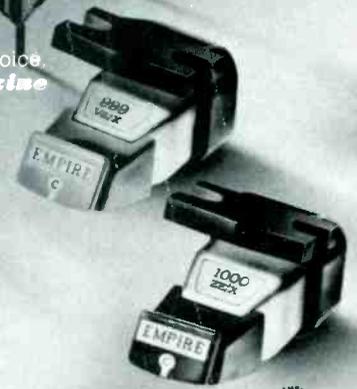
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final public appearances when he'd pass over the line from satire to preachiness. The flip side, however, is hilarious. It contains old material, reissued, smashing icons left and right (Snow White, the Church, love among the hip, politics, war flicks, sex—and, to boot, drugs, homosexuality, and racial discrimination).

—WATTSTAX (Stax, STS-2-3010), subtitled "The Living Word," brings to middle America through music an inkling of what the black experience is all about. The live concert music, lifted from the original soundtrack of the film of the same name, is crammed into a two-disc package sure to obtain maximum penetration of the black market. The album neatly captures the flavor of the concert in Los Angeles' Coliseum, with both words and music, and there's an added plus of good sound reproduction. Featured are the Staple Singles, who do four numbers (including *Respect Yourself*); Eddie Floyd, who offers a pair (including *Knock on Wood*); Carla Thomas, who does three; Rufus Thomas, with another three (including *Do the Funky Chicken* and *Do the Funky Penguin*), the Bar-Kays, Albert King, the Soul Children and, climactically, Isaac Hayes. Oh, wow, as they say.

JOURNEY (Warner Bros., BS 2663) provides a portrait in music of a wanderer that, according to vocalist-composer-pianist John Simon, is "starting from a point of rest and ending at a point of rest." The LP, for which Simon penned all 10 cuts, is somehow avant garde while remaining traditional. Motifs are jazz-oriented, with pop vocals tossed in almost as an afterthought; Simon's voice isn't really much, but is somehow expressive as dynamite. The highly personal album, the second for Simon, who previously had produced recordings for The Band, Simon & Garfunkel, Gordon Lightfoot, and Blood, Sweat & Tears, is filled with paradoxes. Fascinating!!!

BACK TO FRONT (MAM-5) spotlights Gilbert O'Sullivan, alone again, naturally. But this time around, the singer—who composed all dozen tunes (plus an "Intro" and a pair of "Outro's")—has found a musical rut that threatens to kill his freshness. The chartbuster *Clair* is here, of course, but then there's sameness, sameness in voice and arrangements. London distributed the disc, more's the pity.

1776 (Columbia "Masterworks," S 31741) is an original soundtrack recording that is equal to the original Broadway cast on vinyl. The only problem is that both casts, though pro-

fessional in every regard, are dealing with third-rate musical material. The show, a patriotic spoof dealing with the Constitutional Convention, was highly amusing. But its songs are good only in context, not standing alone.

CATCH BULL AT FOUR (A&M, SP4365) completes Cat Stevens transformation from teenybopper idol to full-fledged performer. He's still trying to be a one-man band (playing piano, electric piano, electric guitar, drums, percussion and organ) in addition to singing, but don't let it bother you 'cause the overall effect is better than most. Backed by a quartet, the songwriter-vocalist offers intricate melodies that appear deceptively simple. Most fascinating are "18th Avenue," a musical tour de force, and the Latin-lyric tone poem, "O Caritas," a song for all time.

DIAMONDS IN THE ROUGH (Atlantic, SD 7240) is John Prine at his best with the kind of music you can't listen to casually, for the lyrics have too much impact to ignore. Prine, a songwriter-singer bound to be a superstar, is backed by David Bromberg, Steve Burgh, Steve Goodman and Dave Prine. Of the 13 cuts, it's almost impossible to pick a loser. The former mailman, always in a heavy country bag, doesn't mince many words. For instance, in *Rocky Mountain Time*, he intones: "Christ I'm so mixed up and lonely/I can't even make friends with my brain." Listen. You might learn something. And you'll enjoy.

A TRAITOR IN OUR MIDST (United Artists, UAS-5596) marks the debut LP of Country Gazette, a bluegrass quartet that's excellent if you're at all into their kind of thing. Byron Berline's fiddle work, to cite only one high point, is magnificent. A traditional sound placed in a modern framework, the group excels on *Hot Burrito Breakdown*, an instrumental masterpiece of pickin'; "I Wish I Knew," featuring good country harmony, and *Swing Low Sweet Chariot*, a true country rendition difficult to accept at first but then surprisingly pleasing.

—THE HISTORY OF THE RIGHT-EOUS BROTHERS (MGM, SE-4885) contains reissued material dating from the beginning of what was termed "blue-eyed soul"—that is, the white variety. Baritone Bill Medley and tenor Bobby Hatfield joined to become one of the leading soul-pop outfits, and a quick refresher course in chartbusting is obtained by hearing these, *Stagger Lee*, *Ebb Tide*, *Let the Good Times Roll*, *Georgia on My Mind*, *You'll Never Walk Alone* and *Unchained Melody*. Good memories!

LOVE THEME FROM THE GOD-FATHER (Kapp, KS-3665) includes the best instrumental version of the hit so far. *Roger Williams*, always the pro, also does particular justice on the keyboard to "Theme from Kotch," "Brian's Song" and "Until It's Time for You to Go." The format is typical for him, 11 cuts that include nine pop items and a couple of classical adaptations.

—THE HISTORY OF MGM MOVIE MUSIC, VOLUME 1 (MGM, 2-SES-15-ST), a double-disc package offering

16 cuts, spotlights orchestras conducted by Max Steiner, Alfred Newman, Johnny Green, Andre Previn and others. The music—good listening, with good variety—ranges from themes from *Gone With the Wind* and *Brigadoon* to the jazzier *Slaughter on 10th Avenue* and *An American in Paris Ballet*. All are instrumentals except *The Girl Hunt Ballet*, with narration by Fred Astaire, and *Broadway Ballet*, with vocal by Gene Kelly. This is a must for those who want their music posh. **AE**

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Classical Reviews

Edward Tatnall Canby

The Fantastic Philadelphians, Vol. 2. (Smetana: *Dance of the Comedians*; Ponchielli: *Dance of the Hours*; Khachaturian: *Sabre Dance*; Grieg: *Anitra's Dance*, etcetc. Phila. Orch. Ormandy. RCA Quadradisc ARD1 0017, \$5.98. **Bach's Greatest Fugues (Scored for Double Orch.)** Phila. Orch. Ormandy. RCA Quadradisc ARD1 0026, \$5.98. **Rimsky-Korsakov: Scheherazade.** Phila. Orch. Ormandy. RCA Quadradisc ARD1-0028, \$5.98.

Fantastic—not fabulous (that's Columbia's word). Well, if you can call any such totally predictable batch of super-elderly chestnuts fantastic, then these performances are, and maybe the recording in quadrasonic sound too. These were my first introduction, *chez moi*, to the glories of CD-4, and my astonishment at RCA's success (and, of course, JVC's in Japan—they are the progenitors) was matched by my astonishment that so many chestnuts of the symphonic repertory were still around to be played—I really thought some of these must have died an unnatural death by *this* time. *Dance of the Hours!* Lordylordy. I suppose the Philadelphians will play that one until Kingdom come. They do it ever so nicely. And the *Sabre Dance*. Hadn't heard it since about the third Audio Fair in NYC, when it was blasted out of every room in the entire audio show until (I was going to say) it was coming out of our ears. Boring into them, rather, and I mean the pun.

Quite seriously, the un-glory of the CD-4 system in its first production run has been the rewarmed hash of old-fashioned repertory. Some, like Debussy, really worthwhile, in rarely good performances. Some, like these, just highly professional corn. Others—well, just awful. If you only owned RCA quadradiscs and naught else, you'd have a worm's eye view of music.

The glory, of course, is that the CD-4 system of quadrasonic "discrete" discs is beginning to work, and to work well, against all probability

(my own thought). See "Audio, E.T.C." Apparently RCA has been experimenting in quadrasonic recording, not only behind the scenes but in the actual published offerings. Each of these seems to have a different acoustic and/or a different species of mic arrangement, judging by the sounds. The driest of the series, already reviewed, was the Debussy-Ravel disc. The Scheherazade offering is warmer in sound, shinier in tone. The Greatest Fugues (ugh) is positively cavernous, enormous, tremendous, and very effective too—considering the super-old-fashioned styling of the music, à la Stokowski of the 1930s. It works. If you are *not* a Baroque fan, this could be superb for you. It sure doesn't sound like Baroque! It sounds like the Philadelphia Orchestra, augmented.

Conclusion: I think it is vital to keep perspective in these first CD-4 experiences. The pros—critics, record sales people, engineers et al—tend to be *much* too technical, missing the larger impact that really counts. Mr. Average Listener is *not* going to fuss over minuscule phasing errors, microbackground hiss, even a modicum of possible distortion, if the grand effect is right—and it *is* right, here. It's like driving a new car. You may know nothing about auto mechanics but the "feel" of that new car, plus or minus, hits the average driver instantly. Same with used cars. The RCA "feel" is astonishingly good. It has the basics of real quadrasonic impact. It *works*. Leave the details to be worked out!

Performances: B+ up.

Sound: (in quadrasonic demodulation) A-

Stolen Goods. Gems Lifted from the Masters. Dr. Teleny's Incredible Plugged-In Orchestra. RCA Quadradisc ARD1 0015, \$5.98.

I'd call it incredibly *un*-outrageous.

Look, RCA and Dr. Teleny! The business of lifting the classics was briefly a sensation back maybe thirty years ago when one Freddie Martin did it and everybody said naughty-naughty. Them days, RCA, are gone forever. Even rock musicians don't get away with it. They have more outrageous ways of getting attention, as you may know. Steal the classics and everybody yawns. Frozen turkey. (Unless you do it with musical interest.) This disc is no more than super-augmented cocktail music, superbland with everything—orchestra, traps, some Latin-American, wordless voices, you name it they have it, mixed glutenously together to kill any last remaining spark of classical interest, and substitute—nothing. The soporific ear will be happy. It's expensive wall-paper music, loud, clear and quadraphonic.

(OK, Editor, better get somebody else to rebut this review).

If I could listen, I'd be likely to say that the quadraphonic effects are ingenious and the surround sound surrounds all over the place. But I really couldn't bring myself to care.

Performance: No comment.

Sound: Probably first rate.

Al Stewart's Museum of Modern Brass. RCA Quadradisc ARD1-0032, \$5.98.

Ah, but this! It's full of stolen classics and it's *very* good. I like! How come? Well, the mystery of any art is that it isn't what you do, it's how you do it. Words, formulae, categories, prove nothing. The proof of the pudding is in the, er, hearing.

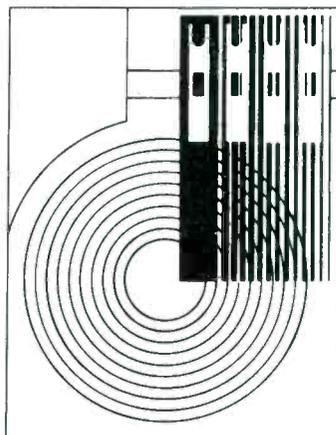
This is not all-brass; there's an interesting admixture of rhythm section, solo electric of one sort or another, even a nicely used harpsichord (which sounds acoustic tho' it might be an electric sound for all I know . . .). The effect is of a brassy big-band group, updated, highly pro and extremely smooth. The arrangements are excellent, both in the music and in the sound distribution. Some of the things are outrageous—familiar Baroque classics breaking up into big-band brass jazz and the like. OK! It's all very expert and outwardly casual, which is good; the music rates well even if you've never heard a note of the originals which, by the way, are "classics" of a healthy variety, from Bach's *Magnificat* and Purcell's *Music for the Funeral of Queen Mary* to *Amazing*

Grace and, of all things, *A Whiter Shade of Pale*, out of Procul Harem. That piece, an inspired derivative of Bach in itself, has rightly become a pop classic and is as alive in new arrangements as the leading Beatle tunes. Here, the Bach-like sound is further transcribed into a third-generation emanation.

The brass is paramount and the remarkable trumpet playing of Stewart is himself always in the lead—he plays as good a Bach-Vivaldi trumpet as a pop brass. Brass, of course, is ideal for any sort of quadraphonics and this job really goes four ways to town.

Performances: A

Sound: A



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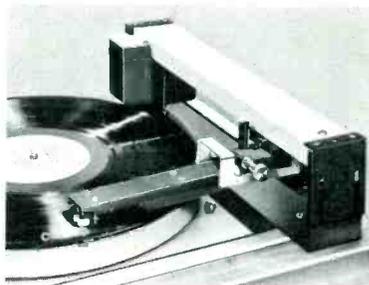
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Jazz & Blues

Martha Sanders Gilmore

Ellen McIlwaine: *We The People*
Musicians: Ellen McIlwaine, vocals, guitar, piano; Don Payne, bass; Don Moore, bass; Jimmy Madison, drums; Jerry Mercer, drums; Collin Tilton, saxophone; Candido, conga; West 44th Street Noise Choir; The Persuasions.

Songs: *Ain't No Two Ways To It; All To You; Sliding; Never Tell Your Mother She's Out of Tune; Farther Along; I Don't Want To Play; Underground River; Everybody Wants To Go To Heaven; Jimmy Jean; We The People.*

Polydor PD-5044, stereo, \$4.98.

Ellen McIlwaine with her mint green eyes, red hair, and freckles has been described as "a seminal force in the next era of rock." She is indeed an electrifying performer as is evidenced by this recording on Polydor named after a tune, *We The People*, from her triumphant concert at Carnegie Hall last summer and recorded here live.

Her voice is as difficult to categorize as is her approach. She draws from rock, country, blues, flamenco, but with a difference.

Ellen McIlwaine sings and plays guitar, using her voice much as an instrument and implementing all manner of vocal calisthenics in *Ain't No Two Ways To It*, an up-tempo, hard-sell number which features Collin Tilton, a saxophonist who leans heavily toward r & b.

Ms. McIlwaine enunciates very clearly and has an extensive range, executing generous scalular leaps. In *All To You*, she is most persuasive. There is an intimacy about her approach that makes us cluster all around her. In *Sliding* she strums furiously, inserting a touch of flamenco and bending notes to her will, while *Farther Along* is in a traditional vein. With the *Persuasions* in the background, it possesses the moving quality of a hymn.

Ellen's dynamic performance in *I*



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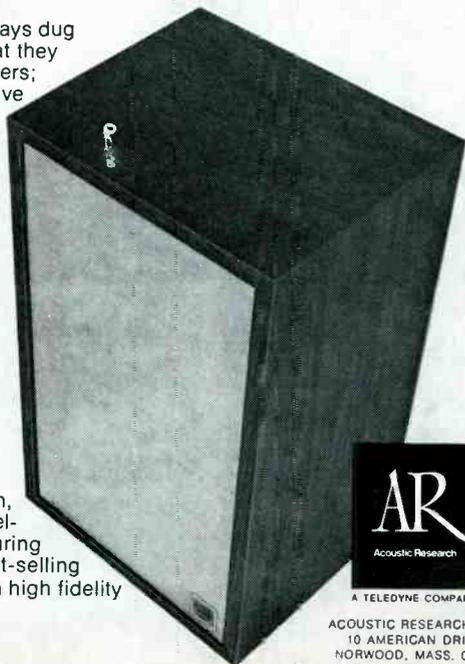
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Don't Want To Play can't be put down as she harmonizes with herself, and the minor-keyed *Underground River* is a symbolic, suspense-filled composition which holds one's interest throughout. She plays a honky-tonk piano with a boogie beat in *Everybody Wants To Go To Heaven*, a charming rollicking tune that demonstrates her extreme facility and versatility as a performer.

The reproduction is clear and well-separated.

After hearing this recording it would be a rewarding experience to hear Ellen McIlwaine in person. She has great impact!

Sound A-

Performance B+

Carmen McRae: The Great American Songbook

Musicians: Carmen McRae, vocals and piano; Joe Pass, guitar; Jimmy Rowles, piano; Chuck Domanica, bass; Chuck Flores, drums.

Songs: *Satin Doll; At Long Last Love; If the Moon Turns Green; Day by Day; What Are You Doing the Rest of Your Life; I Only Have Eyes For You; Easy Living; The Days of Wine and Roses; It's Impossible; Sunday; A Song For You; I Cried for You; Behind the Face; The Ballad of Thelonius Monk; There's No Such Thing as Love; They Long To Be Close To You; Three Little Words; Mr. Ugly; It's Like Reaching for the Moon; I Thought About You.*

Atlantic SD2-904, stereo.

Discussing a recording of the high caliber of this is precisely what makes my job as reviewer such an immense pleasure. To be honest, I couldn't wait to get to this two-record artistic achievement by Carmen McRae, a singer's singer and real pro by anybody's standards. The superlatives one could heap upon her are many. I had looked forward to hearing this with great expectations. Carmen McRae fulfills them all. This is a magnificent chapter in her life's book. She's reached the skies and has plucked out some stars that will fairly dazzle your eardrums.

Admittedly, Ms. McRae has been one of my favorites after hearing her live in a club performance at Washington's Cellar Door. She's at her best in the intimate smoky surroundings of a small club which her earlier recording for Time Records, *Live at Sugarhill*, bears out. We are blessed to have her live once more in this effervescent

AUDIO • AUGUST 1973

effort on Atlantic Records in which Carmen scats, chats, sings, and swings and it's as if we were all out there clinking our glasses along with the rest of the gang who, incidentally, doesn't offend.

No butter 'n eggs gal, this Carmen McRae. She's tough, dry, bittersweet, and compassionate all at once, a bold dramatist, an actress non-pareil when it comes to projecting a lyric. Listen to her growl out "green" in the tender *If The Moon Turns Green*, a song formerly unfamiliar to me but one I shall never forget after hearing Carmen sing and play it. At her onomatopoeic best, Carmen draws out "crawls" in *Mr. Ugly*, reaching way up, and lolls out the l's in "listen" in Leon Russell's *A Song For You* in a beautifully unhurried and spare arrangement enhanced by Chuck Dominicano's broad-boned bowed bass.

It doesn't hurt one bit that Carmen has surrounded herself with multiple talent of a high order. Joe Pass creates some incredibly fleet lacework on guitar and Jimmy Rowles speaks volumes on piano. We also learn that Rowles composes. Two tunes here by him couldn't differ more, utterly charming in their own individual ways. *Behind the Face* is a song that decries prejudice and the *Ballad of Thelonius Monk* is a jaunty Falstaffian parody which, according to Carmen, "is built to make you laugh."

In addition to the fine musicianship Carmen displays, one gets to hear her tongue-in-cheek introductions and quick repartee with the audience. Carmen McRae's technical competence is staggering as she dips deftly down to the lower register, then swoops back up to the highs effortlessly. Her material is choice and she knows what there is to know about pace, not missing a kink, pitting a slow number against a fast one. Her diction is right and true, her timing superb and ranking with that of a Judy Garland. She conveys a jazz feeling that is rare and shared by only a few of her peers such as Ella Fitzgerald, Sarah Vaughan, Anita O'Day, and Betty Carter. It's intoxicating to hear her scat in *I Cried For You*, *I Only Have Eyes For You*, and *Sunday* against Dominicano's rotund bass notes. The interplay within the group is tremendous and one finds oneself treasuring every note of this mellifluous timbral mesh of bass, drums, guitar, and piano as one would grains of wild rice.

Carmen McRae has sung with some of the big ones back in the forties, namely Benny Carter and Count Basie. But for some reason—her uncompromising manner and non-commercial

approach perhaps—she has never really received the recognition she deserves, scoring high in the polls without actually winning them. But the critics like her and perhaps all she needs is more exposure to the public. If this Lady of Song keeps this up, her time will come.

The sound is as clear as a bell with Michael Cuscuna supervising the remix. You may have read him in the pages of *DOWN BEAT* among other pubs. A good ear!

Carmen McRae is a GIANT! Her songbook is indeed great! I could write a book about it but take my advice and get out and get this record. If you haven't met her before it will be a very special encounter for you and if you have . . . well, you know what you're in for.

Carmen McRae can sing for me anytime. Every now and then you come across one of those records which you cannot do without . . .!

Performance A+ Sound A+

WAYLON JENNINGS: *Lonesome, On'ry & Mean*

RCA Victor LSP-4854, stereo, \$5.98.

The silk-smooth unruffled voice of Waylon Jennings is suggestive of Johnny Cash here in a round of tunes with the Nashville sound. Jennings sings out with a clear, honest delivery. There is a lonesome quality to his sound. His is a voice that comforts.

Despite his authenticity, the material here is commercially slick and superficial with little or no development or added interest except in Kristofferson's *Me and Bobby McGee* which thumps right along complete with chorus and where they finally let it all hang out as though it were their last chance.

The set features lots of harmonica as in *Lonesome, On'ry and Mean* and the pretty *Freedom To Stay* and there is some fancy picking on acoustic guitar in the melodic *Lay It Down*.

Jennings sings with a touch of Elvis in *You Can Have Her* which features a string section complete with violins, violas, and cellos and a gospel-like chorus. Most interesting, however, lyric-wise is the anecdotal *San Francisco Mabel Joy*, the saga of a Waycross, Georgia farmboy who "jumped a freight in Waycross and wound up in L.A." and met up with Mabel Joy, described as "Destitution's child born on an L.A. street called Shame."

The sound is disappointingly undistinguished.

And incidentally, Randy Scruggs, son of the famous banjo picker Earl Scruggs, is in the midst of it all playing guitar, but it would be a long day's journey to pick him out of the throng.

ART HODES: Mostly Blues

Musicians: Art Hodes, piano; Marty Grosz, guitar; Eddie Burleton, clarinet; Truck Parham, bass; Freddie Kohlman, drums.

Songs: *Dardanella*; *B-Flat Blues*; *Chimes Blues*; *Angry*; *After You've Gone*; *Apex Blues*; *Ain't She Sweet*; *Liberty Inn Drag*; *I've Found a New Baby*.

Audiophile AP-54, compatible.

Mostly blues is mostly and that's where this recording excels most, but it also includes a few old standards. The result is a classic, a delightfully compatible timbral mixture of instruments: piano, guitar, clarinet, bass, and drums which evokes memories of Django Reinhardt's Hot Club of France.

Hodes' easy-livin' touch is light, airy, even Mozartian, but authoritative when necessary as in the chorus of the bell-like *Chimes Blues* which has a *Battle Hymn of the Republic* patriotism to it and the puckishly formidable *B-Flat Blues* in which clarinetist Eddie Burleton achieves a Crescent City indigo sound. Burleton's style, while thin of tone, is lively and possessed of a warm vibrato as we hear him on the above as well as *After You've Gone* and the minor-keyed *I've Found a New Baby* in which Hodes gets off some engaging runs. And the inference Hodes makes to *In the Mood* is pure craftsmanship.

Marty Grosz's guitar is amiably acoustic, his attack largely chordal and rhythmic but infused with highly selective picking. Grosz and Hodes complement one another well harmonically.

The sound is fair—a bit fuzzy, the effect totally relaxed and mellow as vintage wine. Russian-born Art Hodes has made a major place for himself in American jazz, both through his piano artistry and contributions to jazz literature. He is now and will ever be a legend.

This is good for early morning listening, a noontime pick-up, and would set well with an evening's brandy. An effervescent balm to soothe the savage spirit.

Sound B Performance B+

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RENT ANY CASSETTE or Open Reel Pre-recorded tape. All Labels. Catalog 75¢. Tape & Time, 1116 4th Ave., No. Sauk Rapids, Minn. 56379.

COBALT ENERGIZED CASSETTES Ultra high frequency tape special price C40—\$1.00; C60—\$1.25 C90—\$1.58. Special Low Noise tape 1800' 1 mil 7"—\$1.50 all ppd DAK Dept. A81, P.O. Box 69920 Los Angeles, Calif. 90069

VALUABLE RECORDED TAPES lose highs and become progressively noisier each time they are played on equipment that is not thoroughly demagnetized. You can measure damaging magnetic residuals with the Pocket Magnetometer and really demagnetize recorder components with the powerful Han-D-Mag. Now available, complete Audiophile Han-D-Kits including: Magnetometer, Probe, Han-D-Mag, experimental sensors and "Notes" Kit 20/B5 \$29.75, Kit 25/S5 \$51.00, postpaid U.S.A. Literature available. R. B. Annis Company, 1103 North Delaware, Indianapolis, Indiana 46202

KENNEDY/TIPPIT/OSWALD MURDERS! Actual episodes & police recordings! Reels/cassettes: \$10. Majestic, 9651 Foxbury, Rico-Rivera, California.

"**8**" **TRACK TAPES** only \$3.00 each postpaid. Send for our free catalog. Lists over 400. G.M.O., 58 Hillside, Verona, N.J. 07044 Dept. 8TRAm-73

NEW TAPE EXCHANGE CLUB. All Formats. Details 25¢. Bob Musial, Box 11907-A, Chicago, Ill. 60611.

OLD Radio Show Monthly Special Club—TBOR, Box 1692A, F.D.R. Station, New York 10022.

TAPE RECORDINGS

OLD Time Radio tapes—reels—cassettes. Free catalog. Garant, Box 331, Greeneville, Tennessee 37743.

PROFESSIONAL QUALITY AMPEX 600 TAPE, 7"-1800' reels \$2.25 each. No purchase limit. **REAL TO REEL RECORDING,** Box 1271, Garland, Texas 75040

PROFESSIONAL ALUMINUM BLOCK parallel precision grooves expertly splices 250 or cassettes. Tabs included. Guaranteed \$4.95 plus .75 handling. Details NRP, Box 289, McLean Va. 22101.

RADIO PROGRAMS

RADIO MEMORIES. Custom recorded reels and cassettes. Professional quality equipment assures best sound, but at prices YOU can afford. Large catalog and supplement \$1.00 (refundable) 1033 Gypsum, Salina, Kansas 67401.

REMEMBER RADIO? On cassettes or reels. Amos & Andy, Inner Sanctum, Jack Armstrong, Fred Allen, I Love a Mystery, Your Hit Parade, Grand Ole Opry, All your Favorites live again. High quality, low prices. Catalog only 50¢. Remember Radio, Inc., Box 2513-B, Norman, Okla. 73069.

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FREE CATALOG. Radio mysteries. Detective House. 218 Orangeview Lane, Lakeland, Fla. 33803.

WANTED—"GRAND CENTRAL STATION" radio dramas written by Roger Gallagher 1946-1950. Contact Gallagher, RFD2, Amherst, Mass. 01002.

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TUBES receiving, factory boxed, low prices, free price list. Transletronic Inc., 1306 40th Street, Brooklyn, N.Y. 11218. Telephone: 212-633-2800.

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VIOLIN AND GUITAR MAKERS—send for latest Free Catalogue of woods—accessories. International Violin AU1, 414 East Baltimore St., Baltimore, Md. 21202.

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MATURE, CAREER MINDED, success oriented, young college graduate with broad experience in HiFi and Consumer Electronics desires position with reputable Marketing oriented firm. Will submit resume, extensive references and transcripts upon request. Inquire c/o Kenneth D. Gartrell, 1028 Irish Road, Kent, Ohio 44240.

BOOKS AND PUBLICATIONS

YOU'VE SEEN THE REPRINTS of our nice equipment reports. If you want to read the nasty ones you'll have to subscribe. For free prospectus, write: STEREOPHILE, Box 49A, Elwyn, Pa. 19063.

I bought a Marantz 4 channel receiver because I refuse to be stuck with an electronic antique.



Not one to tolerate obsolescence (planned or unplanned), I considered the stereo vs. 4-channel question carefully, then purchased a Marantz receiver for three compelling reasons.

One. Marantz has Dual Power. This means you get full power of four discrete amplifiers working all the time. When you're listening to regular 2-channel tapes and records you can combine the power of all four channels into the front speakers. This means even if you're not ready to commit yourself to a complete 4-channel system, you can buy Marantz now and when you get the other two speakers just flip a switch. You have 4-channel. Meanwhile, you're not compromising 2-channel because you're getting more than twice the power for super stereo.

Reason number two. Marantz receivers feature the exclusive snap-in snap-out adaptability to any 4-channel matrix decoder. This means that your Marantz stereo will never be made obsolete by any future 4-channel technology because the Marantz snap-in SQ* module is designed to keep up with the changing state of the art. What's more, Marantz receivers have Vari-Matrix—a built-in circuit that will synthesize 4-channel sound from any stereo source (including your stereo records and tapes) and will also decode any matrix encoded 4-channel disc or FM broadcast.

Reason number three. Marantz receivers, from the Model 4230 up, feature built-in Dolby** noise reduction to bring you the quietest FM reception ever. And you can switch the built-in Dolby into your tape deck for noise-free, no-hiss recording from any source. A real Marantz exclusive.

I chose the Marantz Model 4270 because it suits my needs perfectly. It delivers 140 watts continuous power with under 0.3% distortion. And it's literally loaded with features. However, your requirements may be more modest than mine. In which case you can own the Marantz Model 4220 which delivers 40 watts with Dual Power. Or you can go all the way and get the Marantz Model 4300 with 200 watts. It is the very best. Choose from five Marantz 4-channel receivers from \$299 to \$799.95.

The point to remember is this—whichever model Marantz 4-channel receiver you do buy, you can buy it today without worrying about its being obsolete tomorrow. Look over the Marantz line of superb quality receivers, components and speaker systems at your Marantz dealer. You'll find him listed in the Yellow Pages. Think forward. Think Marantz.

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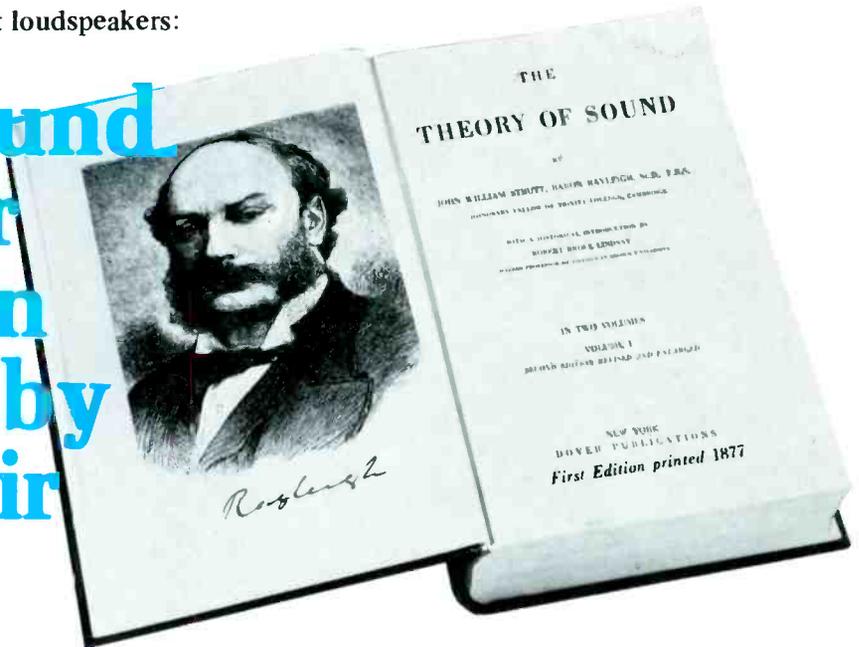


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Check No. 43 on Reader Service Card

The most frequently asked question about loudspeakers:

Does the sound of a speaker depend upon the method by which the air is moved?



All speakers sound different from each other and when you hear a difference between two speakers that employ different principles of moving the air, it is only natural to wonder whether the variance in sounds is a consequence of the principles involved. After all, moving the air is what produces the sound.

Back in the 1950's, when electrostatic speakers reached a peak of popularity, some people thought that they might have a fundamental advantage because of the lower mass of the moving element compared to that of a cone speaker. Then, in the 1960's, ionic speakers were developed with no moving parts at all, and therefore, zero moving mass. Today, in the 1970's, a wide variety of transducers exists using principles ranging from piezoelectric to magnetostrictive, which either push the air with a diaphragm or squeeze the air out between moving surfaces.

Indeed, some of the principles of moving the air do have advantages over others in terms of size, weight, efficiency, and cost. **But there is absolutely no advantage of any particular method of moving the air in terms of the potential quality of the sound that can be produced.**

Let's see why this is so. We experience sound through the medium of acoustic waves traveling in air. It has long been known¹ that once the air is set into motion, it moves by the laws of acoustic wave propagation which are totally independent of the method by which the air was set into motion.

Therefore, a source (speaker) influences the sound field only through the amount of air it moves at each frequency and through the directions that the speaker moves the air. The method of moving the air in no way affects the sound that you hear.

In a basic experiment presented at a meeting of the I.E.E. professional group on Electroacoustics in 1964, it was demonstrated² that a multiplicity of full-range cone speakers can produce music that is subjectively identical to that produced (with the aid of computer simulation) by an ideal massless membrane free of all resonances and distortion. While this very basic result was proved only for full-range cone type speakers, the above discussion indicates that the same result could be obtained by the use of other types of full-range speakers as well. Thus, the secret of excellent performance doesn't lie in the type of speaker used (i.e. the way the air is moved). It lies in the use of a *multiplicity of full-range* speakers in one enclosure, in the *exact proportioning* of the ratio and the directions of direct and reflected sound radiated by the total enclosure, in the *precise equalization* of the speakers to radiate the correct balance of frequencies, and in *extreme quality control measures* that select and match all the speakers in the enclosure.

To fully appreciate the effect of a multiplicity of full-range speakers, with precise equalization and the optimum combination of direct and reflected sound, simply A-B the BOSE 901 Direct/Reflecting[®] speaker with any other speaker. Hear why the BOSE 901 is the most highly reviewed speaker regardless of size, price, or type of speakers.



References

1. The Theory of Sound, Vol. 1. By J.W.S. Rayleigh. 1877.
2. The results are documented in the Audio Engineering Society Paper, ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS, by Dr. A. G. Bose. Copies are available from the Bose Corporation for fifty cents.

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