

Audio

Car Stereo
& Speaker Directory

THE AUTHORITATIVE MAGAZINE ABOUT HIGH

JULY 1977 \$1.00
47425 

Dynamic
Requirements Of
Phono
Preamps -
Holman

Heyser on
Frequency
& Time
In Loudspeaker
Measurement

U1776863 1277 60107014P1M02514 * *
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BOX 147
KNEELAND
CA 95549



WHEN YOU'RE NOT
IN A RUSH TO CATCH UP,
YOU'VE GOT THE TIME
TO BUILD THINGS RIGHT.



* 160 watts per channel minimum RMS continuous power output at 8 ohms, from 20 to 20,000 Hz, with no more than 0.1% total harmonic distortion.

WHY THE FIRST HIGH POWERED RECEIVER IS STILL THE BEST HIGH POWERED RECEIVER.



When Pioneer first introduced the 160 watt* SX1250 last year, it prompted our competitors to hastily introduce a bevy of high powered receivers.

Unlike the others, however, the SX1250 wasn't a rush job. And the time and care that went into it can both be seen and heard.

EVERY SECTION SHIELDED.

Unlike most high powered receivers, every critical section in the SX1250 is shielded. Enveloped in aluminum. So spurious signals from one section can't leak into another. And dirt and dust can't slowly build up to affect performance. So the receiver not only produces crisp, interference-free sound when it's new, but still sounds great as it grows old.

A 22 POUND TRANSFORMER.

In our power supply, instead of finding a conventional transformer, you'll find a heavier, more advanced toroidal-core transformer. It's less susceptible to voltage fluctuations. And less likely to leak noise. Which means you get cleaner, clearer sound. And instead of finding the usual two electrolytic capacitors in the power supply, you'll find four. Because we've found that the two extra capacitors help improve low frequency response. And protect against tone burst distortion.

THE FM SECTION: A FIVE GANG VARIABLE CAPACITOR.

The average high powered (and low powered) receiver comes with a three, or four gang variable capacitor for FM tuning. Not the SX1250. It comes with a five gang zinc plated variable capacitor that cleans up FM reception much better. And helps to pull in stations that some three or four gang capacitors can't touch.

This same kind of thinking even went into things like our heat sinks. They're massive, and located around the outside of the 1250 to dissipate heat away from the innards, instead of into them. (In the Technics SA 5760, by comparison, the heat sinks are located right in the middle of the receiver.) And where many manufacturers choose to solve the heat problem with fans, we choose not to. Simply because electrical fans can cause noise and vibration. While our heat sinks can't.



Massive heat sinks to keep the heat off delicate electronics.

OTHER POWERFUL ARGUMENTS FOR THE SX1250.

Our pre-amp circuit was designed with an unheard-of phono overload level of 500 millivolts. Which means that no magnetic

cartridge in the world can make it distort. It was also designed to follow the RIAA curve (the recording standard of the record industry), to within 0.2 decibels. A figure that competes favorably with even the costliest separate pre-amps.

And where some high powered receivers give you two or three tone controls, the SX1250 gives you four. Two for regular treble and bass, and two for extended treble and bass. They're calibrated in 2 decibel click stops; which give you a total of 3,024 ways to make the most out of your music.

Given all this, it should come as no surprise that the SX1250 even weighs more than most of our competitors' high-powered offerings.

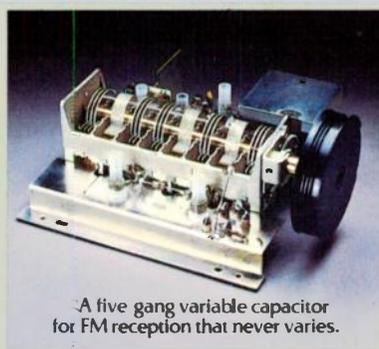
So before you run out and buy just any high powered receiver, consider all the time and engineering that went into the SX1250. And weigh your decision carefully.

High Fidelity Components
PIONEER
WE BRING IT BACK ALIVE.

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An extraordinary power supply, for an extraordinary amount of power.



A five gang variable capacitor for FM reception that never varies.

PIONEER'S SX1250.



DISCWASHER®

presents

RECORD CARE BASICS

The finest record care system is Discwasher, and the research of the Discwasher labs shows four ways to dramatically extend the fidelity of your discs:

1. Beware of the heat monster. Taking records from very cold conditions to hot conditions, or playing records at temperatures in excess of 90° F, accelerates record wear and distortion.
2. Beware of a "clean" stylus. A stylus may look clean, but can be glazed with contamination after playing two or three records. This glaze holds dust which abrasively destroys records. Discwasher's SC-1 Stylus Cleaner is the best way to keep your clean-but-dirty stylus really clean.
3. Do not replay records quickly. Playing a record more than once every hour causes chemical and physical stress to the vinyl that will eventually destroy the album.
4. Clean micro-dust before playing. Micro-dust is attracted to records and may not be noticeable. Playing a dust-contaminated record welds this micro-dust into the grooves. The Discwasher brush with a few drops of D3 fluid is the finest, most convenient way to remove this threat to your valuable record collection.

For technical information on the complete line of Discwasher products, see your hi-fi specialist or discriminating record store.



d discwasher inc.

1407 N. Providence Rd.
Columbia, Missouri 65201

Audio

July 1977

"Successor to **RADIO** Est. 1917"

Vol. 61, No. 7

Feature Articles

- 22 Turntables & Noise/Joseph F. Grado
- 28 Sound on Wheels
- 34 Car Stereo Directory
- 56 Three Car Components Tested/Leonard Feldman
- 72 Dynamic Range Requirements of Phonograph Preamplifiers/Tomlinson Holman

Equipment Profiles

- 84 Jensen Model 530 Loudspeaker/Richard C. Heyser

Record Reviews

- 89 The Column/Michael Tearson & Jon Tiven
- 99 Jazz & Blues
- 103 Classical/Edward Tatnall Canby

Audio In General

- 4 Tape Guide/Herman Burstein
- 8 Audio ETC/Edward Tatnall Canby
- 16 Audioclinic/Joseph Giovanelli
- 18 Behind the Scenes/Bert Whyte
- 104 Classified Advertising
- 106 Advertising Index

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Publisher Jay L. Butler

About the Cover: It seems like everyone is getting into car stereo these days, even those who measure their mobility in pedal power rather than horsepower.

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Disco goes portable... and portable disco pros make Stanton their first choice!



Jack Marsh and an associate load equipment on their van, preparing to go on location.

If people can't get to Discos, then why not bring Disco to the people? Bring it to their Church Halls... to their School auditoriums... to a banquet hall in a nearby Motel... that's just what Murray the K's DISCO ON WHEELS is doing.

At last count, there were numerous franchised Murray the K DISCO ON WHEELS rolling across America, bringing Disco to the people. And, every last one of them has a STANTON CARTRIDGE as part of the system; in this case, the Stanton 500AL, a truly tough performer that is also known as the "work horse" of the broadcast industry. The Stanton 500AL does a fine job of playback while withstanding the rigors of back cueing, slip cueing, heavy tracking

forces, vibration and potential mishandling. This cartridge can take it under circumstances where a damaged stylus means even more than lost music... it means lost business.

For those Disco Operators who prefer a more sophisticated sound quality, Stanton has created the 680EL, the top quality performer for both Disco or Radio broadcasting.

So, Stanton, world famous for its top-of-the-line cartridge, the Calibrated 681 Triple-E, also serves the professionals in an interesting new branch of the Disco industry.

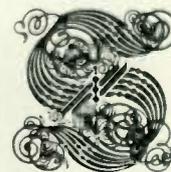
Whether *your* usage involves Recording, Broadcasting, Archives, Disco, or home entertainment, your choice should be the overwhelming choice of the professionals in every field... STANTON CARTRIDGES!



Close-up of the portable disco console.



Dancers in the Syosset (L.I.) High School gym.



STANTON

Write today for further information to Stanton Magnetics Inc., Terminal Drive, Plainview, New York 11803.

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Empire's Blueprint For Better Listening

No matter what system you own, a new Empire phono cartridge is certain to improve its performance.

The advantages of Empire are threefold.

One, your records will last longer. Unlike other magnetic cartridges, Empire's moving iron design allows our diamond stylus to float free of its magnets and coils. This imposes much less weight on the record surface and insures longer record life.

Two, you get better separation. The small, hollow iron armature we use allows for a tighter fit in its positioning among the poles. So, even the most minute movement is accurately reproduced to give you the space and depth of the original recording.

Three, Empire uses 4 poles, 4 coils, and 3 magnets (more than any other cartridge) for better balance and hum rejection.

The end result is great listening. Audition one for yourself or write for our free brochure, "How To Get The Most Out Of Your Records." After you compare our performance specifications we think you'll agree that, for the money, you can't do better than Empire.



EMPIRE

Already your system sounds better.

Empire Scientific Corp.
Garden City, New York 11530

Tape guide

Herman Burstein

Cassette Monitoring

Q. I want to re-record some cassette tapes, using two machines. But I want to be able to monitor the material through a speaker while the signal is going from one recorder to the other. Please tell me how this is done. Why doesn't using a patch cord from the external speaker jack of one recorder to the Aux In jack of the other recorder work?—Happy Gee, Jackson, Miss.

A. Most receivers, and integrated amplifiers and preamplifiers that rate as high fidelity equipment, permit you to monitor the incoming sound and at the same time feed it to a tape recorder. You would play your cassette into such equipment, listen to the sound through your amplifier and speaker equipment, and simultaneously feed the amplifier output (via the jack usually marked *Tape Out*) into another cassette for recording.

It seems that your connection from *External Speaker* to *Aux In* should work, and I don't know why it doesn't work in your case. Perhaps the signal voltage available at the *External Speaker* jack is too low, perhaps the jack is defective, or perhaps you are putting the wrong kind of plug, or a defective plug into this jack. Another possibility is that the *Aux In* jack is defective, or the cable might be defective. You should check all of these.

Impedance Mismatch

Q. How important is microphone-tape recorder impedance matching? I am interested in using a 600-ohm microphone for a tape deck with an input impedance of 10 kilohms.—Frank Greene, Kerlely, Cal.

A. Microphone impedance is important from the viewpoint of avoiding treble loss, possibly hum, and other noise pickup owing to cable length between the microphone and the tape deck. If you have a cable run of

more than 15 feet, a mike with low impedance is desirable. Ordinarily, an upward mismatch will have no adverse effects in terms of treble response and distortion, thus a 600-ohm mike could be fed into a 10-kilohm input. However, there remains a question as to whether the 600-ohm mike will deliver sufficient signal for a satisfactory signal-to-noise ratio. If not, then you require a step-up transformer mounted on the tape deck side of the cable whose output should approximately match the impedance of the deck's mike input.

8-Track to Open-Reel

Q. I have an extensive collection of 8-track cartridges which I am planning to transfer to open-reel tape. I would like to know what speed to use on the open-reel deck, 7½ or 3¾ ips? I would also like to know the frequency response of an average 8-track tape and if there will be any improvement if I use a Dolby unit?—William Kenney, Ridgewood, N.J.

A. With an open-reel deck of moderate or better quality, the 3¾ ips speed should be quite adequate for copying your 8-track cartridges. These cartridges tend to have little response above 10,000 Hz, while good open-reel machines should go well beyond that at 3¾ ips. These open-reel machines have quite high signal-to-noise ratios, so they add very little noise compared with the noise already on an 8-track cartridge. Therefore, I doubt that the use of a Dolby unit in the copying process would make any significant difference.

Tape Preservation

Q. I have a large collection of recorded tapes that I want to save intact. I am designing my own storage cabinets and would like to know if there is any way I can shield my tapes

"I've always wanted Bose 901's, but won't I need a 100-watt amplifier?"

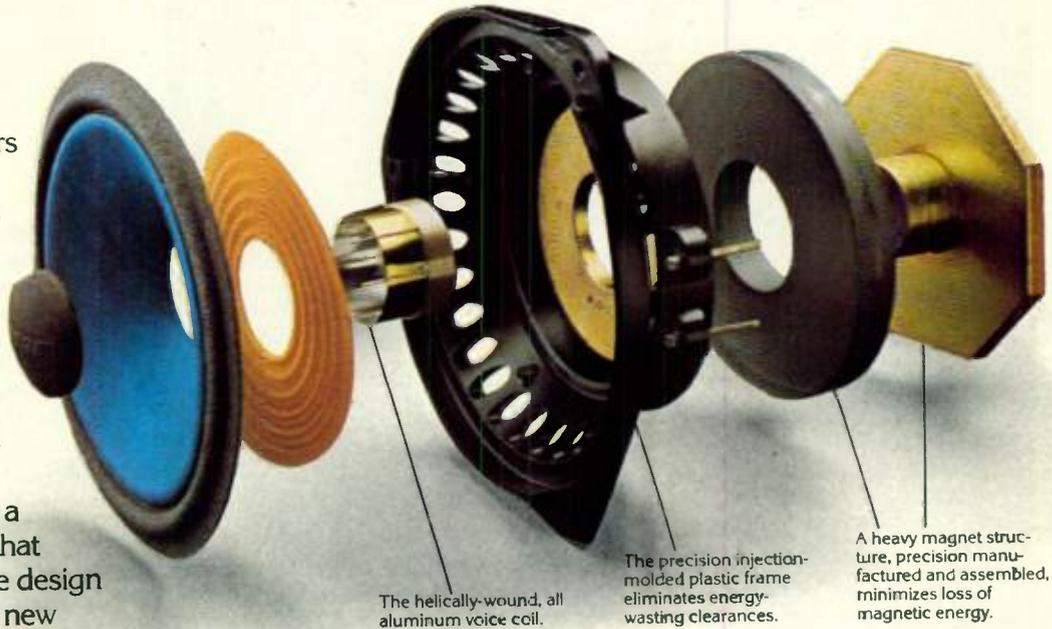
The original Direct/Reflecting® Bose 901® was one of the most acclaimed loudspeakers ever. But many people who admired the 901's didn't buy them because they thought they demanded a big, expensive amplifier.

The New Bose 901 Series III

Now comes the new Bose 901 Series III. It is a revolutionary speaker that combines proven Bose design concepts with startling new technology to achieve performance that is superior to the original 901 in every dimension—including even the spatial realism and spectral accuracy for which the 901 was justly famous.

Yet the 901 Series III requires less than one-third the amplifier power of the original 901. That means it can produce the same sound volume with a 15-watts-per-channel receiver as the original 901 with 50 watts. In fact, we suggest that anything over 70 watts is simply unnecessary.

No advertisement can describe fully the 901 Series III and the technology behind it. So we've put together a comprehensive literature package that includes a detailed 16-page color brochure, a 20-page owner's manual, and a copy of Dr. Amar Bose's paper on "Sound Recording and Reproduction," reprinted from *Technology Review*. To receive this literature, send \$1.00 to Bose, Dept. AU7, The Mountain, Framingham, Mass. 01701.



The helically-wound, all aluminum voice coil.

The precision injection-molded plastic frame eliminates energy-wasting clearances.

A heavy magnet structure, precision manufactured and assembled, minimizes loss of magnetic energy.

The New Driver

The key to the remarkable efficiency of the 901 Series III is a totally new, high performance



The voice coil consists of flat aluminum conductor wire wound on-edge on an aluminum core, eliminating the inefficient air gaps between the round copper windings of a conventional voice coil.

driver—a driver so advanced we had to build our own state-of-the-art driver manufacturing facility to produce it. It combines a light-weight, ultra-high-efficiency, helically-wound voice coil with a precision injection-molded plastic frame that practically eliminates loss of magnetic energy. Just as important, this strong plastic frame allows computer controlled assembly to tolerances far tighter than those imposed on conventional drivers.

The Payoff

This efficiency lets you enjoy the spectacular performance of the 901 Series III without a large investment in something you can't hear: pure power. And that might make the difference between getting just good speakers, and the speakers you've really wanted all along.

"A speaker unlike any other."



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Better sound through research

Cabinets are walnut veneer. Patents issued and pending.

Introducing New Quantum by Memorex. Four Reasons It Sounds So Good.

1. Quantum offers low distortion. You get a true recording of any type of music at high output, with virtually no distortion.

2. Quantum has very high sensitivity. This maximizes output and allows you to effectively capture all signals at a greater level.

3. Quantum provides an excellent signal-to-noise ratio because its high sensitivity is obtained with no increase in noise level. This means a pure, brilliant sound.

4. Quantum gives you high saturation, resulting in a wide dynamic range and broad recording flexibility.

Quantum achieves improved recording performance while maintaining a high degree of mechanical excellence. With long life, durability, precision edge quality and excellent oxide adhesion.

The best way to hear the Quantum difference is to try it out for yourself. Available in 7" x 1800', 7" x 2400' and 10½" x 3600' reels.

MEMOREX Recording Tape.
Is it live or is it Memorex?



© 1977, Memorex Corporation, Santa Clara, California 95052, U.S.A.

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World Radio History

against magnetic fields.—Barry Schwartz, Phila., Pa.

A. Tapes are pretty safe if you keep them at least a foot or so from strong magnetic fields. However, you might consider lining your storage cabinets with magnetic shielding material, which is rather expensive. You can get information about such material from Magnetic Shield Division, Perfection Mica Co., 1322 N. Elston Ave., Chicago, Ill.

Deck Modification

Q. I have an old tape deck and would like to know if you recommend having it adjusted to take advantage of the low noise, high output tapes. If so, please explain how this should be done.—Peter Lombardo, Gary, Ind.

A. As low noise tapes are pretty much universally used now, it seems like a good idea to adjust your machine for them. These adjustments apply only to recording, and they entail approximately a 15 per cent increase in bias, about a 3-dB reduction in treble boost at 15 kHz, and about a 2-dB increase in record drive current. It would be best to make these adjustments when using the specific brand of tape you plan to use in the future. When these adjustments are properly made, you should be able to get flat response within about 2 dB out to at least 15 kHz, and when recording a 400-Hz signal at a level that produces one per cent harmonic distortion, the VU meter should read zero. If your machine has a magic eye tube, the recording reference level should be three per cent harmonic distortion.

Stereo from Mono

Q. I have a mono cassette recorder. I can't afford a stereo system, so could I use two microphones, two level meters, and a microphone mixer to get stereo?—John Soliday, Mattoon, Ill.

A. Inasmuch as yours is a mono machine, the use of several mikes and a mixer will *not* enable you to stimulate a stereo effect. However, several mikes and a mixer would enable you to obtain better sound coverage and thereby a much more pleasing effect.

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

AUDIO • July 1977

Soundcraftsmen presents the NEW MA5002

a NEW CLASS super-amp

250 WATTS RMS PER CHANNEL 20 HZ-20KHZ BOTH CHANNELS DRIVEN INTO 8 OHMS, LESS THAN 0.1 % THD—\$699.00



FANTASTIC PERFORMANCE BECAUSE IT HAS ITS OWN ANALOG LOGIC CIRCUIT!

Soundcraftsmen's revolutionary new Patent Pending "VARI-POR-TIONAL" system uses Analog Logic Circuitry to anticipate power demands, then supplies only a proportional amount of power, as required by varying input signal voltages. This new power-conserving and energy-saving circuitry was invented by Soundcraftsmen's Chief Engineer, Paul Rolfes, holder of seven patents in the field of solid state electronic power circuitry, together with his assistant, John Holyoake.

The advantages of the "VARI-POR-TIONAL" system are obtained through its continuous monitoring of output power requirements for optimum efficiency. This results in direct and measurable energy savings by reducing the amount of energy dissipated as heat loss, yet with controlled full power always available,

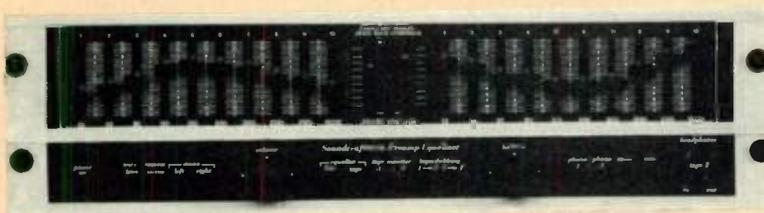
standing by, and supplied as needed. This higher powered amp can be sold at a price even lower than ordinary Class AB amplifiers through cost savings made possible by the Patent Pending "VARI-POR-TIONAL" circuitry. For example, no fan is needed even under most severe operating conditions.

An added advantage is a substantial savings in power consumption. Class AB amplifiers of the same power rating, operating at 1/3 power in accordance with FTC test requirements, will consume over 40% more energy than the Soundcraftsmen "NEW CLASS" amplifier. Thus, the "NEW CLASS" amp provides savings in heat dissipation of approximately 200 watts. Progressively greater percentages of savings may be obtained at lower power levels.

Other outstanding PERFORMANCE FEATURES of the Soundcraftsmen "NEW CLASS" amplifier are its uniquely designed exclusive all solid-state CROWBAR fail-safe overload protection circuitry with automatic reset, (no circuit breakers or fuses), for 100% protection in the event of shorted speaker leads, etc. Totally NON-LIMITING output circuitry eliminates any possibility of limiter-caused distortion due to excessive current demands.

SPECIFICATIONS: 250 watts per channel RMS 20Hz-20KHz both channels driven into 8 ohms, less than 0.1% THD. Noise—105dB, Damping factor 100, Slew rate 25, Frequency response 0.25dB 20Hz-20KHz. Size 7 in. x 19 in. x 15 in. deep. Side panels included. Suggested price \$699.00.

CIRCLE READER CARD FOR COMPLETE ENGINEERING AND TECHNICAL REPORT



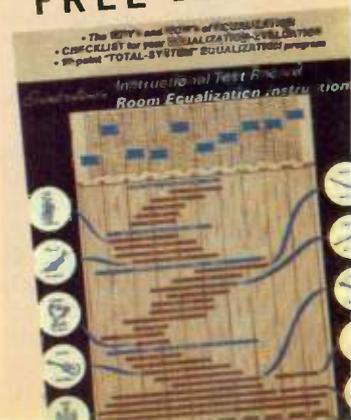
THE PERFECT MATCHING PREAMP-EQUALIZER

Now the PE2217 rated "State-of-the-Art" and "Best-Buy" in magazine Test Reports is available as the PE2217-R in rack silver-black form as a matching mate for our new amplifier. With the control flexibility of pushbutton-patching for tape monitoring and tape dubbing between two or three machines together with tape and program discrete-octave equalization, the PE2217-R is still the **MOST POWERFUL** and **FLEXIBLE** Preamp available at **\$549.00**.
1721 Newport Circle, Santa Ana, California, 92705/Telephone (714) 556-6191

PE2217-R SPECIFICATIONS

FREQ. RESPONSE—Hi-level $\pm 1/2$ db, 5 Hz to 100 KHz
FREQ. RESPONSE—Phono $\pm 1/2$ db, 20 Hz to 20 KHz
THD: less than 0.5% at 1 volt (Typ. 0.1% at 1 volt)
IM: less than 0.5% at 1 volt (Typ. 0.1% at 1 volt)
PHONO INPUT CAPABILITY: 105mv
SIGNAL-TO-NOISE—Hi-level 100 db below full output
SIGNAL-TO-NOISE—Phono 84 db below a 10mv input
SIGNAL-TO-NOISE—Equalizer 106 db @ full output
GAIN—Phono 63 db 96 db @ 2v RMS
GAIN—Hi-level 21 db 90 db @ 1v RMS
OUTPUT IMPEDANCE: 600 ohms
EQUALIZER LEVEL: Zero-gain controls for left and right continuously variable, for unity gain compensation
INDIVIDUAL OCTAVE-CONTROL RANGE: Minimum ± 12 dB (Typ. ± 14 dB), each octave centered at 30, 60, 120, 240, 480, 960, 1920, 3840, 7680, and 15,360 Hz
MAX. OUTPUT SIGNAL: Variable master volume control allows adjustment of optimum output to match amplifier
GOLD SWITCHES: All contacts are gold plated for low-noise, long life, and resistance to oxidation and corrosion
CIRCUIT BOARDS: Military grade G-10 glass epoxy
RESISTORS: Low-noise selected carbon-film
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FREE BROCHURE



Audio etc.

Edward Tatnall Canby

With all these anniversaries sailing past, the 200th, the 100th, our own 30th and 60th, I'm feeling retrospective—which means, with me, looking forward in the light of the past. Perspective! I have a sense that this is a good time for all of us to do just that. We are in a sort of interim in spite of all the excitement generated by new developments, early-digital and otherwise. We need some new names, I think.

I am not referring to sales efforts. Nor to new models. The biggest sales tend to be rung up, like on Wall Street, when there is an era of profit taking. It is the fully matured and developed product that sells, not the Latest Revolution—though we're always talking about revolution. A few revolutions catch on quick but most don't. More often, the latest sensation, if it has any solid worth, soon finds itself falling flat on its face, snarled into every imaginable kind of unforeseen trouble and hassle, and doesn't pull itself out and into the clear for an agonizingly long time. You know what I mean! Like with stereo. Not stereo now. Back when stereo was the revolution. Or the LP disc, which had its problems and before it was a year old ran smack into the 45 and the all-too-familiar wars of the rival systems.

But now conventional stereo is the fully matured product, as well as the LP disc. A matchless pair! Next year, the stereo disc has its 20th anniversary and the LP its 30th. Wow! Old geezers like us can scarcely believe it.

Silly Revolutions Succeed

Only the silly revolutions succeed right away. Instant miracles. Frisbies, hula hoops, bubble gum, the Great T-Shirt Explosion. And, of course, George.

Now don't run down George. In terms of purpose and utility, George has to be the most frivolous (and expensive) gadget in recent memory,



but George is indeed a miracle, the very embodiment in a van-like shape of current technological know-how. And George works by audio. Totally minus complications like, say, decoders, demodulators, Shibata styli and four speakers in the living room. George just *is*, and *does*. What more do you want for sales?

What we need in the hi fi biz is James, which I'm inventing. James is the pint-sized electronic robot who turns on your hi fi when you smile. And turns it off the instant you frown. So your system becomes subliminal

and is subconsciously automated. You need merely *think*, positively, and it goes on. Howzat? James isn't quite yet perfected but I'm working on the digital circuitry and the smile/frown chip. Any day now and I expect to make millions.

Meanwhile, that slightly larger Sensation with the name that begins with a Q has done it. Predictably fallen flat

on its face. What else? As I say, it never fails. As usual, this once-Latest Revolution turned out to be a bit more complex and profound than previously thought, and took a wee bit longer to fall on its fizz than most. That's where it is now, and the ardent people who once promoted it are pretending it isn't there any more, nor ever was. OK—par for the course! So now in all the stores there are stereo records and stereo records, the former two-channel, old tried-and-true, the latter, shall I say, discreetly four. Look for the fine print on the back side.

All in all, this isn't a bad idea. I am not about to deplore the present situation, as you may have thought. Indeed, I think that in a way this is a healthy reaction after eight-odd years of overpromotion, ill-digested technology and the sort of war between systems that merely bores most of us, to the tune of million \$ wasted. I am—as one of the proponents of the new idea right from the beginning—not backing down, just re-evaluating as we all must. Because from here on out we must take a new tack altogether and maybe our very first

WE'RE ALL EARS



WE WANT TO HEAR FROM YOU

You will notice that several pages in AUDIO each month are heavy duty stock.

And, as you can see, there are cards here that help us serve you better.

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There is even a card for placing classified advertising.

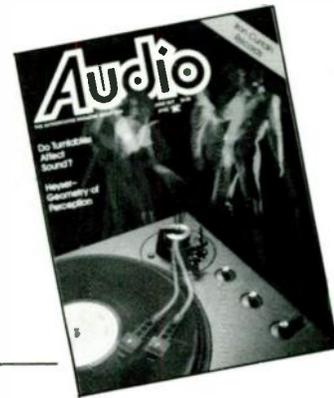
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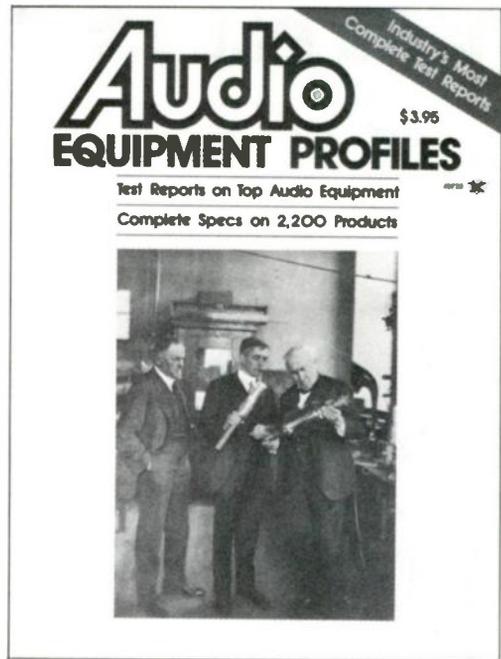
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The Dolby System in FM Broadcasting – April 1977



In June 1973 Dolby Laboratories proposed an improvement in FM broadcasting which would overcome high-frequency overmodulation problems and at the same time reduce receiver noise. The technique combines a reduction in the pre-emphasis time constant to 25 microseconds and the use of the Dolby B-Type noise reduction system. In May 1974 the new method was approved by the Federal Communications Commission for optional use in the U.S.A. A number of other countries either have approved the system or are considering it.

Transmitters

Since 1974, 160 FM stations in the U.S.A., in addition to 25 in other countries, have purchased the Dolby Model 334 FM broadcast encoder unit.



Receivers

Concurrently, Dolby consumer product licensees have been preparing tuner and receiver models incorporating Dolby FM decoder circuits. At the present time there are 51 different models of such receivers from 22 manufacturers. About 300,000 units are in use, increasing by some 30,000 units per month.

Listening Advantages Gained

1. High-level high-frequency signal recoverability.
2. Noise reduction.

The Dolby FM process works at both extremes of the dynamic range. The maximum permissible level of high frequency signals is

increased, while low level noise is reduced. The 10 dB action of the Dolby B system is split in an optimum way between these two equally important areas of operation. The net result is an FM system which can pass signals from transmitter input to receiver output with high integrity.

Information Available

To find out more about this new development, please write to us for further details.

A NOTE ON DOLBY LABORATORIES

Founded in 1965, Dolby Laboratories specializes in complementary noise reduction methods and systems. In London the company manufactures equipment for professional use by recording studios, broadcasters, and the motion picture industry. In the consumer field, Dolby Laboratories functions purely as an R & D and licensing organization, based in San Francisco, California. Licensing is handled by a subsidiary, Dolby Laboratories Licensing Corporation, which has world-wide non-exclusive agreements with about 60 manufacturers for the incorporation of the Dolby B-Type noise reduction system into consumer audio products. A uniform royalty rate is applied on a sliding scale based on circuit quantities; the average royalty paid is about \$0.21 per circuit (two circuits for stereo). All Dolby circuits are manufactured to meet standardized performance requirements for universal interchangeability of hardware and software; 20 million such circuits have been made since 1968. Software products (duplicated tapes and FM broadcasts) are produced on a royalty-free basis.



Dolby Laboratories

'Dolby' and the double-D symbol are trademarks of Dolby Laboratories

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move should be to get rid of that word itself, which begins with a Q and goes on to an i, an a or an o, depending. (Look—we couldn't even agree how to spell it, let alone sell it!)

That word was just as misleading, I think, as the word we once used for stereo, back at its beginning—binaural. In case you are too young, you should know that two-channel recording, tried before WWII, first broke into our audio news around 1950 but not as stereo. We called

it binaural, even though intended for loudspeakers, and the term stuck for a number of years until the more accurate "stereo" took over, just in time for commercialization. In those days I used to refer to "loudspeaker binaural," to make it clear that I wasn't talking about headphones. But it was such a clumsy term that, as I now note, I often left the matter in doubt and can't even tell at this late date whether I meant loudspeakers or phones, just referring to

binaural. Stereo was much better.

So, I say, we might as well call Q----- what it really is, which is indeed a form of loudspeaker stereo. Stereo—old Greek, meaning solid, or with shape. An excellent description of the sound we hear out of multiple speakers and more than one channel of information. And the useful minimal number of channels, plural, is of course two. Q----- is stereo out of four sources, set variably around the listener rather than up-front, and from four channels of info. The basic idea remains not only a valuable modification of the original stereo but—in spite of present problems—an increasingly practical concept as multiple circuits become progressively easier and tinier. The important modification, then, is that the number four, as indicated by that obsolete letter Q, is arbitrary. We will have even more varieties of stereo, before we are finished, and in numerous channels too, as Dyna (3), Audio Pulse (6), AR (16) and Entity I (40) continue to remind us.

The Limiting Letter

Indeed, the letter Q is much too limited itself. The most we can squeeze out of it is Quintaphonic, which doesn't even satisfy existing commercializations. So please, down with Q, as well as Q-----, and let's start talking. We need new names, more accurate names, to clear the air before we go much further. Until we find them, the name of the present game is emphatically STEREO. In two, four, or more channels.

Speaking of that, I must remind again that the basic idea of our standard stereo is not the limitation to two channels but a much more important aspect, stereo *up front*. It could be out of twenty channels and still be up front. This was the original concept and you have heard of the U.S. debut of this type of sound with the aid of Leopold Stokowski back in the Thirties, when music by a "live" orchestra was transmitted directly from one hall to another via microphones and loudspeakers. Two channels? If I remember, not having the data before me, there are many more than two. But all of them were reproduced up front.

And yes, you have anticipated me: next (in the U.S.) came the movie "Fantasia," again with Leopold S., and this time we had—what? No, not Q----- but the more important concept behind Q-----, which is multiple sound sources (x in number) *distribu-*

The beginning of the end



The Crown IC-150A/D-150A stereo combination pre-amp/amp is a good place to begin building your ultimate system. This Crown approach to the design of an "integrated" amp offers some unusual advantages.

Power now 80 watts per channel minimum RMS into 8 ohms, 1 Hz-20 KHz, total harmonic distortion of 0.05%.

More power later The D-150A amp converts instantly to mono. Delivers 250 RMS watts into 8 ohms in mono. Two D-150A's could be the way to big power without big instant money.

Reliability Drives almost any speaker. Can't be hurt by hookup problems. Three-year full warranty includes round-trip shipping.

Total control Eight inputs, switch selectable. Front panel jack. "Panorama" control.

Future expansion Add other D-150A's or IC-150A's for more power, for quad, for bi-amp.

Start your ultimate system with a good foundation: the Crown IC-150A/D-150A combination. You may never outgrow its specs.

Write. We'll send brochure, specs and test reports. Check it out at your nearest Crown Dealer.



crown

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Our new AD cassette takes the normal bias position to extremes.

We made a name for ourselves by creating the world's first non-chrome, "high" (CrO₂) bias/EQ cassette tape, TDK Super Avilyn (SA). The state-of-the-art tape that has quickly become the standard of reference for cassette tape performance.

Our latest innovation is called AD (ay-dee), and we predict it will soon become the standard of performance and economy in the "normal" bias/EQ position.

We produced the first high fidelity ferric oxide cassette tape some ten years ago, and we've been perfecting the formulation ever since. Our new AD delivers superior performance, especially at the critical high-frequency range (7kHz to 20kHz), where many mid-priced cassette decks and even premium-priced cassettes tend to fall off too quickly.

AD is our ultimate ferric oxide tape designed for the "normal" bias/EQ position. Overall, it provides the lowest noise, highest frequency response and widest dynamic range of any pure ferric oxide cassette tape. In 45, 60, 90 and 120 minute lengths, AD has the same super-precision cassette mechanism found in TDK SA, in a new blue-gray shell.

And AD brings its audible benefits to all cassette decks, with and without switchable bias/EQ, including those found in cars, portables and home stereo systems. So the music you love can travel with you, with all of the clear, crisp, brilliant sounds that make music so enjoyable.

AD is the finest pure ferric oxide cassette tape you can buy at any price. And it has TDK's full life time warranty. Give our new high-fidelity, moderately-priced AD a try—it's anything but normal.

TDK Electronics Corp., 755 Eastgate Boulevard, Garden City, New York 11530.
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 **TDK**
The machine for your machine.

Enter No. 41 on Reader Service Card

Defog your ears

with a Decca



14

Cartridge makers are talking about how their shorter cantilevers reduce tip mass for better transient response. But just shortening the cantilever won't help much if it still pivots in the standard seesaw manner. Pivoting cantilevers cannot help but *add* their own friction and unwanted back-and-forth movement, to the vibrations of the stylus. These "cantilever haze" factors result in substantial loss of definition and transients available from all good recordings.

Decca MKVI cartridges use Decca's "Positive Scanning" system, meaning *no* cantilever in the conventional sense. The stylus is mounted on an incredibly light but strong "super-cooled" armature. Its vibrations are scanned by stationary pickup coils *directly above* the stylus, rather than at the far end of a pivoting cantilever. "Cantilever haze" is eliminated for unmatched realism and transient response. The difference from other cartridges is audible enough to make the discerning audiophile feel he is *really* listening to his records for the first time.

Decca MKVI's also feature extra quality control to ensure excellent uniform tracking, separation and channel balance as well as flat frequency response on every unit shipped. Two models to choose between: the Gold Elliptical (tracks at 1.5 grams) at \$149.50*, and the Plum Spherical (tracks at 2 grams) at \$129.50*. Gold or Plum, you'll defog your ears with a Decca.

*Suggested List Price

Sole North American Distributor:

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Canada H4X 1M8
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ted around the listening space. Will I ever forget, in the original production, the big choral number, Schubert's *Ave Maria* blown up to enormous size, spread out in enormous stereo, which then proceeded to flop back and forth, oscillating between the front and the back of the theatre! In those days it was an impressive sonic fantasy. I suspect that in recent re-playings, even with speakers in the rear, it has been modified. Nowadays that sort of thing sounds a bit corny. Anyhow—you see that we had both of the fundamental types of stereo, the up-front kind and the surround or semi-surround kind, 'way back in the pre-war years. And you also see that the limitation to two channels or *four* channels did not exist; it was the *placement* of the available channels that counted.

It is still the same today, and will be as we expand into our destined future in living-room sound.

I must add one minor story, as of a week or so ago. That wealthy lady in my neighborhood who owns an estate in Antigua and another in France, plus a considerable hunk of my Connecticut home town, came up to my place one recent afternoon in her old clothes to give me a book she had found, my mother's writing as of 1932, and stayed on to talk once more about the vast stereo system her husband had installed in Antigua back around 1959—he's dead (leaving his millions) and she wants out. The trouble is, she says, every time she leaves Antigua those big speakers, all three of them, have to be hauled by truck into a special dry room, to avoid rot and mildew. She wanted my recommendation for three little speakers, to replace them.

Get my point? *Three* speakers, for stereo in 1959. Of course! In that year, with stereo discs just beginning, the whole idea of stereo was untrustworthy, not yet settled down, and people generally didn't like what they called "the hole in the middle," which was clearly—as we now see it—due to faulty procedures in recording, in phasing, even in listening to a new and unfamiliar medium. So you bought yourself a third and essentially mono speaker as a kind of insurance, to blend the sides into the middle and so fill up the hole. This lady, now in 1977, still wants three speakers, to replace the original trio. She hadn't heard about four.

I never fell for the center channel idea myself, though for a time it was even built into many amplifiers (and

maybe still is), with a third set of output terminals to accommodate the extra speaker. I tried it, and quickly found that all I was doing was in fact diluting the very stereo I was trying to create with all that equipment. If there was an absence of sound in the middle, the answer was elsewhere and, most of all, it was in phasing—which at that time could be reversed in the darndest places. Not only your own pair of speakers (or between woofer and tweeter) but anywhere in dozens of points within the electronic equipment (they hadn't yet gotten used to the idea of phase continuity as between channels, now taken for granted) and even, occasionally in some records. I still have a few marked in grease pencil *OUT OF PHASE!*

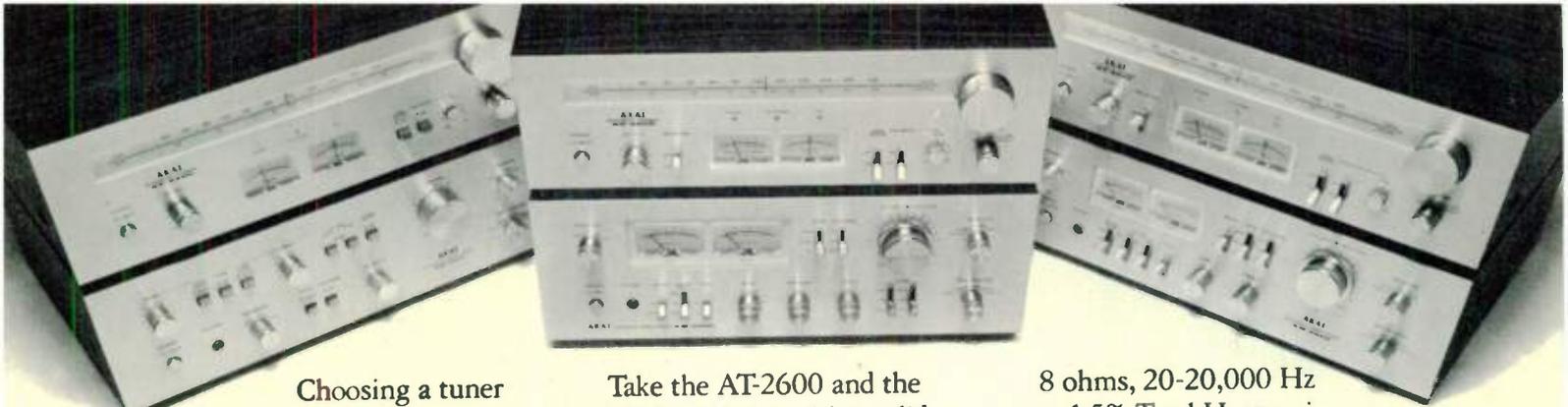
Also, to be sure, in terms of ping pong, which exaggerated channel separation in various crude ways, for greater sales impact. I can tell you, no center speaker ever cured a case of ping pong. All it could do was to make the pingpong table a bit narrower. Which you could do just as well by sliding your two speakers closer together.

Hard Experience

I will allow the abundant analogies between all this and our recent experiences with Q----- to fall where they may. So clear! The same has happened all over again but worse, since the surround type of sound was a very much unexplored concept in terms of the living room and few recording people or audio engineers really had much of a positive idea as to what would work out for useful *listening*. We blundered, and argued, and we still blunder. It's a long road into pioneer territory, and in no way comfortable for such as record and hi fi dealers, we might add. But we have learned. As we did for up-front stereo. The new stereos to come, whatever their names, will be the better for it. And even the old stereo records, two-way or four-way, will sound better and better as we improve our knowledge of multiple-channel reproduction.

As I've said before, and even if Q----- as such remains on its flat face for some time to come, we have not dropped the idea of more-than-up-front, nor the idea of more-than-two. Whether the shape of the sound is triangular, quadraphonic or multi-polygonous, there will be a lot more of it coming up for the next batch of anniversaries. **A**

AUDIO • July 1977



Choosing a tuner and an integrated amplifier is a lot like choosing a mate. You look for things like compatibility, performance, appearance and, of course, fidelity.

AKAI just made the process of matching component separates foolproof with a new line of tuners and integrated amplifiers. Paired on the grounds of total compatibility. And priced to be affordable.

Take the AT-2600 and the big AM-2800 amp, with a solid 80 watts, RMS per channel, 8 ohms, 20-20,000 Hz at .08% Total Harmonic Distortion.

Or the AM-2600 amp at 60 watts, RMS per channel, 8 ohms, 20-20,000 Hz at .1% Total Harmonic Distortion. And match it with the AT-2600 tuner.

Or maybe the AM-2400 amp at 40 watts, RMS per channel,

8 ohms, 20-20,000 Hz at 1.5% Total Harmonic Distortion. And the AT-2400 tuner.

No matter which of the perfect AKAI couples you choose, you get specs and features not found on all-in-one receivers in the same price category. Improvements you can hear. With clean, clear power per channel.

To hear the new separates, see your AKAI dealer. And live in perfect harmony.



For a 18" x 24" poster of this Charles Bragg etching, send \$2 to AKAI, Dept. A, 2139 E. Del Amo Blvd., P.O. Box 6010, Compton, CA 90224, ATTN: Couples.

AKAI INTRODUCES THE PERFECT COUPLES.



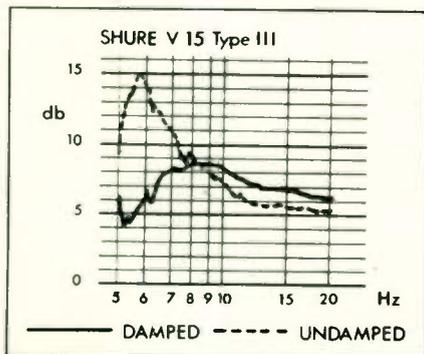


3009+FD200

The FD200 is a new accessory from SME: a fluid damping device which can be fitted, easily and quickly, to any Series II or Series II Improved arm. The benefits of fluid damping have long been known: resistance to external shock, audibly improved bass, and reduction of spurious low frequencies; but these are not fully realised when the damping is applied at the bearings. For this reason the FD200 is designed to be fitted at a point along the length of the arm.

The FD200 design overcomes the usual problems of leakage and low efficiency. It offers a choice of two damping rates, to suit a wide range of cartridge compliances. The attractively presented kit includes viscous fluid and full instructions.

16



The illustration shows the extreme low frequency response characteristics of a typical high-quality cartridge in the Series II Improved arm.

Note the substantial reduction in the Q of the low frequency resonance. Although these frequencies are themselves outside the range of human hearing they give rise to undesirable side-effects which are audible.

Write to Dept 1443A, SME Limited
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Audioclinic

Joseph Giovanelli

FM Antennas

Q. This is a request for your help in setting up the best antenna system for my location. Most of the stations I would like to receive are from Montreal, Canada, 120 miles up the Champlain Valley. Should I use a stacked or an unstacked antenna, how many in the stack? Tower, rooftop, or mast; how high? How about getting the last microvolt of signal down to the ground; are there commercial amplifiers as well as super cables and connections to do the job?—Ronald McKinnon, Middlebury, Vt.

A. It is often quite possible to obtain satisfactory FM reception from stations which are more than 200 miles from the receiving site, but if the terrain is not favorable, no antenna system, no matter how great its gain, will ever help. If the antenna cannot be erected high enough to clear obstructions you stand little chance of obtaining reliable reception. You may, at times, hear these signals, but this will be a matter of weather conditions rather than solid groundwave reception.

Where obstructions are not present, you should experience no problem, especially with today's tuners which are far better than the best commercial units available 10 years ago.

The FM band covers a wide portion of the r.f. spectrum and in order for the antenna to encompass such a range, its Q must be rather low which results in a decrease in available gain. However, if you are not concerned with tuning in the entire FM band, but want only to hear some specific station or cluster of stations within a certain section of the dial, an antenna could be cut to resonate at this area of the dial. The response over the rest of the band would not be optimum, but you would have gain where you need it.

By stacking antennas, gain can be increased, regardless of the Q of the antenna systems used. Adding a second antenna will add 3 dB gain. Adding two or more antennas will add another 3 dB gain, for a total gain of 6 dB.

While it is possible to buy ready-made or custom cut commercial antennas, it is also possible to make your own if you know the formulas involved. This may be obtained from "The Antenna Handbook" by Krauss, a classic in the field. Also, "The VHF Handbook" by the American Radio Relay League in Newington, Conn. is another good source of information.

No matter what kind of antenna you use, the higher you erect it the better your reception will be. However, any antenna mounted in the open, high above surrounding objects, must be protected against lightning. A competent person must do this work. Also such an antenna must be protected against the force of high winds. The more complex the antenna system, the greater will be the effect of the wind upon it.

If the run of cable between the receiver and antenna is great you will best be served by what is known as an "open wire feeder" which resembles a chain ladder—two parallel conductors are separated by insulators spaced about 18 inches apart, running at right angles to the conductors. The distance between the conductors determines the impedance of the feed line.

Where the need exists for use of coaxial cable, there may be a need for using antenna booster amplifiers, which are located right at the antenna and make up for cable losses. However no significant improvement in the signal-to-noise ratio can be expected from the use of such amplifiers, even though there is more signal. If there are strong local signals in your area, the amplifier will boost them also and their added strength can possibly overload your tuner. However, this condition can also occur by virtue of having a better antenna system than previously. In this event, band-pass or band-reject filters may have to be used to reject the effects of these strong signals. A

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

AUDIO • July 1977

There Are Bigger, Chromier, Knobbier, More Expensive Cassette Machines Than The Advent 201A. But...



If you are going to buy a high-performance cassette deck, you ought to know that no cassette machine will make more satisfying recordings (and keep on making them for year after year) than the Advent 201A.

The Advent 201A is a new version of the machine that made cassettes the high-fidelity medium they are today.

It is a uniquely simple, precise, and durable piece of recording machinery that will make cassette tapes that sound essentially identical to the best material you will find to put on them—with an ease (and repeatability) that is approached by very few cassette decks at any price and surpassed by none.

The 201A is designed to be *used*, not worshipped. Its unique single VU meter (which continuously scans both stereo channels and reads out the louder at any given moment) and its precise recording controls make it the same kind of day-after-day joy to operate as a fine camera.

If you will send us the coupon, we will be

happy to send full information on the Advent 201A (including a description of the new features, such as the Sendust tape head, that distinguish it from the original 201).

In the meantime, we suggest that before you buy *any* tape machine, cassette or open reel, you give the 201A the performance test it deserves. And check with anyone who owns an Advent on the kind of satisfaction it gives year after year.

Thank you.

TO: Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

Please send information on the Advent 201A, including a list of your dealers.

Name _____

Address _____

City _____

State _____ Zip _____

Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

Behind the scenes

Bert Whyte

A little over 10 years ago, Philips introduced their compact cassette system, which stripped to essentials, was a tape recording system utilizing tape slightly over 1/7th inch in width, which operated at a speed of 1-7/8 ips, and was enclosed in a plastic shell which could be easily inserted and withdrawn from the record/playback mechanism, thus eliminating tape threading. The cassette was intended to be an inexpensive, convenient, portable speech recorder, suitable for dictation purposes. Within the Philips company, I'm sure that even the most wildly optimistic advocate of the cassette system never envisioned it becoming a high-fidelity stereo recording medium; in terms of prerecorded cassettes and in the opinion of many people the cassette is now a viable alternative to the phonograph disc. The advent of high-energy oxide formulations, new types of high-efficiency magnetic heads, Dolby-B noise reduction, advanced solid-state record/playback circuitry ... all have contributed to the establishment of the cassette as a truly high quality means of magnetic tape recording.

The high quality, versatility, and relatively modest cost of the cassette resulted in a veritable sales explosion, with literally hundreds of models of cassette recorders on the market. While the cassette drove "low-end" open-reel magnetic tape recorders off the market, open-reel aficionados with the wherewithal supported the

"high-end" recorder market and pointed out the technical shortcomings of the compact cassette. They said that cassette tape was lacking in headroom ... it couldn't handle a wide enough dynamic range ... the tape went into saturation too fast and caused distortion ... tape motion wasn't stable, because guidance was a function of the shell, and the shells were inconsistent in construction. While acknowledging all this, there were many tape enthusiasts who idly speculated on what a good thing it would be if someone could combine the best features of both systems.

Japanese Ingenuity

The ever-industrious, ever-ingenious Japanese evidently had just this sort of thing in mind when they announced the Elcaset tape recording system early last year. In essence, the Elcaset is a scaled-up version of the compact cassette, some 2 1/2 times larger in size, and it uses standard quarter-inch magnetic tape, operating at 3 3/4 ips ... double the speed of the cassette. Besides these obvious points, the Elcaset is considerably more sophisticated than the regular cassette. For instance, in the Elcaset the tape is pulled out of the plastic shell and onto the tape heads, eliminating the guidance problems inherent in the cassette system. The Elcaset shell was designed from the first to accept three heads, so true "off-the-tape" monitoring is possible. Sensing notches are moulded into the Elcaset to automatically program the recorder for such things as Dolby-B noise reduction and proper bias and equalization for the three specially formulated tapes designated Type One ... a low noise/high output gamma ferric oxide, Type Two ... a ferrichrome tape, and Type 3 ... chromium dioxide tape. While the Elcaset

comes in C-60 and C-90 lengths and is stereo/mono compatible, a third "pilot" track between the stereo tracks can be used for such things as slide show synchronization and pre-set program selection. With the quarter-inch wide tape, 3 3/4 ips speed, and special tapes, the Elcaset is capable of a much wider dynamic range, wider frequency response, less distortion, and a better signal-to-noise ratio than the cassette.

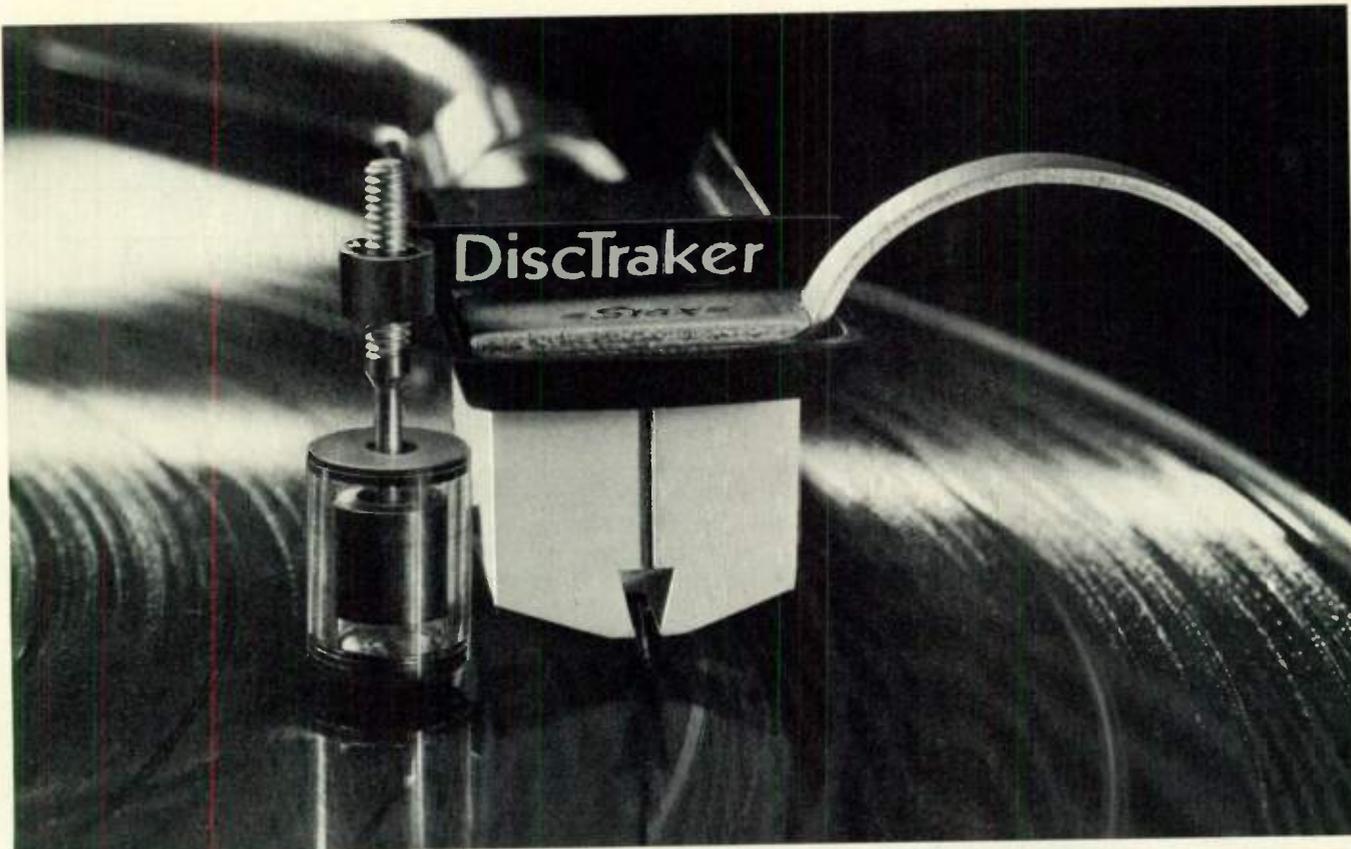
The Elcaset was a joint development of Sony, Matsushita, and Teac, and they were soon joined by JVC and Akai. There were some previews of the system for the audio press corps, who learned there were models of the Elcaset to be shown at the 1976 summer CES. As it turned out, to a limited extent, this did indeed happen. I was "button-holed" by the public relations minions of one company, who gave me very positive promises that an Elcaset unit would be sent to me in short order for my evaluation. Well, tempus fugited, I fidgited, and no Elcaset appeared. During this period, it seemed that some internecine unpleasanties were going on within the Elcaset consortium.

One of the things the group had to contend with was a certain amount of apathy and indifference to the Elcaset concept on the part of some audio dealers and some of the press. There were the usual expressions of "who needs it?"—common to many new developments in audio. These nay-sayers are entitled to their opinions, but to voice such ideas before they ever got to see or hear an Elcaset is patently unfair. If the ideas of these people prevailed, we would still be sharpening cactus needles and playing our music through "morning glory" horns!

Licensing Lethargy

Eventually, the reason for the reduced activity and nonappearance of Elcaset models from the various companies became apparent. It appears that Sony, probably the prime-mover in the Elcaset project and sole manufacturer of the special Elcaset tapes, wanted other tape companies like TDK and 3M, to pay a fee for a license





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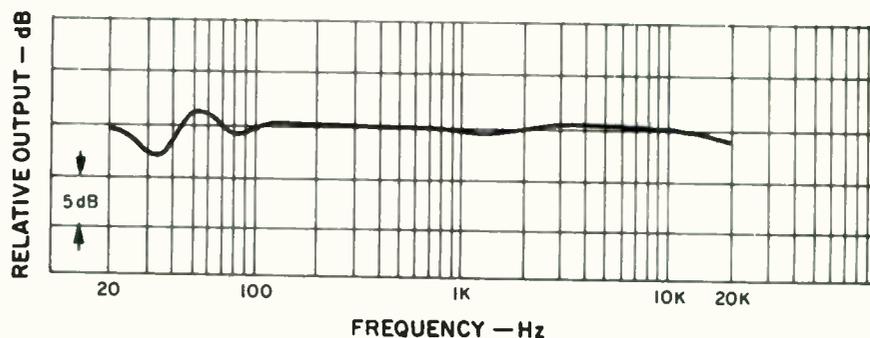
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to manufacture these tapes. They are, of course, perfectly within their rights in making such a request, and one cannot castigate them for so doing. However, might we gently suggest they take a leaf from Philips' book and offer their technology free of any license fees? There is little doubt that this Philips gesture was of inestimable value in the rapid proliferation and establishment of the cassette format. As of now, negotiations are still going on, and one hopes that the issue will soon be resolved. One hopes that there may be some movement in this direction from the announcement by Teac that their Elcaset deck will soon be available. Superscope has begun to market the Sony decks, and the Sony decks are on the market in England, and have, in fact, been glowingly reviewed in the prestigious *Hi-Fi News and Record Review*. Technics demonstrated their Model RS-7500US Elcaset deck at the New York AES convention and at the recent Washington and Philadelphia Hi-Fi Shows. In December of last year, I was with a group of audio writers at the Technics plant



back heads, permitting off-the-tape monitoring. The tape drive is via a frequency generator servo-controlled d.c. motor, with a connecting belt driving the take-up reel. Wow and flutter is claimed to be 0.06 per cent rms, and while I did not test it with a flutter bridge, sustained piano chords (piano is a fixed-pitch instrument) sounded quite clean and stable. Tape motion and record/play functions are controlled by the usual mechanical "finger" leverage system. The unit has two good-sized VU meters (peak in-

important? I personally feel the answer is self-evident . . . both machines should have the combination of three heads and Dolby B noise reduction. Both Sony and Technics do have higher priced Elcaset units with both facilities. Frequency response of the Technics RS-7500US is rated at 25-18,000 Hz ± 3 dB with Type One tape and 25-20,000 Hz with Type Two or Three tape.

Testing Tells . . .

I have a great new device for measuring overall record/playback response with three-head tape machines. This is the United Recording Equipment Industries (UREI) Model 2000 automatic X/Y response plotter. This sweeps from 20 to 20 kHz, and a pen recorder plots the curve on log audio paper. I will be bringing you a detailed report on this unit in an upcoming column . . . I am awaiting a new UREI module 2010, which can plot amplitude and frequency from test tapes and records, etc. so I can give a full report. Anyway, the curve I obtained speaks for itself!

I hooked up a Dolby 505 Type B noise reduction unit to the Technics Elcaset, and at 9-10 dB better than the claimed 63 dB S/N ratio, hiss was no problem. I played a 15-ips master with Dolby-A noise reduction through an Ampex 440C and recorded it on Type One Elcaset tape. On A/B comparison, it was almost impossible to consistently tell one from the other. The Elcaset handled the wide dynamics of Prokofiev's *Lt. Kije* suite with no strain, and the S/N was quite good. I played quite a few Elcasets I had recorded from master copies, and without exception, people who have heard them have been singularly impressed, not the least of which were some ladies, who loved the simplicity of the loading. It is early in the game, but on the basis of my experience and the fine reviews from England, the Elcaset deserves a hearing (no pun intended). **A**

20



in Osaka, where we got a thorough rundown on this Technics Elcaset unit. Now I finally have a RS-7500US Elcaset unit and a supply of Type One and Type Two blank Elcasets. It seems that the chromium dioxide Type Three Elcasets are not yet available.

The RS-7500US Elcaset recorder is a very rugged-looking unit, in the "rack mount with large handles" configuration and the currently popular "black look." It is a front-loading unit, and there is an ingenious mechanism which automatically pulls the tape out of the Elcaset when the shell is inserted and locked in place. There is a double-gap ferrite erase head and separate permalloy record and play-

dication with an LED would be helpful), tape-monitor switch, memory rewind, and separate pots for mike/line mixing. As noted previously, bias and equalization are automatically set by the sensing notches on the Elcaset shell, and front panel lights indicate what type of tape is being used. A panel covering the three heads unscrews for easy cleaning. There is no Dolby-B noise reduction furnished in this \$599.00 Elcaset deck, and this brings up a marketing point . . . The Sony EL5 Elcaset deck is the same price as the Technics and has Dolby B noise reduction . . . but it only has two heads and does not permit off-the-tape monitoring! Which is the more

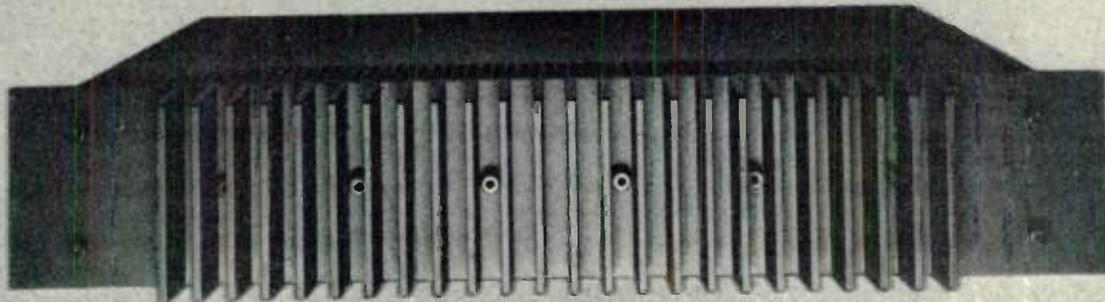
A New Dimension



Two new electronic products from Nakamichi may be just what you've been waiting for. The 410 Preamplifier and 420 Power Amplifier are incredibly compact, beautifully styled and decidedly affordable. Measuring less than 9" x 16" and barely 3 1/4" thick, both are timeless design expressions—pure Nakamichi in quality and performance.



The 410 approaches the theoretical limits of error-free amplification. A superb phono section, inherited from Nakamichi's amazing 610 Control Preamplifier, utilizes unique circuitry to minimize noise and distortion while maximizing dynamic range. Three phono input sensitivities accommodate a wide variety of cartridges. There is even a switchable active subsonic filter that keeps rumble and tonearm resonances from degrading sound quality. Additional features include fully defeatable tone control circuits, variable contour compensation, high-output headphone jack, and a 2 dB-stepped precision volume attenuator.



The 420 Power Amplifier is a neat, efficient unit for perfectionists with moderate power requirements. The unique output circuitry originally developed for the Nakamichi 620 virtually eliminates crossover and switching distortions without high idling current. The resulting low operating temperatures ensure long-term reliability. And, like the 620, the 420 employs a super-efficient toroidal power transformer, low negative feedback and foolproof protection circuitry—all of which add up to exemplary performance specifications and an effortless sound quality that belies its conservative power rating.

Let the 410 and 420 add new dimensions to your listening pleasure. See and hear them at a Nakamichi dealer soon. Your ears will thank you. For further information, write Nakamichi Research (U.S.A.), Inc., 220 Westbury Avenue, Carle Place, New York 11514.



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Phono S/N (HF-A): Better than 80 dB @ 1 mV
RIAA Deviation: Within 0.3 dB
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Distortion: Less than 0.003%
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420 Power Amplifier:

Power Output: 50 watts per channel (rms) @ 8 ohms
5-20,000 Hz, with less than 0.2% THD
S/N Ratio (HF-A): Better than 110 dB @ rated output
THD @ 1 kHz: Less than 0.0005% at any power level below clipping
Frequency Response: 5-50,000 Hz ± 0.1-1dB

TURNTABLES

Turntables and Noise

Joseph F. Grado*

22

In my first article I discussed the various types of noise one might encounter in a phono playback system, and particularly the fact that the pickup sees mechanical motion and converts it into an electrical signal. Unfortunately, the pickup cannot discriminate one mechanical motion from another, and therefore if an extraneous mechanical motion is added to the signal on the record, a distorted playback will result. The two general classifications of extraneous noise are those resulting from poor turntable design and those created by external sources, the latter problem being feedback. The first article ended by describing a mechanical-energy decoupler, consisting of a series of springs and a special dense board, designed to isolate the turntable from both mechanical and acoustical environmental energy. The description of this energy decoupler was simplified considerably for purposes of illustration. It was shown that a vertical spring action was effective for decoupling mechanical energy to the turntable, and this is true to a degree. However, the problem of completely decoupling the turntable from environmental energy is considerably more complex. Environmental energy does not reach the turntable in only the vertical direction. It arrives at the turntable from several major directions and an almost infinite number of integrated directions. A damping unit must therefore be capable of isolating the turntable environmental energy arriving from all directions. The mechanical energy caused by

poor turntable design is yet another story. It cannot be controlled by the user, yet it is important that he be aware of it when making his initial purchase.

As we discussed earlier, a turntable's design may be classified into several basic sections: 1, the drive system (motor); 2, the transmission system (motor-to-turntable coupling); 3, the platter and/or flywheel system, and 4, the main chassis.

The drive system in early turntables generally consisted of a motor shock mounted to the main chassis by means of rubber supports, a turntable platter, and a rubber idler. When the turntable was switched off, the rubber idler wheel was automatically disengaged from contact with the motor shaft and the turntable platter. When the turntable was switched on, the rubber idler wheel would swing into its operating position and the mechanical operation was as follows—the rotating motor shaft contacted the rubber idler wheel, which in turn rotated against the inner rim of the turntable platter which rotated.

There were two methods used to keep the rubber idler in contact with the motor shaft and platter. One method was to use a spring-loaded lever to hold the idler in position, and the other was to use the rotational direction of the motor shaft to actually jam the idler into its operating position. Needless to say, both approaches are inadequate for a state-of-the-art design. If we examine this basic design approach, it becomes immediately obvious that the high-stress contact between the motor shaft and the idler wheel forces the motor shaft to rotate eccentrically in its upper

bearing, with a counter rotating action in its lower bearing. This motor shaft and bearing action is intolerable since it creates high-stress mechanical vibrations easily within the audible range. The rubber idler wheel, being compressed against the inner rim of the turntable, forces the turntable platter shaft to rotate off center in its upper bearing contact and, at the same time, counter rotating in its lower bearing area. This creates a second mechanical vibration condition within the turntable system. The rubber idler wheel, being compressed between the motor shaft and the inner rim of the turntable platter, has now become distorted in shape and produces multi-directional rippling motions intermittently in and out of mechanical phase with the motions of the motor shaft and the turntable platter. This is a third mechanical vibration, and when you add these three mechanical vibrations together, you can see how monstrous the situation is beginning to get. But wait a minute, I'm not finished yet!

As was mentioned, the idler wheel's operating position is maintained by either a spring-tension device or by the rotational operating pressures of the motor shaft driving force and the resistive force of the inner rim of the turntable platter. If the spring-tension system is used, you may add spring oscillation to the list of problems. If you use the system of rotational contact, considerable force is applied to the rubber idler, thereby increasing the mechanical vibration level. This general system is still being used today. In all fairness, however, I must add that it has been refined to a reasonably acceptable performance level.

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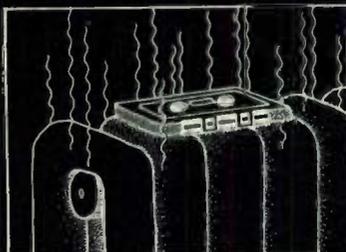
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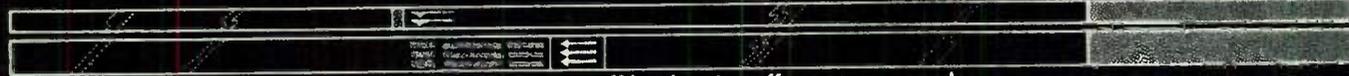
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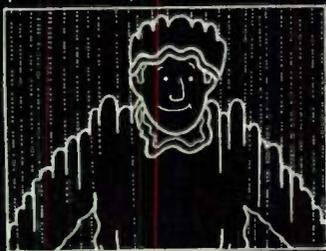


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Tonearm Vibration

Now that we've seen where mechanical vibrations occur within the turntable itself, let us also examine their influence upon the tonearm. The direction of the above mechanical vibrations follow to reach the tonearm and upset its function are as follows. The mechanical vibrations from the turntable platter and shaft are transmitted to the record, added to the recorded signal and picked up directly by the phono stylus. The other mechanical vibrations are transmitted from the drive mechanism to the turntable chassis, then to the rear tonearm support, continuing up into the tonearm tube itself, and finally into the phono pickup. It can be easily seen that this second vibration reaches the phono pickup much later than the first, creating phase, delay, and decay problems in the recorded signal. (Please keep in mind that I am only glossing over highlights of turntable problems. To do a complete analysis of turntable design would be a very complex affair and could not be completed even in several articles like this.) The two remaining turntable designs are the belt drive and the center motor or direct drive. Since the belt drive is next in the evolutionary cycle, I will discuss it first.

A belt-drive turntable is just that, a turntable driven by the motor via a flexible belt. The belt is simply used in place of the rubber idler wheel. Figures 5, 6, and 7, show three variations of the belt-drive system. In Fig. 5, you see the basic belt drive, a motor with its shaft positioned outside the turntable perimeter and a flexible belt stretched around the outer diameters of the motor shaft and the turntable platter. Figure 6 shows the double-motor drive system in which a motor is positioned on each side of the turntable platter with a single belt stretched around the two motors and the turntable. In the first belt-drive system the belt tension is between the motor shaft and the platter. This belt tension causes both the motor shaft and the turntable shaft to be pulled toward each other, resulting in an erratic shaft and bearing action identical to that which I described in the idler wheel system. In the double-motor belt-drive system, the belt pressures on the platter are equalized, however, we now have two motor shafts being pulled together by belt tensions. This of course results in an erratic motion between the motor shafts and their respective bearings.

The third example of the belt-drive

system has two belts and an intermediate idler wheel pulley. The motor shaft drives the pulley by means of the first belt, and the pulley drives the turntable by means of the second belt. The theory of the belt drive is that it will drive the turntable and at the same time absorb mechanical vibrations from the motor. The big drawback here is that the filtering of the belt is accomplished through its flexibility, and this very same flexibility creates its performance limitations. When the belt system was first introduced, a belt that was highly flexible, had a minimum of longitudinal stretch, and had long term elastomeric stability simply did not exist. At the present time, the technology of flexible belt design and manufacture has become highly sophisticated, and the net result is that a good belt drive system may easily compete with the best direct-drive systems.

Direct Drive Systems

The last system to be discussed is the center motor or direct drive. In the direct-drive system, both the belt and the rubber idler wheel are eliminated, and the turntable platter is mounted directly onto the motor shaft. One could assume that this would be the ideal system, but, alas, it too has problems. Since we have now mounted the platter directly to the motor shaft, we no longer have either the belt or the idler wheel to filter motor vibrations. In the center-drive system, every mechanical inaccuracy and vibration of the motor is directly transmitted to the turntable platter! Fortunately, the motors designed for the direct-drive system are superbly built, but there are some electronic control problems of a minor nature which are being corrected at a very fast rate. There are already digital controls which are beginning to approach quartz crystal control accuracy and yet still afford the ease of manual speed variation. There is very little doubt that future turntable design will continue in the direction of the direct-drive system, considering the potential sophistication it is capable of providing.

Although the turntable drive systems are improving at a fairly rapid rate, one problem basic to all turntables still exists—I call it the teeter-totter of the turntable platter. Figure 9 shows a conventional platter and shaft standing on the end of the shaft. It is obvious that the weight of the platter will cause the platter to topple over if it were to stand by itself. When the

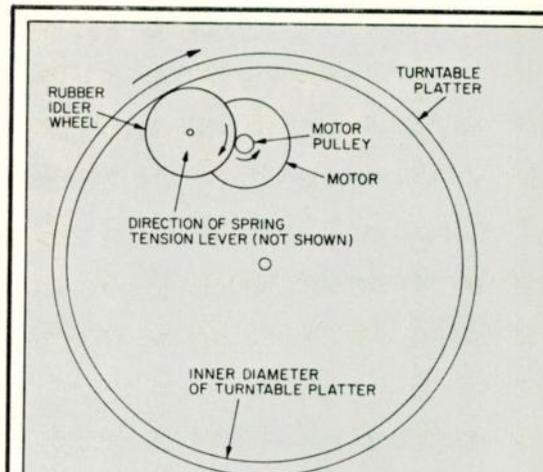


Fig. 1—Drive system of early turntables.

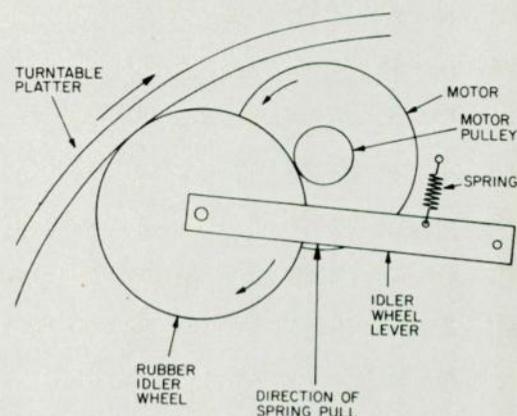


Fig. 2—This drive system uses a spring-loaded lever to keep the idler wheel in contact with the motor pulley and the platter rim.

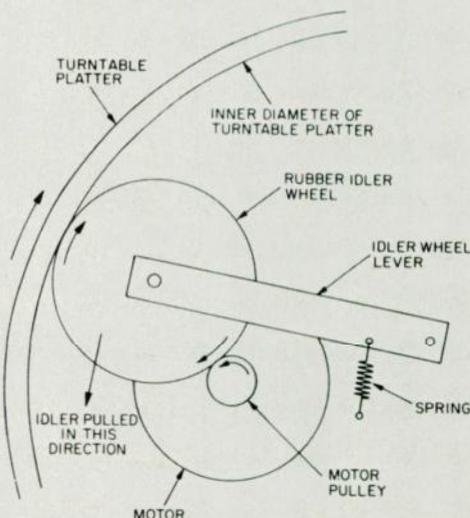


Fig. 3—This variation of the lever system jams the idler wheel between the motor pulley and the platter rim.

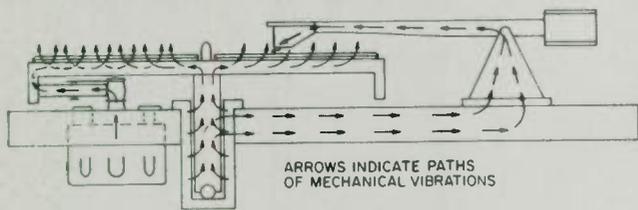


Fig. 4—The arrows indicate the paths that mechanical vibrations take to reach the tonearm and cartridge.

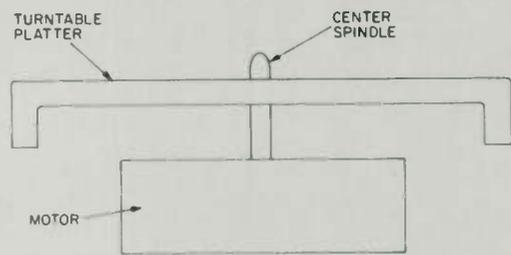


Fig. 8—Direct-drive system.

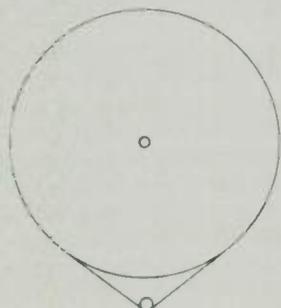


Fig. 5—Single-motor belt-drive system.

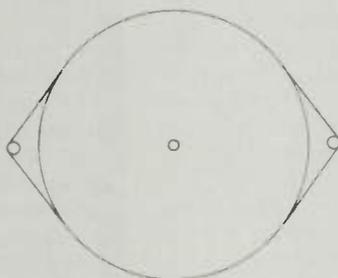


Fig. 6—Dual-motor belt-drive system.

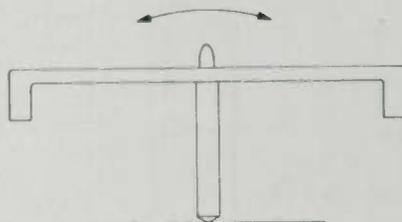


Fig. 9—Basic "teeter-totter" motion of platter and spindle.

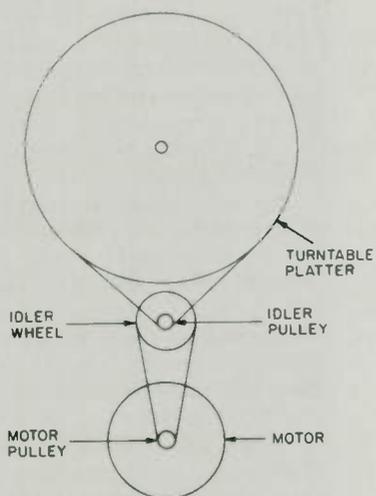


Fig. 7—Belt-drive system using an intermediate idler.

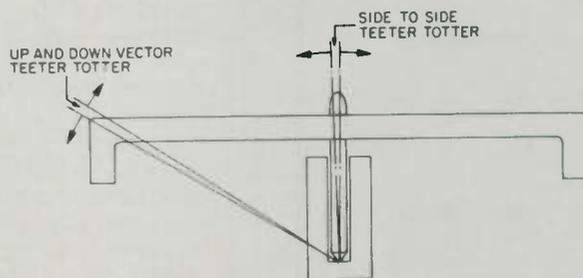


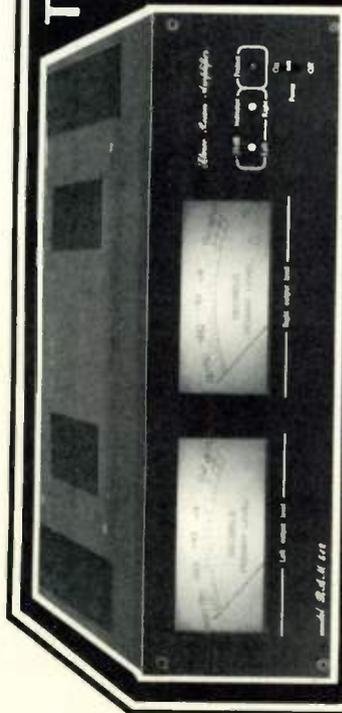
Fig. 10—The amount of "teeter-totter" motion is the product of the side-to-side motion of the spindle times the ratio of spindle length to platter radius.

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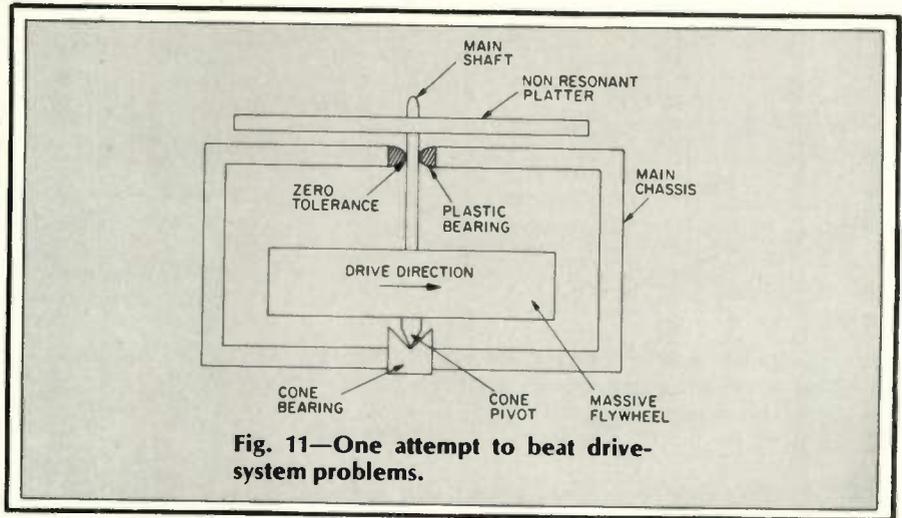


Fig. 11—One attempt to beat drive-system problems.

platter is in the turntable bearing assembly, it tries to do the very same thing—it tilts. The result is that one side of the platter shaft contacts the upper bearing and the opposite side of the shaft contacts the lower bearing. When the shaft rotates, then, it does not rotate on axis. The weight of the platter high above the shaft and bearings creates a sideward thrust and a counter rotating of the platter shaft in its bearing assembly. This counter rotation of the shaft causes a vibratory action in the shaft which is transmitted directly to the turntable platter and then to the phono pickup. The above condition exists in all conventional turntables, regardless of the drive system employed.

It can be seen in Fig. 10, that if the turntable radius is six inches and the bearing length is three inches, a two-to-one ratio exists between the shaft and bearing clearance and the platter teeter-totter. The additional vertical signal generated by the pickup due to the vertical teeter-totter is added to the recorded signal as distortion! This condition exists in all turntables regardless of the drive system employed in them.

Many years ago, in an effort to combat these problems, I designed a turntable which had a massive flywheel mounted in the lowest possible position on the shaft (Fig. 11) and a very light platter on the top of the shaft. The upper platter was made of a non-resonant material and was used to carry the record. The shaft was as long as the turntable radius, the lower support bearing was a cone type, and the shaft made a single point contact with the cone bearing. The upper bearing was a sleeve bearing of self-lubricating plastic. The elastomeric qualities of the plastic allowed a zero tolerance between the shaft and the bear-

ing. The shaft and bearing friction was so low that the eight pounds of flywheel could be driven beautifully by two tiny clock motors. The stylus force could be increased to 50 grams without slowing the turntable. Needless to say, the flutter and wow were extremely low, but more important the rumble figure was better than -85 dB.

Granite-Epoxy Platters

In my first article I discussed the problem of acoustic feedback in turntable platters. This, as I said, is caused by acoustic energy creating mechanical energy in the platter itself, much the same as wind in a church bell causes it to hum or resonate. The only way to overcome this condition is to damp the platter or to make the platter of a dense, non-resonant material. I, for one, would like to see platters made of the granite-epoxy presently being used for turntable chassis. A turntable platter of this material would make an excellent flywheel and be dense and massive enough to effectively mass damp mechanical vibrations from either design or environmental sources.

The turntable chassis should also be as massive and as dense as possible since it must perform two important functions, mass-damp acoustical energy coming to the turntable from room sources and mass-damp mechanical energy created by the turntable drive system before it can reach the tonearm base.

As we have seen, turntables and their extraneous mechanical vibrations may affect a change in the sound of a phono pickup, but the turntable itself does not "sound." In my next article, I will discuss tonearm design and how the tonearm manages to affect the sound of pickups. A

If you take a creative approach to recording, you'll appreciate the special versatility of the new Dual C 919 cassette deck. Four separate slide controls for the line-level and microphone inputs allow you to mix and record signals from disc, tape or FM with live voices and instruments. Output level controls eliminate the need to readjust your amplifier's volume when switching programs, such as to tuner or record player. (These and additional features are shown below.)

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SOUND ON WHEELS

There's no reason to leave good sound at home just because it's an hour commute to the office or you're going to the shore for the weekend—no reason at all, not when a good custom shop can outfit you with a rolling listening room complete with a sound system approaching the quality of the multi-kilo-buck rig you've got at home.

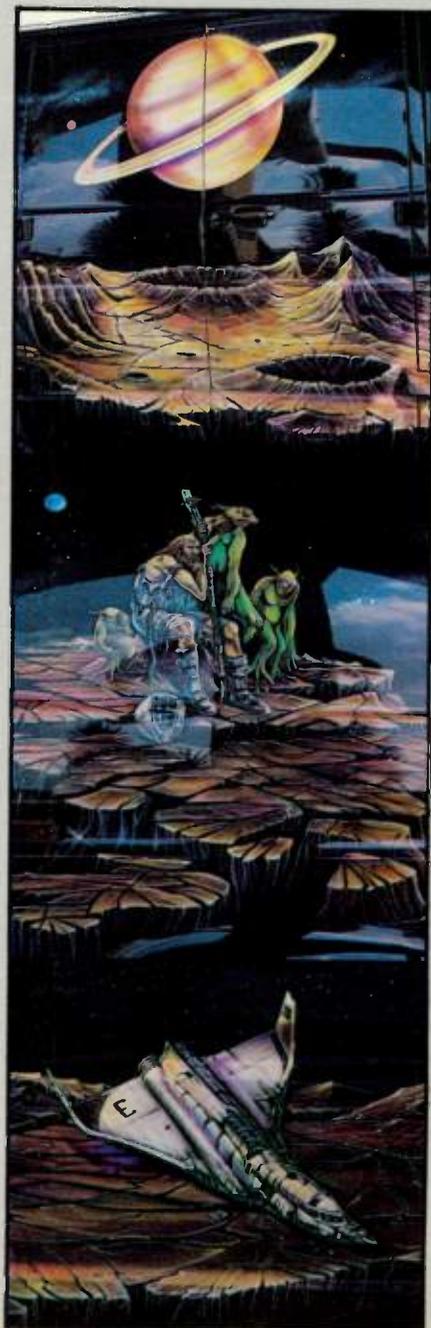
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The sound studios on wheels shown here were done by Vandango, Pembroke Park, Fla., who specialize in "customizing any means of transportation anyone wants" and have already done just about everything from motorcycles to yachts. Their specialty is the custom van, but they've even done an ambulance!

If you're looking for good ways to get good sound into your van or car, feast your eyes on the jewels these pros have produced and in particular the paint work by Vandango's mural artist, Shelby Goode.



Wyatt Fuller, Vandango's President, owns this '76 Ford Econoline; close-ups of its murals are shown below. Two entertainment consoles feature a Pioneer FM supertuner/cassette; Panasonic CB; and Audlovox digital clock, FM booster, and weatherband receiver; a B-W TV, and a computer-driven CRT which flashes true random patterns of colored squares. Other goodies include black plexiglas dash with micorswitch control panel, bedroom area with fiber-optic display of night sky complete with Milky Way and comets, and portholes showing deep space. Six Pioneer TS-167 speakers were hidden throughout the van.





Installing speakers and other components isn't hard — so long as you take your time and use common sense. Several makers, including Pioneer and JIL, have produced self-help booklets, and "Auto Stereo Service & Installation" by Dorweiler & Hansen (Tab # 694) provides more information for the advanced do-it-yourself-er. Above we see two of the steps in speaker installation, while at left an overhead console is being prepared for final assembly.



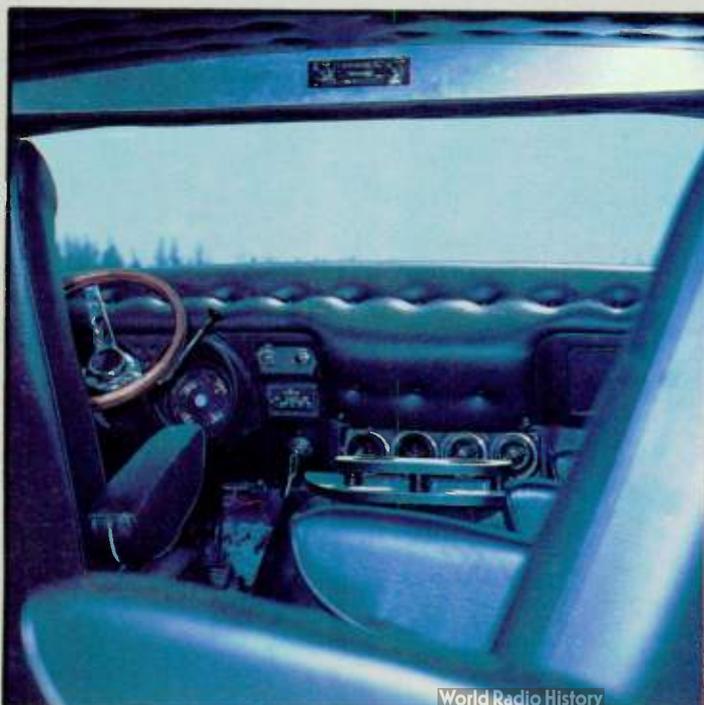
This 1971 Cadillac ambulance was designed and built as an executive limousine for the city of Sunrise, Fla., as transportation for entertainers performing at the Sunrise Music Theater. The sound system features a Pioneer FM supertuner cassette unit driving four Pioneer TS-167 speakers located in the four corners of the passenger compartment.



FOUND ON WHEELS



WSHE / WSRF, radio stations in Fort Lauderdale, own this 1975 silver Dodge maxi-van. An overhead console in the driver's compartment contains a Superscope AM / FM stereo / cassette unit and hides two Pioneer speakers, while two more Pioneer 6x9 speakers are hidden in the front of the couch. The murals again are by Shelby Goode and topped by 50 coats of clear lacquer. The interior features four captain's chairs in vinyl with velvet inserts. Buttoned vinyl covers the door panels, dash, engine cover, console, walls and overhead liner.

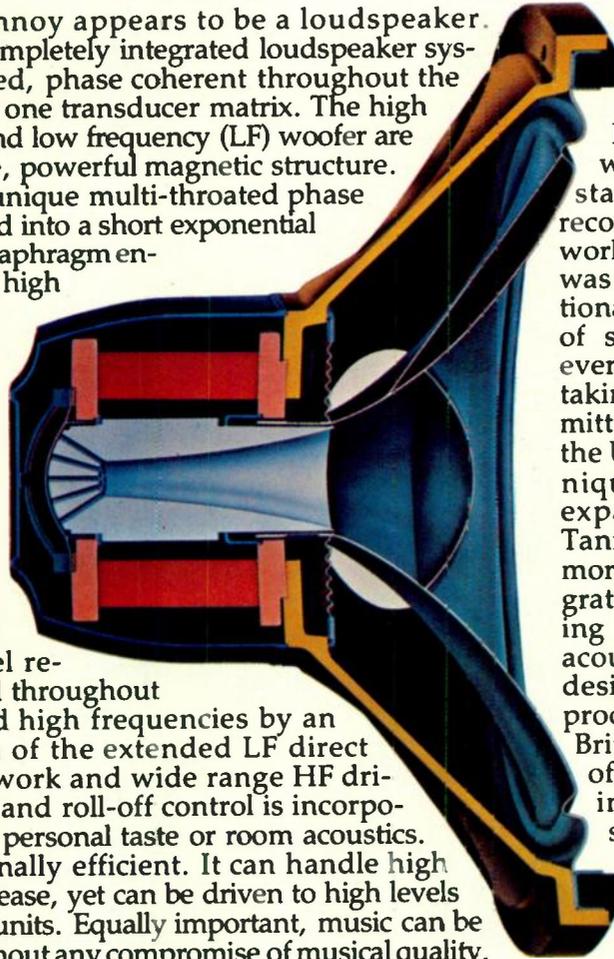


Tannoy

INTEGRATED SPEAKER SYSTEMS

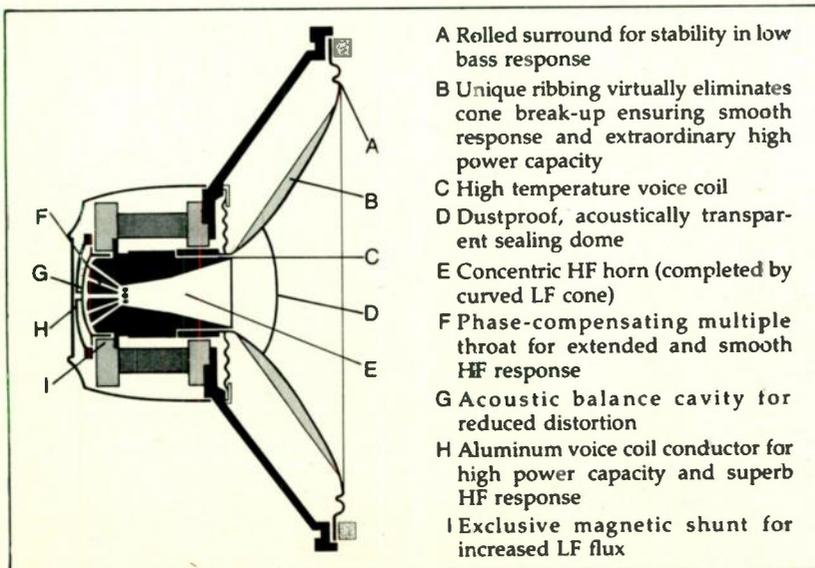
At first glance, the Tannoy appears to be a loudspeaker. *It is more.* It is in fact a completely integrated loudspeaker system. Sound is reproduced, phase coherent throughout the entire audio range, from one transducer matrix. The high frequency (HF) tweeter and low frequency (LF) woofer are combined within a single, powerful magnetic structure. Sound is collected by a unique multi-throated phase compensating unit and fed into a short exponential horn. The curvilinear LF diaphragm ensures wide dispersion of high frequencies and an unbroken audio spectrum.

□ The LF diaphragm acts as a true piston from the lowest bass up to 1kHz. The tweeter handles frequencies from 1kHz to beyond 20kHz. The crossover network ensures smooth transition between the woofer and horn-loaded tweeter. A superb, level response curve is achieved throughout the low, mid-range and high frequencies by an ingenious combination of the extended LF direct radiator, crossover network and wide range HF driver. A dynamic balance and roll-off control is incorporated for adjustments to personal taste or room acoustics. The Tannoy is exceptionally efficient. It can handle high powered amplifiers with ease, yet can be driven to high levels by moderately powered units. Equally important, music can be played at low volume without any compromise of musical quality.



Tannoy has been engaged in continuous research and production of high quality transducers for half a century. From the outset, its products were adopted as a listening standard by broadcasting and recording companies all over the world. By 1968, the term, "Tannoy" was in the Chambers English Dictionary as synonymous with the art of sound reproduction. □ However, modest facilities and painstaking standards of production permitted only limited distribution in the United States. Now... new techniques and materials, as well as expanded facilities have made Tannoy systems available to many more listeners. □ The Tannoy integrated speaker system is the crowning achievement of generations of acoustic consultants, researchers, designers, sound engineers, and produced in the best traditions of British craftsmanship. The hand of the master cabinetmaker is immediately apparent in the system's exquisitely finished enclosure. The Tannoy will provide the maximum quality your electronic equipment is capable of delivering.

31



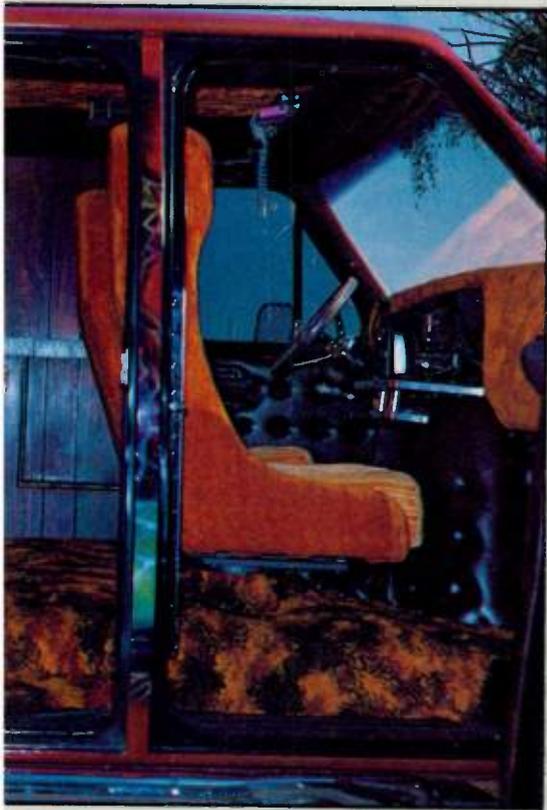
For additional information:

TANNOY®

122 Dupont Street, Plainview, N.Y. 11803

Enter No. 40 on Reader Service Card

SOUND ON WHEELS



Terry Messer's 1975 orange Ford Econoline E-300 was a work van before Vandango did its number. The sound system is mounted in an overhead console and includes a Pioneer AM/FM/cassette unit and a Lafayette CB radio, with a Bearcat police band scanner mounted in the dash. Paint work includes a candy apple tangerine lacquer over a gold base coat and custom murals by Shelby Goode topped with some 60 coats of clear lacquer.



The engineers who conceived the state-of-the-art DDX 1000 are pleased to announce the MB 15.

At less than one fourth the price.

With its three-tonearm capability, its \$600 nationally advertised value,* and its optional highly-acclaimed MA 505 tonearms, the Micro Seiki DDX 1000 has been accepted as one of the unique advances in turntable concept and design.

Using the same technology, our engineering team has crafted the MB 15 to achieve economy, while preserving musical accuracy.

Elegant and understated, its economy of design reveals not one extra line—contains

not one unnecessary part.

An electronic sensor controls shutoff and arm-lift operation: a Hall-effect IC sensor detects a change in tonearm speed at the end of the record and activates a viscous-damped device which lifts the tonearm and shuts off power.

Its diecast aluminum platter is driven by a 4-pole synchronous motor coupled with a precision-polished belt that effectively acts as a damping device; wow and flutter is less than 0.06%.

A solenoid-activated cueing system and an easy-to-adjust anti-skating control are among its attractions. The MB 15 tonearm headshell is detachable for ease in mounting cartridges.



DDX 1000



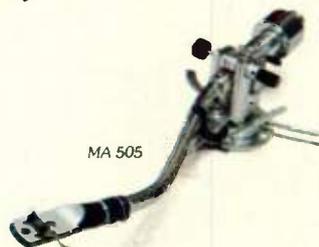
MB 15

At \$150 (nationally advertised value)* you can considerably enhance the enjoyment of your records with Micro Seiki purity of sound.

Isn't it time to upgrade your pleasure?

MICRO SEIKI

Advanced engineering in turntables.



MA 505

Distributed by TEAC Corporation of America, 7733 Telegraph Road, Montebello, California 90640 ©TEAC 1977.
Actual resale prices will be determined individually and at the sole discretion of authorized Micro Seiki dealers.

Car Stereo Directory



34

Car stereo equipment is proliferating, particularly in the wide variety of AM/FM radio, cassette, and eight-track tape gear available for post-sale or add-on installation.

In this issue *Audio* presents a directory of add-on equipment in many different configurations. It should be

added that car manufacturers use some of these same suppliers to construct sets to fit the contours of their particular automobile for original equipment installation. Loudspeakers are listed in their own specific section.

It must be noted that the data in

these listings are supplied to *Audio* by the manufacturers for this directory and are not the results of *Audio's* own laboratory tests.

This listing is not complete as some manufacturers failed to return the forms sent them.

Directory of Manufacturers

Acoustic Fiber Sound Systems, Inc.
7999 Knue Rd., Suite 116
Indianapolis, Ind. 46250

ADS
64 Industrial Way
Wilmington, Mass. 01887

Astrosonix/Boman
9300 Hall Rd.
Downey, Cal. 90241

Audiovox Corp.
150 Marcus Blvd.
Hauppauge, N.Y. 11787

Automatic Radio
2 Main St.
Melrose, Mass. 02176

B&B Import-Export, Inc.
185 Park St.
Troy, Mich. 48084

Blaupunkt
Robert Bosch Corp.
2800 S. 25th Ave.
Broadview, Ill. 60153

Car Tapes, Inc./Jet Sounds
Caltron
9180 Kelvin Ave.
Chatsworth, Cal. 91311

Cerwin-Vega
12250 Montague St.
Arleta, Cal. 91331

Clarion Corp. of America
5500 Rosecrans Ave.
Lawndale, Cal. 90260

Comm Industries, Inc.
1 Gateway Center
Newton, Mass. 02158

Components Specialties, Inc.
393 S. Franklin St.
P.O. Box 398
Hempstead, N.Y. 11550

Craig Corp.
921 W. Artesia Blvd.
Compton, Cal. 90220

Electronic Industries
333 Taft Dr.
S. Holland, Ill. 60473

Far Eastern Research Labs
8749 Shirley Ave.
Northridge, Cal. 91324

Hanabashiya Ltd.
39 W. 28th St.
New York, N.Y. 10001

Hart Acoustics
4423 Saltillo St.
Woodland Hills, Cal. 91364

Herald Electronics
6611 N. Lincoln Ave.
Lincolnwood, Ill. 60645

Inland Dynatronics, Inc.
10 Horizon Blvd.
S. Hackensack, N.J. 07606

Jensen Sound Laboratories
4136 N. United Parkway
Schiller Park, Ill. 60176

Kraco Enterprises, Inc.
505 E. Euclid St.
Compton, Cal. 90505

Lake Communications, Inc.
1948 E. Lehigh Ave.
Glenview, Ill. 60025

Magitran Co.
311 E. Park St.
Moonachie, N.J. 07074

Medallion
Div. Midland International Corp.
P.O. Box 1903
Kansas City, Mo. 64141

Metro Sound
11144 Wedington St.
N. Hollywood, Cal. 91601

Motorola, Inc.
1299 E. Algonquin Rd.
Schaumburg, Ill. 60196

Neosonic Corp. of America
57 Old Country Rd.
Westbury, N.Y. 11590

Nuvox Electronics Corp.
150 Fifth Ave.
New York, N.Y. 10011

Panasonic
1 Panasonic Way
Secaucus, N.J. 07094

Pioneer Electronics of America
1925 E. Dominguez St.
Long Beach, Cal. 90810

Polk Audio
4900 Wetheredville Rd.
Baltimore, Md. 21207

Rogersound Labs
6319 Van Nuys Blvd.
Van Nuys, Cal. 91401

Royal Sound Co.
409 N. Main St.
Freeport, N.Y. 11520

Sankyo Seiki
149 Fifth Ave.
New York, N.Y. 10010

Solar Sound Systems
339 Fifth Ave.
New York, N.Y. 10016

Sparkomatic Corp.
Milford, Pa. 18337

Superscope, Inc.
20525 Nordhoff St.
Chatsworth, Cal. 91311

Utah Electronics
1124 E. Franklin St.
Huntington, Ind. 46750

Visonik of America
1177 65th St.
Oakland, Cal. 94608

Car Radio / Tape Players

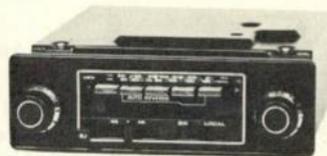
MANUFACTURER	Model	Price	Speaker (S), Mono (M), or 4-channel (D)?	FM Sensitivity (uV) (to 30 dB overing)	Average Watts channel 50 (D) Wth.	% Distortion @ rated watts	Local Distance Switch?	Pushbutton? If Yes Number AM Number FM	Bass Control?	Treble Control?	Cassette?	8 Tracks?	Auto Reverse?	Fast Forward?	Tape Rewind?	Includes Speakers?	In Dash (I) or Under Dash (U)?	Control Shaft Spacing Inches?	Dimensions Inches H x W x D?
ASTROSONIX/BOMAN	305-PB	57.95	M	—	2.5		No	5AM	No	No	No	No	No	No	No	No	U		1 1/4 x 6 1/4 x 3 1/4
	BM-290MPX	179.95	S	10	2.5		No	5FM	No	No	No	No	No	No	No	No	U		3 x 6 x 3 1/4
	BM-260FM	139.95	M	10	2.5		No	5FM	No	No	No	No	No	No	No	No	U		3 x 6 x 3 1/4
	BM-230PB	79.95	M	—	2.5		No	5AM	No	No	No	No	No	No	No	No	U		3 x 6 x 3 1/4
	50-M	29.95	M	—	2.5		No	—	No	No	No	No	No	No	No	No	U		2 1/4 x 4 1/4
	BM-911	84.95	S/D	N/A	5		No	5AM	No	No	No	Yes	No	No	No	No	U		2 1/4 x 4 1/4 x 8 1/4
	AP-16	46.95	S	N/A	2.5		No	No	No	No	No	Yes	No	No	No	No	U		2 1/4 x 5 1/4 x 7 1/4
	CT-2200	144.95	S	N/A	3		No	No	No	No	No	Yes	No	No	No	No	U		2 1/4 x 7 1/4 x 7 1/4
	BM-590	89.95	S	N/A	2.5		No	No	No	No	Yes	No	No	No	No	No	U		1 1/4 x 5 1/4 x 7 1/4
	BM-1312	64.95	S	N/A	3		No	No	No	No	Yes	No	No	No	No	No	U		—
	DP-5000	199.90	S	10	5		No	No	No	No	No	No	No	No	No	No	U		2 x 7 x 6 1/4
	605-MPX	139.95	S	10	5		No	3FM	No	No	No	No	No	No	No	No	U		2 x 6 1/4 x 5 1/4
	405-FM	99.95	M	10	2.5		No	2AM	No	No	No	No	No	No	No	No	U		1 1/4 x 6 1/4 x 4 1/4
	BM-298Q	299.95	Q	13	4		Yes	2AM	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 5 1/4
	BM-294	299.95	S	10	4		Yes	5FM	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 5 1/4
	BM-1150B	199.95	S	10	4		Yes	5FM	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 6 1/4
	BM-1335	229.95	S	6	6		No	No	No	No	Yes	No	No	Yes	Yes	No	I	Adj.	2 1/4 x 7 x 6 1/4
	BM-1332	159.95	S	10	2.5		No	No	No	No	Yes	No	No	Yes	No	No	I	Adj.	2 1/4 x 7 x 5 1/4
	BM-1339	199.95	S	10	3		No	No	No	No	Yes	No	No	No	No	No	I	Adj.	2 1/4 x 6 x 6 1/4
	BM-1330D	129.95	S	6	5		No	No	No	No	Yes	No	No	No	No	No	I	Adj.	2 1/4 x 6 x 6 1/4
BM-1126	224.95	S	10	4		No	No	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 6 1/4	
BM-1129	199.95	S	10	4		No	No	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 6 1/4	
BM-1125	189.95	S	10	6		Yes	No	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 6 1/4	
BM-1123	159.95	S	10	3		No	No	No	No	No	Yes	No	No	No	No	I	Adj.	2 x 6 1/4 x 5 1/4	
BM-1120	199.95	S	10	2.5		Yes	No	No	No	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 4 1/4	
BM-1115	119.95	S	10	5		No	No	No	No	No	Yes	No	No	No	No	I	Adj.	1 1/4 x 7 x 6 1/4	
AUDIOVOX CORPORATION	QD-500	209.95	Q	5	4	10	Yes	No	Yes	Yes	No	Yes	No	No	No	No	I	Adj.	2 1/4 x 7 x 6
	CAS-300	149.95	S	5	5	10	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 1/4 x 7 x 5 1/4
	C-981	119.95	S	N/A	5	10	N/A	No	Yes	Yes	Yes	No	Yes	Yes	No	N/A	I	Adj.	1 1/4 x 5 1/4 x 6 1/4
	C-992	119.95	S	5	4	10	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	U	N/A	2 x 6 1/4 x 6 1/4	
	C-993	109.95	S	5	4	10	Yes	No	Yes	Yes	No	Yes	No	No	No	U	N/A	2 x 6 1/4 x 6 1/4	
	C-977	131.25	S	5	5	10	Yes	No	Yes	Yes	No	Yes	No	No	No	I	Adj.	6 1/4 x 7 x 6 1/4	
	CM-4000	174.95	S	5	5	10	Yes	No	Yes	Yes	No	Yes	No	Yes	No	I	Adj.	2 1/4 x 6 1/4 x 5 1/4	
	TM-2000	159.95	S	5	5	10	Yes	No	Yes	Yes	No	Yes	No	No	No	I	Adj.	2 1/4 x 7 x 5 1/4	
	CP-650	262.50	S	5	6	10	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	I	Adj.	3 3/4 x 7 x 6	
	AUTOMATIC RADIO	SPA 5000	62.95	S	N/A			No	No	Tone	Tone	No	Yes	No	No	No	No	U	N/A
SPB-5001		71.95	S	N/A			No	No	Tone	Tone	No	Yes	No	No	No	No	U	N/A	2 x 5 1/4 x 8
SPC-6002		82.95	S	N/A			No	No	Tone	Tone	No	Yes	No	Yes	No	No	U	N/A	2 x 7 1/4 x 8 1/4
SPE-5004		135.95	S				No	No	Tone	Tone	No	Yes	No	Yes	No	No	U	N/A	2 x 7 1/4 x 8 1/4
SPK-5008		76.95	S	No			No	No	Tone	Tone	Yes	No	No	Yes	No	No	U	N/A	2 1/4 x 6 1/4 x 8
SPG-5006		133.95	S	No			Yes	No	Tone	Tone	Yes	No	No	Yes	No	U	N/A	2 1/4 x 6 1/4 x 8	
SST-1179		41.95	S	No			No	No	Tone	Tone	No	Yes	No	No	No	U	N/A	2 1/4 x 5 1/4 x 7	
SSS-2595		52.95	S	No			No	No	Tone	Tone	No	Yes	No	No	No	U	N/A	2 1/4 x 5 1/4 x 7	
STS-2450		34.50	S	No			No	No	Tone	Tone	No	Yes	No	No	No	U	N/A	2 1/4 x 5 1/4 x 6 1/4	
TFF-1082		80.95	S	No			Yes	No	Tone	Tone	No	Yes	No	No	No	U	N/A	2 1/4 x 6 1/4 x 8 1/4	
UPX-2354		121.50	S	Yes			Yes	No	Tone	Tone	No	Yes	No	No	No	I	Adj.	2 1/4 x 7 1/4 x 7 1/4	
IDC-3224		121.50	S	Yes			Yes	No	Tone	Tone	Yes	No	No	Yes	No	I	Adj.	2 x 7 x 6 1/4	
UPB-3200		151.95	S	Yes			Yes	5 any combination	Tone	Tone	No	Yes	No	No	No	I	Adj.	2 1/4 x 6 1/4 x 7 1/4	
CUD-3230		50.50	S	No			No	No	Tone	Tone	Yes	No	No	Yes	No	U	N/A	2 1/4 x 5 1/4 x 7 1/4	
CSA-9985E		121.95	S	No			No	No	Tone	Tone	Yes	No	Yes	No	No	U	N/A	2 1/4 x 6 1/4 x 7 1/4	



Automatic Radio UPB-3200



Craig T631



Jet Sounds JS-9600



Clarion RE-676A

Car Radio/Tape Players

MANUFACTURER	Model	Price	Stance (S), Mono (M), or 4-channel (Q)?	FM Sensitivity, mV? (for 30-dB weighting)	Average Wrench, channel, 50-10 Mhz. at rated distortion	% Distortion @ rated watts	Local/Distance Switch?	Production? If Yes, Member AM, Member FM	Bass Control?	Treble Control?	Compass?	B-Tape?	Auto Reverse?	Fast Forward?	Tape Reverse?	Includes Speaker?	In-Dash (I) or Under-Dash (U)?	Control Shift Spacing, inches? H x W x D?	
B & B IMPORT-EXPORT INC.	RY-879	24.95	S		3		No		Yes	Yes	No	Yes	No	No	No	No	U	N/A	2x5x7 1/2
	RY-700	26.95	S		3		No		Yes	Yes	Yes	No	No	Yes	No	No	U	N/A	2x6x6 1/2
	RY-861	71.95	S		6	3	Yes		Yes	Yes	No	Yes	No	No	No	No	I	Adj.	2 1/2 x 6 1/2 x 7
	RY-702	69.95	S		6	3	No		Yes	Yes	Yes	No	No	Yes	No	No	I	Adj.	2 1/2 x 6 1/2 x 7
BLAUPUNKT	1071	35.00	M				No	5 AM	Yes	Yes	No	No	No	No	No	No	I	5.1	
	2072	89.90	M	4	3.5	4.0	No	5 AM&FM	Yes	Yes	No	No	No	No	No	No	I	5.1	
	Frankfurt Mono	107.00	M	2.5	4	5.3	Yes	5 AM&FM	Yes	Yes	No	No	No	No	No	No	I	5.1	1 1/2 x 7 x 5
	Frankfurt Stereo	185.00	S	2	4	5.3	Yes	4 AM&FM	Yes	Yes	No	No	No	No	No	No	I	5.1	1.7 x 7 x 4.4
	CR4091	155.00	S	3	4	5.8	Yes	No	Yes	Yes	No	Yes	No	No	No	No	I	Adj.	1 1/2 x 7 x 6
	CR4094	219.50	S	3	4	5.8	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 x 6 1/2 x 7
	CR4096	213.00	S	3	4	5.8	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	1 1/2 x 7 x 5 1/2
	Bamberg U.S. Electronic	785.00	Q	2	4	5.8	Yes	2 AM 2 FM 1 SW	Yes	Yes	Yes	No	No	Yes	Yes	No	I	5.1	1 1/2 x 4 1/2 x 2 1/2
Berlin U.S. Electronic	836.60	Q	2	4	5.8	Yes	3 FM 2 AM 1 SW	Yes	Yes		No	No	-	-	No		None		
CAR TAPES, INC./JET SOUNDS	JS-8120	89.95	S	10	4.5	3	Yes	5 AM	No	Yes	No	Yes	-	No	No	No	I	Adj.	1 1/2 x 6 1/2 x 4 1/2
	CT-4310	79.95	S	10	4	3	No	-	No	Yes	No	Yes	-	No	No	No	I	Adj.	2 1/2 x 7 x 4 1/2
	CT-4355	89.95	S	10	4.5	3	Yes	-	No	Yes	No	Yes	-	No	No	No	I	Adj.	2 1/2 x 7 x 4 1/2
	CT-9300	89.95	S	10	4	3	Yes	-	No	Yes	Yes	No	No	Yes	No	No	I	Adj.	1 1/2 x 7 x 5 1/2
	JS-220	34.95	S	-	5	3	-	-	No	Yes	Yes	No	No	Yes	No	No	U	-	1 1/2 x 5 x 5 1/2
	JS-400	39.95	S	-	5	3	-	-	No	Yes	Yes	No	No	Yes	Yes	No	U	-	1 1/2 x 5 x 5 1/2
	JS-600	69.95	S	-	5	3	-	-	No	Yes	Yes	No	Yes	Yes	Yes	No	U	-	2 x 7 x 6 1/2
	JS-3500	99.95	S	8	5	3	Yes	-	No	Yes	Yes	No	Yes	Yes	Yes	No	U	-	2 x 7 x 7 1/2
	JS-8001	149.95	S	8	8	3	Yes	-	No	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 x 7 x 6 1/2
	JS-8550	139.95	S	10	4.5	3	Yes	5 FM or 5 AM	No	Yes	No	Yes	-	No	No	No	I	Adj.	2 1/2 x 7 x 4 1/2
	JS-9200	149.95	S	8	8	3	Yes	5 FM or 5 AM	No	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 1/2 x 7 x 6 1/2
	JS-9600	159.95	S	8	8	3	Yes	5 FM or 5 AM	No	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 1/2 x 7 x 6 1/2
CLARION CORP.	450	49.95	S	-	3.5	10.0	-	-	No	Yes	No	Yes	No	No	No	No	U	-	2 1/2 x 6 1/2 x 6
	452	74.95	S	-	3.5	10.0	-	-	No	Yes	No	Yes	No	No	No	No	I/U	-	2 1/2 x 6 1/2 x 8
	423	119.95	S	-	8.0	10.0	-	-	No	Yes	No	Yes	No	No	No	No	U	-	2 1/2 x 8 x 7 1/2
	PE-618A	159.95	S	5	4.0	8.0	Yes	No	No	Yes	No	Yes	No	No	No	No	I	Adj.	2 x 7 1/2 x 4 1/2
	PE-702	229.95	S	5	4.0	-	Yes	4 AM or FM	No	Yes	No	Yes	No	No	No	No	I	Adj.	2 1/2 x 7 1/2 x 7
	826	59.95	S	-	2.5	10.0	-	-	No	Yes	Yes	No	No	Yes	No	No	U	-	2 x 5 1/2 x 6
	827	84.95	S	-	3.5	10.0	-	-	No	Yes	Yes	No	No	Yes	No	No	U	-	2 x 5 1/2 x 6
	829	99.95	S	-	3.5	10.0	-	-	No	Yes	Yes	No	No	Yes	Yes	No	U	-	2 x 5 1/2 x 6
	828	139.95	S	-	3.5	10.0	-	-	No	Yes	Yes	No	Yes	Yes	Yes	No	U	-	2 x 5 1/2 x 6
	PE-676A	159.95	S	5	4.0	8.0	No	No	No	Yes	Yes	No	No	Yes	Yes	No	I	Adj.	2 x 7 1/2 x 5 1/2
	PE-686A	239.95	S	5	4.0	8.0	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 x 7 1/2 x 5 1/2
	PE-662B	279.95	S	5	5.0	-	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	1 1/2 x 6 1/2 x 7
	RE-338C	159.95	S	5	4.0	10.0	No	3 FM 2 AM	No	Yes	No	No	No	No	No	No	I	5-1/8	2 x 6 1/2 x 4 1/2
	RE-351B	179.95	S	5	4.0	10.0	No	5 AM or FM	No	Yes	No	No	No	No	No	No	I	Adj.	2 x 7 1/2 x 4 1/2
	RE-361A	209.95	S	5	4.0	10.0	No	5 FM 5 AM	No	Yes	No	No	No	No	No	No	I	Adj.	2 x 7 1/2 x 4 1/2
100-EQB equal.	129.95	S	-	10.0 15.0	1.0 3.0	No	No				No	No	No	No	No	U	-	2 1/2 x 6 1/2 x 6	
CRAIG CORP.	3149	159.95			4														7 1/2 x 3 x 6 1/2
	S630	169.95			4														2 1/2 x 7 1/2 x 5 1/2
	S681	199.95			12														2 1/2 x 7 1/2 x 5 1/2
	T180	139.95			12														2 1/2 x 6 1/2 x 6 1/2
	3515	49.95			3.5														1 1/2 x 5 1/2 x 6
	T100	79.95			4														2 1/2 x 6 x 7 1/2
	3517	79.95			3.5														2 x 7 1/2 x 6 1/2
	T200	119.95			4														2 1/2 x 7 1/2 x 7 1/2
	3519	119.95			12														2 1/2 x 6 1/2 x 8 1/2
	3152	39.95			3														2 1/2 x 6 x 7
(Continued)	3144A	49.95			3.5														2 1/2 x 6 x 6 1/2

"at their price, they are simply a steal"

The **AUDIO ADVISOR**

AUDIOGRAM

VOLUME I, NUMBER 7

1976

This is the full text of the review of the Polk 10's which appeared in the AUDIOGRAM, a discerning and independent audiophile journal which is entirely supported by its readers and accepts no manufacturers' advertisements. Subscriptions are available for \$15.00 per year.

POLK MODEL 10 LOUDSPEAKER

POLK AUDIO
4900 Wetheredsville Rd.
Baltimore, MD 21207
\$199.95 - suggest retail

When we heard the Polk speakers at Summer CES we knew we had to test them. We were so impressed that we could not believe the prices. But first let us say that there are a few factors that might make us prejudiced in their favor. The Polk people use the Spondor as a reference. They like the sound of ARC tubes. They are the East coast distributors of the Formula 4 tone arm. We, at AUDIOGRAM, share so many likes with the folks at Polk that it is hard for us not to like their speakers. And the company is a local one that has made good - the pride of Baltimore and Washington.

Nonetheless, the sound coming forth from the Model 10 "monitors" is something really special. It is a sound that is open, well defined and very low in coloration. One does not generally expect such low coloration in a modestly priced box speaker, and certainly not anything like the definition exhibited by these speakers. How does Polk do it? We think it is mostly execution. They hear very well and they care.

The Model 10 uses a 1-inch soft dome tweeter, two 6 1/2-inch plasticized midrange drivers and one 10-inch sub-bass radiator (which is really a passive radiator). Polk calls the crossover between the bass and midrange drivers "fluid-coupling". It occurs at 60 Hz and provides fourth order Butterworth loading for the energizing cones.

We auditioned the speaker on the optional stand which Polk sells. The stand, or one like it, is highly recommended. It tilts the front of the speaker slightly back from the listener, providing better phasing between drivers and reducing undesirable floor-coupled resonant effects. We would say that the sound of most bookshelf speakers currently placed on the floor would certainly be improved by such a stand.

Inasmuch as Polk had indicated that they use the Spondor as a reference and inasmuch as we had one on hand, we compared the Model 10 to this speaker. In fact, we have compared many speakers to the Spondor and most of them have sounded extremely colored by comparison. (The only speaker systems that have been able to make the Spondor sound colored have been a well-tuned Fulton J and the Rogers LS3/5A's.) Although the Spondor did manage to make the Model 10 sound a trifle nasal, we were amazed at the similarity of sound - and that's good!

But the Spondors cost upwards from \$700 a pair (if one can find them), will not handle much power and cannot reproduce the bass of the Polks. It really isn't fair to compare the Model 10 to a reference monitor. It should be compared with other modestly priced speakers. However, such a comparison is no fairer than the Spondor comparison. Other \$200 speakers simply do not come close to the standards set by the Model 10. In fact the Polks compare very favorably with the Magnepan and Dahlquist DQ 10's. Bass response of the Model 10 surpasses that of the DQ 10. Definition is almost on the par with the Magnepan (stereo imaging is better). Driver blending is excellent, the midrange is open and exceptionally clear, and there is much less hint of boxiness than that which is found in most box speakers.

If we had to fault the Model 10's, we would say that they are slightly bright and just a little fat in the low end. However, they are extremely neutral throughout most of their range. Only in comparison with some of the world's best speaker systems do they sound the least bit colored. They are a high definition speaker system deserving the very best associated electronics. And at their price, they are simply a steal.

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Astrosonix/Boman BM-1335

Car Radio / Tape Players

38

MANUFACTURER	Model	Price	Stereo (S), Mono (M), or 4-channel (D)?	FM Sensitivity dB? (for 30 dB weighting)	Average Watts/channel, 50-10 kHz at rated distortion	% Distortion @ rated watts	Local/Distance Switch?	Preselector? If Yes, Number AM, Number FM	Bass Control?	Treble Control?	Cassette?	8-Track?	Auto Reverse?	Fast Forward?	Tape Rewind?	Includes Synthesizer?	In-Dash (I) or Under-Dash (U)?	Control Shaft Spacing, inches? If x W x D?	Dimensions, inches
CRAIG CORP. (Continued)	S100	64.95		4															2 1/2 x 4 1/4 x 7 1/4
	S143	69.95		3.5															2 1/2 x 7 x 8
	S153	79.95		3															2 1/2 x 7 1/2 x 7
	S200	95.95		4															2 1/2 x 7 1/2 x 7 1/4
	S180	119.95		4	12														2 1/2 x 6 1/2 x 6 1/2
	S280	179.95		12															8 1/2 x 2 1/2 x 9 1/2
	S281	129.95		12															2 1/2 x 7 1/2 x 7 1/4
	S101	84.95		4															2 1/2 x 6 1/2 x 6 1/2
	S148A	99.95		4															2 1/2 x 7 1/2 x 5 1/2
	S600	109.95		4															2 x 7 1/2 x 6 1/2
	S145	119.95		3.5															2 1/2 x 7 1/2 x 5 1/2
	S601	129.95		4															2 x 7 1/2 x 5 1/2
	S680	139.95		12															2 x 7 1/2 x 5 1/2
	S146	149.95		3.5															2 1/2 x 7 1/2 x 5 1/2
	T601	134.95		4															2 x 7 1/2 x 5 1/2
	S514	159.95		4															2 x 7 1/2 x 5 1/2
	T600	169.95		4															2 x 7 1/2 x 6 1/2
	S516A	169.95		4															2 x 7 1/2 x 6 1/2
	T605	149.95		4															2 x 7 1/2 x 6 1/2
	T680	159.95		12															2 x 7 1/2 x 5 1/2
	T631	259.95		4															2 x 7 1/2 x 6 1/2
	T602	119.95		4															2 x 7 1/2 x 6 1/2
	S520	179.95		12															2 x 7 1/2 x 5 1/2
T281	149.95		12															3 1/2 x 8 1/2 x 8 1/2	
T101	59.95		4															2 1/2 x 7 1/2 x 7 1/4	
T201	99.95		4															2 1/2 x 4 x 5 1/2	
T102	99.95		4															2 1/2 x 7 1/2 x 7 1/4	
T202	139.95		4															2 1/2 x 7 x 7	
S521	99.95		4															2 1/2 x 7 1/2 x 7 1/4	
S513	119.95		3.5															2 x 7 1/2 x 5 1/2	
																		2 x 7 1/2 x 6 1/2	
FAR EASTERN RESEARCH LABS	XA-800	119.95	S	54	4	3.6	Yes	3FM ZAM	Yes	No	No	Yes	No	No	Yes	No	I	Adj.	7 1/2 x 4 1/2 x 2
	XA-803	89.95	S	54	4	3.6			Yes			Yes			Yes	No	I		7 x 2 x 6 1/2
	XA-807	149.95	S	54	5	4.5	Yes	5	Yes			Yes			Yes	No	I		5 1/2 x 5 1/2 x 2 1/2
	XA-93	79.95	S	54	4.5	4			Yes		Yes	Yes			Yes	No	U		5 1/2 x 2 1/2 x 7 1/4
	XA-903	99.95	S	54	4	3.6	Yes		Yes		Yes	Yes			Yes	No	I		7 x 2 1/2 x 6 1/2
	XA-906	169.95	S	54	4	3.6	Yes		Yes		Yes	Yes			Yes	No	I		7 1/2 x 6 x 2
	XA-840/940	139.95	S	54	4	3.6	Yes		Yes		Yes	Yes	Yes	Yes	Yes	No	I		7 x 1 1/2 x 7
XCB-880	349.95	S	54	4	3.6	Yes	3FM ZAM	Yes			Yes			Yes	No	I		7 x 2 1/2 x 7 1/4	
HANABASHIYA LTD.	H978	129.00	S		2.5		Yes		Yes		No	Yes	No	No	No	No	I	Adj.	2 x 6 x 7
	H999	149.00	S		2.5		Yes		Yes		Yes	No	No	No	No	No	I	Adj.	2 x 7 x 4 1/2
	S15AF	129.00	S		2.5		No		Yes		Yes	No	No	Yes	No	No	I	Adj.	2 x 6 1/2 x 6 1/2
	S02AF	159.00	S		2.5		No		Yes		Yes	No	No	Yes	Yes	No	I	Adj.	2 x 7 x 7
INLAND DYNATRONICS, INC.	APC-1200	219.95	S	less than 14			Yes	2FM 3AM	-	-	Yes	No	No	Yes	No	No	I	Adj.	2 1/2 x 7 x 6
	APB-904	199.95	S	3.2	4.0	8	Yes	Yes	-	-	No	Yes	No	No	No	No	I	Adj.	2 1/2 x 7 x 6
	PBX-200	129.95	S	10			Yes	5FM 5AM	-	-	No	No	No	No	No	No	I	Adj.	2 x 7 x 5
	PBM-100	99.95	S/M	10			Yes	5FM 5AM	-	-	No	No	No	No	No	No	I	Adj.	2 x 7 x 5
	AXT-885	131.95	S/M	3.0			No	No			No	Yes	No	No	No	No	I	Adj.	2 1/2 x 7 1/2 x 4 1/2
	AXC-881	133.95	S/M	3.5			No	No			Yes	No	No	No	No	No	I	Adj.	2 x 7 1/2 x 5 1/2
	*PB-66	41.95	S		2.0														
AR-150	109.95	S	-			-	-			yes	No	Yes	Yes	Yes	No	U	-	1 1/2 x 4 1/2 x 6 1/2	
KRACO	S60-A	139.95	S	6.3	4.0	10	Yes	No	Yes	Yes	No	Yes	No	No	No	No	I	Adj.	2 x 7 1/2 x 6 1/2
	S65	139.95	S	6.3	4.5	10	Yes	No	Yes	Yes	No	Yes	No	No	No	No	I	Adj.	1 1/2 x 7 1/2 x 5 1/2
	S70-A	159.95	S	4.45	4.0	10	No	3FM ZAM	Yes	Yes	No	Yes	No	No	No	No	I	Adj.	3 x 7 1/2 x 6 1/2
	S80-B	159.95	S	2.5	4.0	10	No	No	Yes	Yes	Yes	No	No	No	No	No	I	Adj.	2 1/2 x 7 1/2 x 5 1/2
	S90	99.95	S	-	4.4	10	-	No	Yes	Yes	No	Yes	No	No	No	No	U	-	3 x 6 1/2 x 7
	S90	99.95	S	4.45	2.9	10	-	No	Yes	Yes	No	No	No	No	No	No	U	-	3 x 7 1/2 x 7 1/4
	S95	69.95	S	-	2.5	10	-	No	Yes	Yes	Yes	No	No	No	No	No	U	-	2 x 6 x 7
	S40	39.95	S	-	1.4	10	-	No	High/Low Switch	High/Low Switch	No	Yes	No	No	No	No	U	-	2 1/2 x 6 x 7 1/4
LAKE COMMUNICATIONS	MD-5000	239.95	S	10	2.2		Yes		Yes	Yes	No	No	No	No	No	No	I	Adj.	7 1/2 x 5 1/2 x 2 1/4

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MANUFACTURER	Model	Price	Stereo (S), Mono (M), or 4-channel (D)?	FM Synthesized MT? (for 30 dB sensitivity)	Average Meter, Channel, SD, 10 kHz at rated distortion	% Distortion @ rated watts	Local / Distance Switch?	Preselection? If Yes, Number AM, Number FM	Bass Control?	Treble Control?	Cassette?	8-Track?	Auto Reverse?	Fast Forward?	Tape Reverse?	Includes Speakers?	In Dash (I) or Under-Dash (U)?	Control Shaft Spacing, inches?	Dimensions, inches, H x W x D?
MEDALLION	65-413		M	-	-	-	No	5FM 5AM 5AM	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	No	No	No	No	No	I	-	4 1/2 x 7 1/4 x 2 1/2
	65-416		S	-	-	-	No	5FM 5AM 5AM	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	No	No	No	No	No	I	-	4 1/2 x 7 1/4 x 2
	65-485		S	-	-	-	-	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	Yes	Yes	Yes	No	U	-	2 x 4 x 7 1/4
	65-489		S	-	-	-	Yes	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	Yes	Yes	Yes	No	U	-	7 x 2 1/2 x 7 1/4
	65-494		S	-	-	-	Yes	3FM 3AM	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	No	Yes	No	No	I/U	-	7 1/2 x 3 x 5 1/2
	65-496		S	-	-	-	Yes	No	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	No	Yes	Yes	No	I	-	7 x 2 x 6
	65-498		S	-	-	-	Yes	No	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	No	Yes	Yes	No	I	-	7 x 2 x 5 1/2
	65-499		S	-	-	-	-	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	Yes	No	No	Yes	No	No	U	-	6 1/2 x 2 x 6 1/2
	65-516		D	-	-	-	No	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	Yes	No	No	U	-	7 1/2 x 2 1/2 x 7
	65-536		S	-	-	-	No	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	No	No	No	U	-	5 1/2 x 2 x 7 1/2
	65-554		S	-	-	-	Yes	No	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	No	No	No	I	-	5 1/2 x 7 1/4 x 1 1/2
	65-558		S	-	-	-	Yes	No	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	No	No	No	I	-	5 1/2 x 7 1/4 x 2
	65-564		S	-	-	-	Yes	5FM 5AM	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	No	No	No	I	-	7 1/2 x 3 x 7 1/4
65-577		S	-	-	-	-	-	Tone Cont. Tone Cont.	Tone Cont. Tone Cont.	No	Yes	No	No	No	No	U	-	5 1/2 x 2 1/2 x 7 1/4	
METRO SOUND	MS-8570	189.95	S	-	8	No	No	-	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	7 x 1 1/2 x 6
	MS-7570	179.95	S	-	5	No	No	-	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	7 x 1 1/2 x 6
	MS-7560	169.95	S	-	5	Yes	No	-	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	7 1/2 x 2 x 6 1/2
	MS-7550	159.95	S	-	5	Yes	No	-	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	7 1/2 x 2 x 6 1/2
	MS-7450	139.95	S	-	5	Yes	No	-	Yes	Yes	Yes	No	Yes	Yes	Yes	No	I	Adj.	7 x 2 x 6
	MS-7250C	129.95	S	-	5	No	No	-	Yes	Yes	Yes	No	Yes	No	No	I	Adj.	8 3/4 x 1 1/2 x 4 1/4	
	MS-818	169.95	S	-	5	No	Yes 5	-	No	Yes	No	Yes	No	No	No	No	I	Adj.	7 x 2 x 4 1/2
	MS-816F	119.95	S	-	5	Yes	No	-	No	Yes	No	Yes	No	No	No	No	I	Adj.	6 1/2 x 1 1/2 x 4 1/4
	MS-817F	108.95	S	-	5	Yes	No	-	Yes	Yes	No	Yes	Yes	Yes	Yes	No	U	N/A	5 1/2 x 2 1/2 x 7
	MS-120	99.95	S	N/A	4	No	No	-	Yes	Yes	No	No	Yes	Yes	No	No	U	N/A	4 1/2 x 2 x 6
	MS-308	39.95	S	N/A	3.5	No	No	-	Yes	Yes	No	Yes	No	No	No	No	U	N/A	5 1/2 x 2 x 7
	MS-887	39.95	S	N/A	4	No	No	-	Yes	Yes	No	Yes	No	No	No	No	U	N/A	5 1/2 x 2 x 7
	MS-c/8	65.95	S	N/A	4	No	No	-	Yes	Yes	Yes	Yes	No	Yes	No	No	U	N/A	5 1/2 x 2 1/2 x 8
MOTOROLA	TM124S	29.95	S	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	U	-	-
	TM226S		S	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	U	-	-
	TM316S		S	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	U	-	-
	TM416S		S	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	I	Adj.	-
	TM756S		S	-	-	-	Yes	5FM 5AM 5AM 5AM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	I	Adj.	-
	TM836		S	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	I	Adj.	-
TC877AX		S	-	-	-	-	-	Yes	Yes	Yes	Yes	No	Yes	Yes	No	I	Adj.	-	
TC876AX		S	-	-	-	-	-	Yes	Yes	Yes	Yes	No	Yes	Yes	No	I	Adj.	-	
NUVOX ELECTRONICS	AFX-830	99.95	S	-	5	Yes	No	-	Yes	No	No	Yes	No	No	No	No	I	Adj.	-
	AFX-3000	109.95	S	-	5	No	No	-	Yes	No	No	No	No	No	No	No	I	Adj.	-
	AF-413	89.95	S	-	5	Yes	No	5FM 5AM 5AM	Yes	No	No	No	No	No	No	No	I	Adj.	-
	AF-410	69.95	M	-	5	No	No	5FM 5AM 5AM	Yes	No	No	No	No	No	No	No	I	Adj.	-
	A-881	69.95	S	-	5	No	No	3FM 2AM	Yes	No	No	No	No	No	No	No	I	Adj.	-
PANASONIC	CX-1100	59.95	M	-	5	N/A	-	-	Sep. Left Rt. Tone Cont.	Sep. Left Rt. Tone Cont.	-	Yes	-	-	-	No	U	-	2 1/2 x 7 1/2 x 6 1/2
	CX-5100	74.95	M	-	5	N/A	-	-	Sep. Left Rt. Tone Cont.	Sep. Left Rt. Tone Cont.	Yes	-	-	Yes	Yes	No	U	-	2 1/2 x 7 1/2 x 5 1/2
	CX-7100	99.95	M	-	5	N/A	-	-	Sep. Left Rt. Tone Cont.	Sep. Left Rt. Tone Cont.	Yes	-	Yes	Yes	Yes	No	U	-	2 1/2 x 7 1/2 x 5 1/2

(Continued)

It's time for everybody else to start playing catch-up. Again.

From the very beginning, experts have acclaimed the performance and feature innovations of Yamaha receivers as nothing less than spectacular.

But now, we've outdone ourselves.

Yamaha is introducing a new line of receivers with such unprecedented performance, it's already changing the course of audio history.

Real Life Rated™ While traditional laboratory measurements provide a good relative indication of receiver performance, they simply don't tell you how a receiver will sound in your living room in actual operation. So Yamaha developed a new standard for evaluating overall receiver performance under real life conditions. It's called **Noise-Distortion Clearance Range (NDCR)**. No other manufacturer specifies anything like it, because no other manufacturer can measure up to it.

We connect our test equipment to the phono input and speaker output terminals, so we can measure the performance of the entire receiver, not just individual component sections like others do. We set the volume control at -20dB, a level you're more likely to listen to than full volume. We measure noise and distortion together, the way you hear them.

On each of our new receivers, Yamaha's Noise-Distortion Clearance Range assures no more than a mere 0.1% combined noise and distortion from 20Hz to 20kHz at any power output from 1/10th watt to full-rated power. **Four receivers, one standard.** On each of our four new receivers, Yamaha reduces both THD and IM distortion to new lows—a mere 0.05% from 20Hz to 20kHz into 8 ohms. This is the kind of performance that's hard to come by in even the finest separate components. But it's a single standard of quality that you'll find in each and every new Yamaha receiver. From our CR-620 and CR-820 up to our CR-1020 and CR-2020.

What's more, we challenge you to compare the performance and features of our least expensive model, the CR-620, with anybody else's most

expensive receiver. You'll discover that nobody but Yamaha gives you our incredibly low 0.05% distortion and -92dB phono S/N ratio (from moving magnet phono input to speaker output).

You'll also discover that nobody else starts out with such a variety of unique features. Independent Input and Output Selectors that let you record one source while listening to another. A Signal Quality Meter that indicates both signal strength and multipath. The extra convenience of Twin Headphone Jacks. Or the accurate tonal balance provided at all listening levels by Yamaha's special Variable Loudness Control.

More flexibility. It's consistent with Yamaha's design philosophy that you'll find the same low distortion throughout our new receiver line. Of course, as you look at Yamaha's more expensive models, it's only logical that you'll find the additional flexibility of more power, more functions, and more exclusive Yamaha features.

For example, there's a sophisticated tuner, with unique negative feedback and pilot signal cancellation circuits (patents pending), that makes FM reception up to 18kHz possible for the first time on a receiver. Plus other refinements like a Built-In Moving Coil Head Amp, Fast-Rise/Slow-Decay Power Meters, and Yamaha's own Optimum Tuning System.

Now's the time to give us a listen. Our new receiver line is another example of the technical innovation and product integrity that is uniquely Yamaha. And your Yamaha Audio Specialty Dealer is an example of uncommon dedication to faithful music reproduction and genuine customer service. It's time you heard them both.

If your Yamaha Audio Specialty Dealer is not listed in the local Yellow Pages, just drop us a line.



Audio Division, P.O. Box 6600, Buena Park, CA 90622
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CR-620		MC HEAD AMP
NFB/PLL		CR-820
OTS		NDCR
CR-1020		0.05%
Signal Q		CR-2020

Sankyo Seiki CS-333



Sparkomatic SR-46



Superscope CA-20



Royal Sound RS-2500

Car Radio/Tape Players

MANUFACTURER	Model	Price	Stereo (S), Mono (M), or 4-channel (D)?	FM Sensitivity, mV? (for 50-dB weighting)	Average Writz channel, 50-10 kHz.	% Distortion @ rated writz	Local/Distance Search?	Prohibitives: If Yes, Number AM, Number FM	Bass Control?	Treble Control?	Compact?	B-Tape?	Auto Reverse?	Fast Forward?	Tape Rewind?	Includes Speakers?	In Dash (I) or Under Dash (U)?	Control Shift Spacing, inches?	Dimensions, inches: H x W x D?
PANASONIC (Continued)	CA-9500	74.95	M		N/A		Yes	-	-	-	-	-	-	-	-	No	U	-	1 1/2 x 1 1/2 x 6 1/4
	CO-1851	139.95	S		10	10	Yes	-	-	-	-	-	-	-	-	No	U	-	2 3/8 x 9 1/8 x 8
	CX-233	69.95	S		3.5	10	-	-	-	-	-	-	-	-	-	No	U	-	2 x 4 x 6 1/2
	CX-385	49.95	S	-	3.5	10	-	-	-	-	-	-	-	-	-	No	U	-	2 x 4 x 6 1/2
	CO-2700	129.95	S		3.5	10	Yes	-	-	-	-	Yes	No	No	No	No	I	Adj.	2 x 7 x 6
	CO-6700	154.95	S		3.5	10	Yes	-	-	-	-	Yes	-	-	-	-	I	Adj.	1 3/4 x 7 x 5 1/2
PIONEER	KP8005	189.95	S	1.1	4	10	Yes	4/1FM 4/1AM	No	Yes	Yes	-	No	Yes	Yes	No	I	Adj.	2 x 5 x 7 1/2
	KP8000 (European Cars)	189.95	S	1.1	4	10	Yes	3FM 2AM	No	Yes	Yes	-	No	Yes	Yes	No	I	130 mm	2 x 5 x 7 1/2
	KP5005	169.95	S	1.1	4	10	Yes	-	No	Yes	Yes	-	No	Yes	Yes	No	I	Adj.	2 x 5 x 7 1/2
	TP9006/5/4	199.95	S	1.1	4	10	Yes	5FM	No	Yes	-	Yes	No	No	No	No	I	Adj.	3 1/4 x 6 1/2 x 7 1/2
	TP7006/5/4	179.95	S	1.1	4	10	Yes	5FM 5/0 AM	Yes	Yes	-	Yes	No	No	No	No	I	Adj.	3 1/4 x 6 1/2 x 7 1/2
	GX5050	139.95	S	1.1	4	10	Yes	5FM 5AM	No	Yes	-	-	No	-	-	No	I	Adj.	2 x 5 x 7
	KP500	159.95	S	1.1	4	10	Yes	-	Yes	Yes	Yes	-	No	Yes	Yes	No	U	-	3 x 7 1/2 x 7 1/2
	TP900	149.95	S	1.1	4	10	Yes	-	Yes	Yes	-	Yes	No	Yes	No	No	U	-	3 x 7 1/2 x 7 1/2
	TP727	79.95	S	-	4	10	Yes	-	Yes	Yes	-	Yes	No	Yes	No	No	U	-	2 3/4 x 6 1/2 x 6 1/2
	GT6600	299.95	S	-	4	10	Yes	5/0FM 5/0AM	No	Yes	-	-	No	-	-	No	I	Adj.	2 3/4 x 6 x 7
	GT1100	279.95	S	-	4	10	Yes	5/0FM 5/0AM	No	Yes	-	-	No	-	-	No	I	Adj.	2 3/4 x 6 x 7
	TP7000	159.95	S	-	4	10	No	5/0FM 5/0AM	No	Yes	-	Yes	No	No	-	No	I	Adj.	2 x 6 x 7 1/2
	TP6001	119.95	S	-	4	10	Yes	-	No	Yes	-	Yes	No	No	-	No	I	Adj.	2 x 6 x 7 1/2
	TP252	49.95	S	-	4	10	No	-	No	Yes	-	Yes	No	No	-	No	U	-	2 x 4 x 6 1/2
	TP200	99.95	S	-	4	10	No	-	No	Yes	-	Yes	No	No	-	No	U	-	2 1/2 x 7 1/2 x 7 1/2
	KP4000	149.95	S	-	4	10	Yes	-	No	Yes	Yes	-	No	Yes	Yes	No	I	Adj.	2 x 6 x 7 1/2
KP292	89.95	S	-	4	10	No	-	No	Yes	Yes	-	No	Yes	Yes	No	U	-	2 x 4 x 6 1/2	
KP250	119.95	S	-	4	10	No	-	No	Yes	Yes	-	No	Yes	Yes	No	U	-	2 x 6 x 6 1/2	
KP212	69.95	S	-	4	10	No	-	No	Yes	Yes	-	No	Yes	Yes	No	U	-	2 x 4 x 6 1/2	
GX2020	99.95	S	-	4	10	Yes	5/0FM 5/0AM	No	Yes	-	-	No	-	-	No	I	Adj.	2 x 5 x 7 1/2	
GX1500	79.95	M	-	4	10	Yes	5/0FM 5/0AM	No	Yes	-	-	No	-	-	No	I	Adj.	2 x 5 x 7 1/2	
AD320	59.95	S	-	16	0.8	-	-	-	-	-	-	-	-	-	-	No	U	-	2 1/4 x 4 x 5 1/2
AD312	39.95	S	-	9	1.0	-	-	-	-	-	-	-	-	-	-	No	U	-	2 x 4 x 4 1/2
ROYAL SOUND CO.	RS-850	70.00	S	-	4 1/2	3.0	No	No	No	No	Yes	No	No	Yes	No	No	U	-	1 3/4 x 5 1/2 x 5 1/2
	RS-900	90.00	S	-	6	3.0	No	No	No	Yes	No	No	Yes	No	No	No	U	-	1 3/4 x 5 1/2 x 5 1/2
	RS-1000	110.00	S	-	6	3.0	No	No	No	Yes	No	No	Yes	Yes	No	No	U	-	1 3/4 x 5 1/2 x 6 1/2
	RS-1500	145.00	S	-	6	3.0	No	No	No	Yes	No	Yes	Yes	Yes	No	No	U	-	2 x 4 x 7
	RS-1600N	220.00	S	2	6	2.0	No	No	No	Yes	No	Yes	Yes	Yes	Yes	No	I	Adj.	2 x 5 1/2 x 7
	RS-1800	110.00	S	-	6	3.0	No	No	No	Yes	No	Yes	Yes	Yes	Yes	No	U	-	2 x 6 1/2 x 5 1/2
	RS-2050N	200.00	S	5	6	3.0	No	No	No	Yes	No	Yes	Yes	Yes	No	No	I	Adj.	1 1/2 x 6 1/2 x 4 1/2
	RS-2500	300.00	S	1	8	2.0	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	No	I	Adj.	2 x 7 x 7 1/2
RS-2900	375.00	S	1	8	2.0	No	5AM 5FM	No	No	Yes	No	Yes	Yes	Yes	No	I	Adj.	2 1/2 x 7 x 6 1/2	
SANKYO SEIKI	SCS-333	159.95	S	1	4	4.0	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	I	Adj.	2 x 6 1/2 x 7
SOLAR SOUND SYSTEMS	CS88	59.95	S	-	2.5	2	-	-	No	No	Yes	Yes	No	Yes	No	No	U	-	3 x 5 1/2 x 8
SPARKOMATIC CORPORATION	SR-42	89.95	S	20	3	10	Yes	None	Comb. Cont.	Comb. Cont.	No	No	No	No	No	No	I	Adj.	1 1/2 x 7 x 7 1/2
	SR-44	119.95	S	10	4.5	10	Yes	5 any combo AM/FM	Comb. Cont.	Comb. Cont.	No	No	No	No	No	No	I	Adj.	1 3/4 x 5 1/2 x 7 1/2
	SR-46	139.95	S	10	4.5	10	Yes	None	Comb. Cont.	Comb. Cont.	No	Yes	No	No	No	No	I	Adj.	1 1/2 x 7 1/2 x 6 1/2
	SR-48	149.95	S	10	4.5	10	Yes	None	Comb. Cont.	Comb. Cont.	Yes	No	No	Yes	No	No	I	Adj.	2 x 6 1/2 x 7 1/2
	FMX-10	59.95	S	15		10	No	None	Comb. Cont.	Comb. Cont.	No	No	No	No	No	No	U	-	1 1/2 x 6 1/2 x 6
SUPERSCOPE, INC.	CA-10	59.95	S	-	3	10.0	No	No	Tone	Tone	Yes	No	No	Yes	No	No	U	-	2 1/2 x 5 1/2 x 6 1/2
	CA-15	119.95	S	-	3.5	10.0	No	No	Tone	Tone	Yes	No	Yes	Yes	No	No	U	-	2 1/2 x 7 x 7
	CA-20	159.95	S	2.0	4	10.0	No	No	Tone	Tone	Yes	No	Yes	Yes	Yes	No	I	Adj.	1 1/2 x 7 x 5 1/2

Own a piece of the rock.



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Actually, you can own two pieces of the rock. Rock music. And a rock solid, dependable machine. The dependability comes from our all electronic control system. This quality feature allows you to switch from the play mode directly to the record mode ... without going through the stop mode first. It's a professional feature rarely offered in a consumer tape deck.

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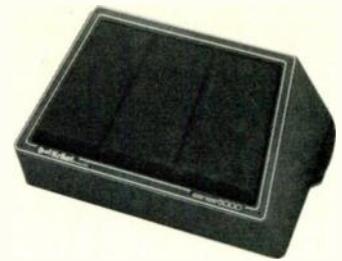
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Astrosonix / Bowman SK-1010

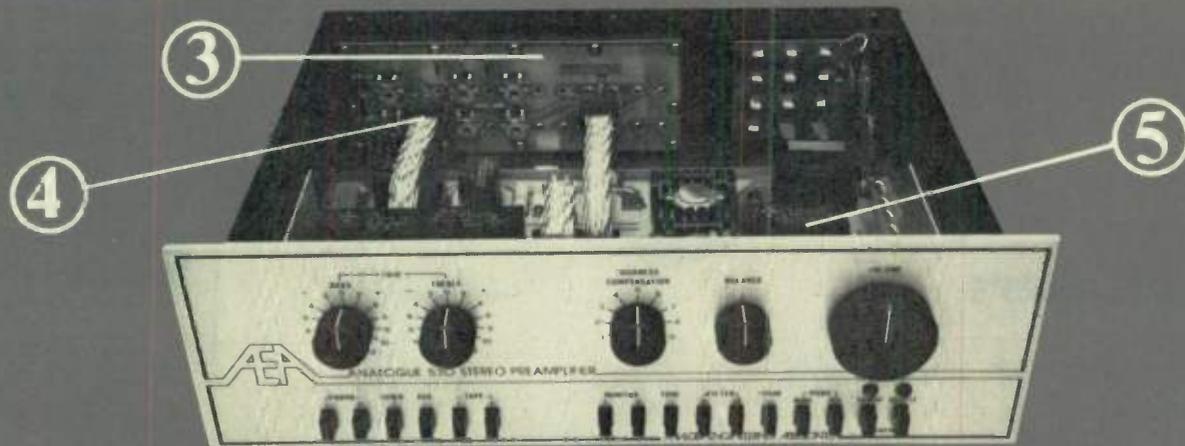


Acoustic Fiber Sound Systems KK-6069

Car Speakers

MANUFACTURER	Model	Price \$ (if sold individually)	Price \$ (if sold in pairs)	Recommended Power, Watts	Driver Size inches?	Magnet Size Oz?	Impedance, Ohms?	Frequency Response, 7 Hz to ? Hz ± 7 dB	Control (C) or T1, Axial (T)?	Flush Mount (F) or Surface Mount (S)?	Overall Dimensions	Notes
ACOUSTIC FIBER SOUND SYSTEMS, INC.	8972	39.95	79.95	30	6x9	20	8	40-18k	C	F		air suspension dual cone speaker
	8971	29.95	59.95	30	6x9	20	8	40-15k	F	F		
	8932	34.95	69.95	18	6x9	10	8	45-18k	C	F		air suspension dual cone speaker
	8931	24.95	49.95	18	6x9	10	8	45-15k	C	F		air suspension dual cone speaker
	8531	22.95	44.95	10	5	10	8	65-15k	F	F		air suspension dual cone speaker
	8232	32.95	64.95	12	5 1/2	10	8	55-17.5k	C	F		air suspension dual cone speaker
	8231	22.95	44.95	12	5 1/2	10	8	55-15k	F	F		air suspension dual cone speaker
	6049	29.95	59.95	25	5 1/2	10	8	60-15,000 +5dB	—	F/S	5 1/2 x 11 x 9 1/2	air suspension dual cone speaker
	6059	39.95	79.95	25	5 1/2	10	8	60-20,000 +5dB	C	F/S	5 1/2 x 11 x 9 1/2	
	6069	49.95	99.95	36	6x9	10	8	50-15,000 +5dB	—	F/S	5 1/2 x 11 x 9 1/2	air suspension dual cone speaker
6079	59.95	119.95	36	6x9	10	8	50-18,000	C	F/S	5 1/2 x 11 x 9 1/2		
ADS	ADS200C	115.00	230.00	5	1 dome 4 cone	12 16	4	50-22k ±5	*	S F(opt) **	4 1/2 x 7 x 4 1/2	*two-way
	ADS300	140.00	280.00	5	1 dome 5 1/2 cone	13 20	4	40-23k ±5	*	F **	5 x 8 1/2 x 5 1/2	*two-way **cus. inst.
	ADS2001A		570.00	160*	1 dome 4 cone	12 16	43k 350k	50-22k ±5	**	S F(opt) S	4 1/2 x 7 x 4 1/2	*bi-amp **two-way
	ADS2002		449.00	80*	1 dome 4 cone	12 16	47k	55-22 +5	**	S F(opt)	4 1/2 x 7 x 4 1/2	*bi-amp **two-way
ASTROSONIX/BOMAN	SK-685		34.95	20	—	20	4	—	—	F	5 1/2 dia.	
	SK-680		29.95	10	—	12	4	—	—	F	5 1/2 dia.	
	SK-660		22.95	10	—	6	4	—	—	F	5 1/2 dia.	
	SK-600		16.95	5	—	3	8	—	—	F	5 1/2 dia.	
	SK-450		18.95	—	—	2.5	4	—	—	F	4 dia.	
	SK-1010		22.95	8	5	10	4	—	—	S	—	
	SK-1055		24.95	8	5	10	4	—	—	F	—	
	SK-75		18.95	8	5	3	4	—	—	S	—	
	SK-55		14.95	8	5	3	4	—	—	F	—	
	SK-94		13.95	5	5 1/2	3.5	4	—	—	S	—	
	SK-690	16.95	—	10	6x9	6	8	—	—	F	—	
	SK-69TR-40		88.95	10	6x9	20	8	—	*	F	—	*Tri-sonic
	SK-525CX-20		39.95	10	5 1/2 x 2	20	8	—	—	F	—	
	SK-69CX-20		24.95	10	6x9	20	8	—	C	F	—	
AUDIOVOX CORPORATION	C01D-69/10	20.95	44.95	15	6x9	10	4/8	60-16k Hz	—	—		
	C01D-69/20	24.95	53.95	20	6x9	20	4/8	60-18k Hz	C	F		
	TRYVOX-X-20		89.95	30	6x9	20	4/8	—	T	F		
	C05C-10		34.95	20	5 1/2 rd.	10	4/8	60-18k Hz	—	F		
	C05C-20		44.95	25	5 1/2 rd.	20	4/8	50-20k Hz	C	F		
	DSW-30		28.95	10	5 1/2 rd.	10	8	85-17k Hz	—	S		
	ID-35		20.95	5	4 rd.	3.57	4&8	—	—	—		
	ID-36		29.95	10	—	10	4&8	70-13k Hz	—	F		
	MRS-10		18.95	5	2 1/2 rd.	—	—	—	—	—		
	MSS-10		18.95	10	—	10	8	—	—	F		
	SC-15		33.95	10	5 1/2 rd.	15	4&8	60-10k	—	—		
	SC-20		37.95	15	—	20	4&8	60-17k Hz	—	F		
AUTOMATIC RADIO	SET 5482		8.95	5	3	8	—	—	—	F		
	FMT 6396		8.50	5	3	8	—	—	—	S		
	SK-300		12.95	5	3	Dual 4&8	—	—	—	S		
	SK-500		13.50	5	3	Dual 4&8	—	—	—	F		
	SK-600		14.95	—	3	8	—	—	—	S		Wedge
	SK-625		17.95	5 1/2	3	Dual 4&8	—	—	—	F		
	SK-650		17.95	5 1/2 x 5 1/2	3	Dual 4&8	—	—	—	S/F		
	SK-675		23.50	—	3	8	—	—	—	S		Wedge
	SK-750		25.95	5 1/2	6.8	Dual 4&8	—	—	—	F		
	SK-800		24.95	—	6.8	Dual 4&8	—	—	—	S/F		
	SK-900		29.95	20	5 1/2	12	Dual 4&8	—	—	F		
	SK-950		29.95	20	5 1/2 x 5 1/2	12	Dual 4&8	—	—	F		
	SK-975		29.95	5 1/2 x 5 1/2	12	Dual 4&8	—	—	—	S/F		
	SK-1010		39.95	25	5 1/2	20	8	—	C	F		
SK-6090		42.95	25	6x9	20	8	—	—	F			
JR-690		14.95	—	6x9	6.8	8	—	—	F			
SH-570		13.95	—	5x7	6.8	8	—	—	F			

44



If you're buying components, and you want performance,

- ① All original circuit design. Pure Class A/Multi-path loop with lowest S/N ever 84 dB unweighted (92 dB A weighted).
- ② 95% of all circuit components are hermetically encapsulated in 6 Epoxy plug-in modules for the ultimate in facility of service and stabilized component protection.
- ③ *Integral Back-plane interface system* allows true integral jack to board wiring for constant impedance

- and consequent elimination of losses.
- ④ NASA and Mil. Spec. throughout—with all highest grade parts available/24k. gold-plated cable connectors, 36 pin/24k. gold-plated phono jacks/silver plated and 24k. gold-plated mode switch contacts.
- ⑤ Continuously variable loudness compensator uses precise *Summation Filter* design for infinite combination of room/amp/speakers.

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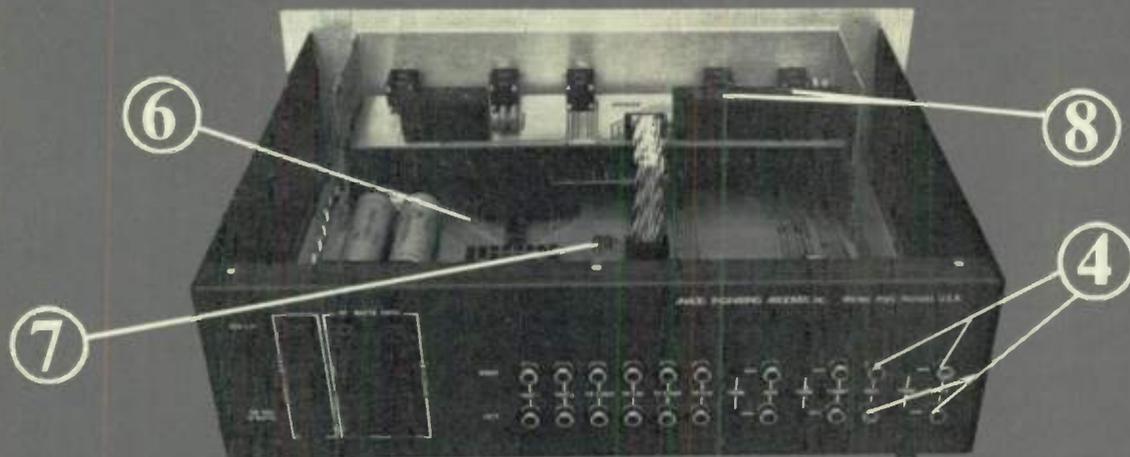


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520 PARK AVENUE SOUTH, WINTER PARK, FLORIDA U.S.A. 32789

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look into the Analogue 520 with ANA-MOD engineering exclusives.

- ⑥ All interconnections, all controls, all circuitry, all input/output jacks are mounted directly on printed circuit *Blue-Boards*.
- ⑦ Aerospace parts throughout, all resistors are 1%/capacitors, mica, metalized polycarbonate or solid tantalum for unvarying specs.
- ⑧ *Integrated Equalizer* tone control circuit with psychoacoustically computed slopes and non-ringing hi-cut filter.

- **⑨ *Low transient error rating* below 0.001% under actual dynamic conditions (while using music as a test signal) TTE Method using proprietary A.E.A. Inc. Transient Error Detection System in Q.C. and circuit design.
- ⑩ 1000% overrated, ultra-regulated power supply with high thermal stability.

**Tech paper on total Transient Error detection techniques is available on request from the factory.

"on the cutting edge of technology—where nothing matters but the music"



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Car Speakers

Comm Industries 69DX

46

MANUFACTURER	Model	Price, \$ (if sold individually)	Price, \$ (if sold in pairs)	Recommended Power, Watts	Driver Size, inches?	Magnet Size, Oz.?	Impedance, Ohms?	Frequency Response 7 Hz to 7 kHz ± dB	Ce and/or Ti-Axial (T)?	Flush Mount (F) or Surface Mount (S)?	Overall Dimensions	Notes
B & B IMPORT-EXPORT INC.	Rhapsody RY-16		5.95	5	3	8		100-15k	-	S	5½x5x3¼	
	Rhapsody RY-10		6.95	5½	3	8		100-15k	-	F		
CAR TAPES INC./JET SOUNDS	JSW500S		12.95	8	5	5	8	100-10	-	F/S		Convertible wedge
	JSW-1200S		19.95	20	5	10	8	100-12	-	F/S		Convertible wedge
	JS-25		9.95	8	5½	3	8	100-10	-	F		*Air suspension
	JS-48-10AS		19.95	20	5½	10	4-8	90-12	-	F		
	JS-550CX		29.95	30	5½	20		80-14	C	F		
	JS-950CX		39.95	30	6x9	20		50-15	C	F		
	JSL-963-TX	34.55	30	6x9	20			50-18	T	F		
	JSL MK1		59.95	30	4	20		50-15	-	S	6x6x5	*Air suspension
CERWIN-VEGA	CS-5		55.00	15	6x9	40	4	50-15k	(C)	F	3¼x9x6	
	CS-10		99.00	15	6x9	64	4	50-16k	(C)	F	4½x9x6	
CLARION CORP.	SK-59		16.95	3	4	3	4	125-9k±6	-	F	4x4x1½	
	SK-95		39.95	8	4	10	8	100-15k±6	C	F	4½x4½x2¼	
	SK-76		22.95	3	5	6	4	100-10k±6	-	S	6¼x5½x4½	
	SK-62		18.95	3	5½	3	4	70-8k±6	-	F	6¼x2½	
	SK-40		29.95	8	5½	10	8	100-15k±6	-	F	6¼x2½	
	SK-41		39.95	10	5½	20	8	100-15k±6	— dual cone	F	6¼x2½	
	SK-44		43.95	8	5½	10	8	100-16k±6	— dual cone	F	6¼x2½	
	SK-45		52.95	10	5½	20	8	100-16k±6	C	F	6¼x2½	
	SK-61		17.95	3	3x5	5	4	100-10k±6	C	S	5¼x3½x1¼	
	SK-86	19.95	10	6x9	10	8		70-18k±6	— dual cone	F	9½x6½x3¼	
	SK-87	23.95	12	6x9	20	8		70-18k±6	— dual cone	F	9½x6½x3¼	
	SK-88	27.95	10	6x9	10	8		70-20k±6	C	F	9½x6½x3¼	
	SK-89	32.95	12	6x9	20	8		70-20k±6	C	F	9½x6½x3¼	
SK-99	59.95	8	5¼ woofer 3 mid-range 1 horn tweeter	20	8		70-20k±6	3 spkr. combo	F	10½x6¼x3¼		
COMM INDUSTRIES	69DX		89.95	90	6x9	10	8	50-13.8±10	(c)	(f)	6x9x4	
COMPONENTS SPECIALTIES	Three for the Road				6x9&4	20&4.5	8	50-20		F		Dual speakers
	SK69CA20T-G				6x9	20	8	50-20		F		Dual speakers
	Van Kit #1				8&4	10&4.5	8	50-20		F		Dual speakers
	Van Kit #2				5½	10	8	80-15		F		Dual speakers
	Van Kit #3				5½	10	8	130-20		F		Dual speakers
	Van Kit #4				8	10	8	50-20		F		Dual speakers
	Van Kit #5				8&4	26&4.5	8	45-20		F		Dual speakers
	Van Kit #6				6x9&4	27&4.5	8	50-20		F		Dual speakers
	SK51CF3W-G				5½	3	8	125-20		F		
	SK51CF5W-G				5½	5	8	125-20		F		
	SK51CA10W-G				5½	10	8	80-15		F		
	SK51CA10C-G				5½	10	8	130-20		F		
	SK69CF10W-G				6x9	10	8	75-18		S		
	SK69CA10W-G				6x9	10	8	55-15		S		
	SK69CA10C-G				6x9	10	8	55-20		S		
	SK69CA20W-G				6x9	20	8	55-15		S		
	SK69CA20C-G				6x9	20	8	50-20		S		
SK69CA27W-G				6x9	27	8	50-15		S			
SK410CF5W				4x10	5	8	140-18		S			
SK410CF10W				4x10	10	8	140-18		S			
CRAIG CORP.	R730		79.95	5½	20	4				F		
	R770		99.95	6x9	20	4				F		
	R780		99.95	5½	11	4				S		
	V401		42.95	5½	10	8				F	17¼x7x9	
	V440		49.95	6x9	10	8				F	6x6x½	
	V460		64.95	6x9	10	8				F	9½x6½x½	
	V461		74.95	6x9	10	8				F	9½x6½x½	
	9420		36.95	5½	11	8				F	8½x6½x½	
	9422		34.95	6x9	11.6	8				F	6¾x1¼	
	9425		43.95	6x9	10	8				S	9¼x5¼x9½	
(Continued)	9430		57.95	5½	11	4			S	10¼x5¼x9		

The "Click and Pop" machine

Ever since the invention of the recorded disc annoying "clicks" and "pops" caused by scratches, static and imperfections have consistently disturbed the listening pleasure of music lovers.

Now, SAE introduces the unique model 5000, an Impulse Noise Reduction System which eliminates those unwanted sounds with no adverse effect on the quality of the recorded material. This breakthrough in electronic circuitry is so demonstrably

effective that the SAE 5000 is destined to become an essential part of any sound system.

The SAE 5000 is compact and sleek, built to SAE's exacting standards, and ready to enhance the performance of any system, from the standard receiver/turntable combination, to the most sophisticated audiophile components.

SAE is proud to add the 5000 to their broad line of Components for the Connoisseur.



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Scientific Audio Electronics, Inc.
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Sparkomatic SK-6922T

Car Speakers

MANUFACTURER	Model	Price, \$ (If sold individually)	Price, \$ (If sold in pairs)	Recommended Power, Watts	Driver Size, inches?	Magnet Size, Oz.?	Impedance, Ohms?	Frequency Response Hz to kHz ± dB	Co axial (C) or Tri axial (T)?	Flush Mount (F) or Surface Mount (S)?	Overall Dimensions	Notes		
CRAIG CORP. (Continued)	9432	59.95		6x9	10	4			C	F	9x6x½			
	V400	34.95		4	8	8			F	F	5½x4½x½			
	9426	24.95		4	5.4	4			F	F	5½x5x1			
	9427	26.95		5½	5.4	4			F	F	6¾x¾			
	9428	29.95		5½	2.9	4			F/S	F	6½x6x1			
	9429	57.95		6x9	30.0	4&8			F	F				
	V140	29.95		6x9	8	8			F	F				
	9433	22.95		3x5	3.6	4			S	S	7¾x3¾x5¾			
	9414	21.95		5½	3.6	4			F	F	6½x1			
	9413	19.95		4	3.6	4			F	F	5½x4¾x1			
9405	18.95		5½	2.9	4			F	F	6½x¾				
ELECTRONIC INDUSTRIES	990X	69.95	30	3& 6x9	10	4-8	50-18k	C	F		9x6x5			
	KE-2	79.95	30	3& 6x9	10	4-8	50-18k ±1	C	F		9x6x5			
	KE-3	99.95	30	6x9& 3& 2	10	4-8	25-20k ±1	T	F		9x6x5			
	6W20XR	49.95	15	5½	20	4-8	55-15k	C	S/F		7x6x6			
	6L20XR	39.95	15	5½	20	4-8	55-15k	C	F		6x6x4½			
	9L20X	54.95	20	6x9	20	4-8	45-18k	C	F		9x6x4			
	9E10	29.95	10	6x9	10	4-8	55-17k	F	F		9x6x4			
	6L10R	24.95	10	5½	10	4-8	60-17k	F	F		6x6x4			
5SF5	19.95	8	5	5	4-8	70-17k	S/F	S		6x5x3				
FAR EASTERN RESEARCH LABS	XS-8D	11.95	5	5	2	8	100-18k±3	2-way	S		4½x6½x6½			
	XS-12C	14.95	10	6	5.3	8	100-20k±3		S		6x5x2			
	XS-18D	24.95	10	5½x2½	5	8	60-20k±3		F		4x5½x9½			
	XS-1W	9.95	5	3x5½	3	8	100-18k±3		S		6x4			
	XS-4Dr	11.95	5	5	3	8	100-18k±3		F		5½x2½			
	XS-6Dr	29.95	40	5½	20	4&8	20-20k±3		C	F		6x4		
	XS-9H	11.95	5	5	3	8	100-20k±3		S		3x7½x5			
	HART ACOUSTICS	RVS-1	100.00	4-25	6in woofer 3in tweeter	12	4-8		90-10k±2		S		13¾x9x6¾	All models incorporate separate (not coaxial) Woofer and Tweeter.
RVS-2		75.00	4-25	6in woofer 3in tweeter	12	4-8	90-10k±2		F		11½x7½			
RVS-3		65.00	4-25	6in woofer 3in tweeter	12	4-8	90-10k±2		F		3¾ dia. 6¾ dia.			
RVS-4		55.00	4-25	6in woofer 3in tweeter	12	4-8	90-10k±2		F		10¼x6¾			
HERALD ELECTRONICS		12.98	25	6x9	10	8	Whizzer		S					
		14.98	30	6x9	20	8	Whizzer		S					
		23.95	30	6x9	20	8	C		S					
		39.95	50	6x9	30	8	C		S					
INLAND DYNATRONICS, INC.	AX3-2096	89.95	25	6x9	20	8	N/A		T	F				
	CX-2096	43.95	20	6x9	20	8	N/A		C	F				
	CX-1096	37.95	15	6x9	10	8	N/A		C	F				
	CX-1052	30.95	15	5½	10	8	N/A		C	F				
	CX-2052	34.95	20	5½	20	8	N/A		C	F				
	RM-755	12.95	8	6½	5	8	N/A		C	F				
	SK-1069	21.00	15	6x9	10	8	N/A		C	F				
	JENSEN SOUND LABORATORIES	C9945	119.95	30	6x9	20	4-8		40-20		T			
C9740		73.95	25	6x9	20	4-8	40-18	C						
C9943		72.95	25	5x7	20	4-8	50-15	C						
C9852		71.95	25	5½	20	4-8	60-15	C						
C9853		61.95	25	5½	10	4-8	60-15	C						
C9851		60.95	20	4	10	4-8	70-15	C						
C9729		49.95	25	6x9	20	4-8	40-14	C						
C9940		48.95	25	5x7	20	4-8	50-12							
C9862		47.95	25	5½	20	4-8	60-12							
C9728		42.95	25	6x9	10	4-8	40-14							
C9937		41.95	25	5x7	10	4-8	50-12							
C9863		40.95	25	5x7	10	4-8	70-12							
C9860		39.95	20	4	10	4-8	60-12							
C9927		89.95	25	5½	20	4-8	50-15	C	S					
C9926		58.95	25	5½	10	4-8	60-12							
C9809		56.95	25	5½	20	4-8	60-12							
C9814		32.95	20	5	5.4	4-8	90-10							

48

"...a pair of 66's may sound unspectacular, even disappointing..."

This is not the sort of quote that manufacturers usually select from equipment reviews. However, we did it for one reason: to get your attention. That's not an easy task, considering the hundreds of other speaker manufacturers clamoring for your ear and your dollar.

The complete excerpt (from *Canadian Stereo Guide*) reads: "To the untrained ear, a pair of 66's may sound unspectacular, even disappointing. There's no thump and sizzle which many equate with good frequency response. No spectacular effects, just the neutral sound of musical instruments playing with nothing added by the speakers. Purity of tone and cleanness of reproduction is particularly noticeable."

The Ditton 66 was in fact developed by Celestion to serve as an authentic monitor speaker, which means

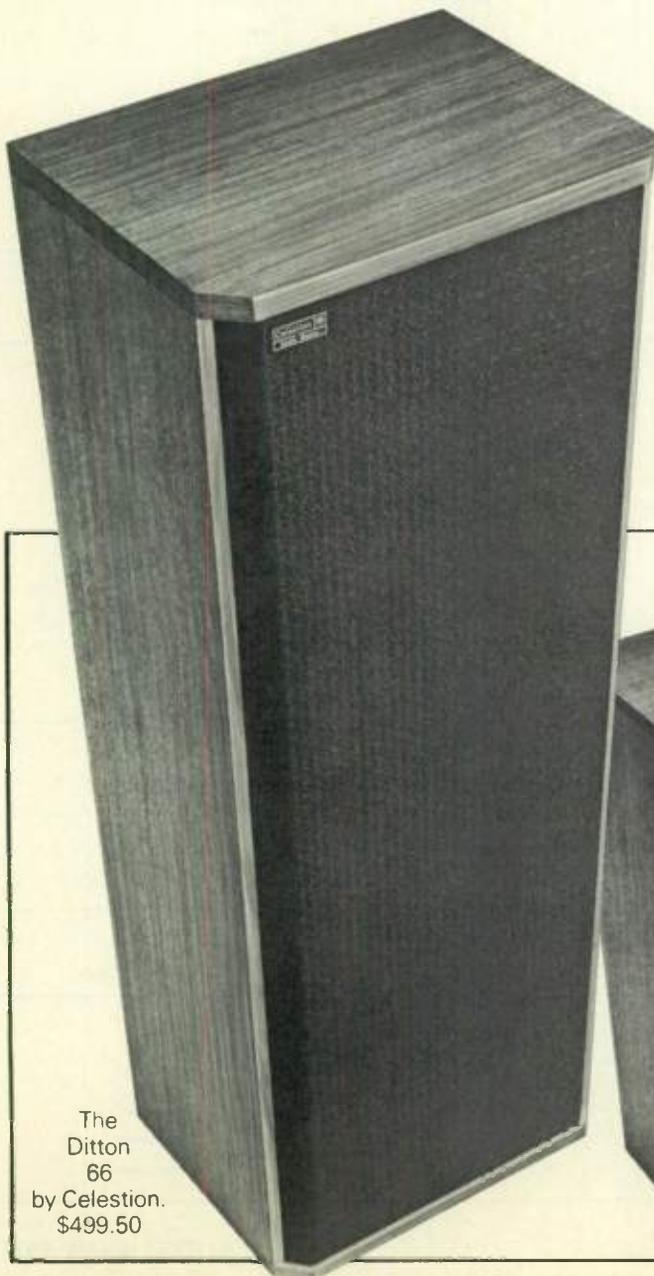
that it was designed to neither add nor subtract anything from the original program material. Recording engineers aren't interested in "hi-fi effects"—they want to hear exactly what's on the master disc or tape with minimum sonic contribution by the speaker.

When the British publication, *Hi-Fi Answers* needed a concert monitor they found the Ditton 66's "... sufficient to cope with the loudest orchestral climaxes available (or even required)... when we wanted to provide concert levels in a large hall, 110 feet x 55 feet with a 25-foot ceiling. A most impressive performance..."

Since most listening rooms are somewhat smaller, the shape of the Ditton 66 should be of special interest. Though its internal volume is three cubic feet, it needs only 1.2 square feet of floor space. It is 15" wide, 11" deep and 39½" high.

Another thoughtful aspect of the enclosure: the drivers are mounted on a finished baffle board. So those who like to operate their speakers with the grille off, for whatever reason, can do so happily.

Now, if you'll drop us a card, we'll send you a list of our carefully selected dealers by return mail. We believe you'll be impressed by the exceptionally "unspectacular" sound of the Ditton Monitor 66.



The
Ditton
66
by Celestion.
\$499.50



Loudspeakers for the perfectionist

Celestion Industries, Inc., Kuniholm Drive, Holliston, Mass. 01746

In Canada: ROCELCO INC., Montreal



The HF-2000 soft-dome tweeter operates from 5,000 to 20,000 Hz. Its exceptionally smooth extended response and wide dispersion achieve an open, airy quality and accurate stereo imaging.

The MD-500 2½" soft-dome mid-range operates from 500 to 5,000 Hz with very low distortion, wide dispersion and correct phase relationships. An extremely powerful magnetic assembly ensures critical damping and high power handling capability.

The FC-12 woofer has a heavy plasticized diaphragm that effectively suppresses resonances. The neoprene roll suspension permits considerable cone excursions without non-linear effects. A massive Feroba II magnet provides critical damping.

The Auxiliary Bass Radiator (ABR) is a highly effective proprietary Celestion device that operates in conjunction with the woofer/enclosure acoustic circuitry. The critically-damped moving system of the ABR has a carefully chosen mass and compliance, acoustically coupled to the woofer and enclosure to control the lower range of the woofer excursion. It takes over completely at the very lowest frequencies. Result: exceptionally smooth reproduction to well under 40 Hz.

Neosonic SP-12



Polk Audio Mini-Monitor

Car Speakers

50

MANUFACTURER	Model	Price, \$		Recommended Power, Watts	Driver Size, inches?	Magnet Size, Oz.?	Impedance, Ohms?	Frequency Response, Hz to kHz, * dB	Control (C) or Tri-Axial (T)?	Flush Mount (F) or Surface Mount (S)?	Overall Dimensions	Notes
		(If sold individually)	(If sold in pairs)									
KRACO	TRI-369	99.95	20	6x9	20	8	60-17k	T	F	3 1/2 x 6 1/2 x 9 1/4	Speaker set w/built-in 45 watt RMS/CH amplifiers	
	CX-269-20F	74.07	12	6x9	20	8	160-15k	C	F	3 1/2 x 6 x 9 1/4		
	CX-1-20F	55.43	8	5 1/2	20	8	190-6.5k	C	S	2 1/2 x 6 x 6		
	CX-2-20CF	66.27	10	5 1/2	20	8	200-13k	C	S/F	4 1/2 x 7 x 6 1/2		
	PBS 90	122.75	-	6x9	10	8	200-4.5k	-	F	-		
	K-269-20F	62.77	12	6x9	20	8	160-10k	-	F	3 x 6 1/2 x 9 1/4		
	SS-1-20F	49.85	15	5 1/2	20	8	180-4.5k	-	F	2 1/2 x 6 x 6		
SS-2-20F	59.63	15	5 1/2	20	8	170-10k	-	S	4 x 7 x 6 1/4			
MAGITRAN CO.	A2000V	11.50	22.95	10	5 1/2	4-8	70-20		F	6 1/4 x 1		
	A500		22.95	10	4 1/2 x 8 1/2	4-8	80-20	F/S	6 x 10 x 1			
	A3000S		29.95	10	4 1/2 x 8 1/2	4-8	90-20	S	5 1/2 x 9 1/2 x 1 1/2			
	A3000S		24.95	10	5 1/2	4-8	80-20	S	7 dia. wedge			
MEDALLION	60-070		20	6x9	10	4 or 8	-	C	F	-		
	60-071		25	6x9	20	4 or 8	-	C	F	-		
	60-073		25	5 1/2	20	4 or 8	-	C	F	-		
	60-074		20	5 1/2	10	4 or 8	-	C	F	-		
	60-090		-	6x9	10	-	-	C	F	-		
	60-091		-	6x9	10	-	-	-	F	-		
	60-157		8	5x7	3	8	-	-	F	-		
	60-169		8	6x9	3	8	-	-	F	-		
	60-170		12	6x9	10	8	-	-	F	-		
	60-171		20	6x9	20	8	-	-	F	-		
	60-173		20	5 1/2	-	-	-	-	F	-		
	60-174		15	5 1/2	-	8	-	C	F	-		
	60-175A		5	5	2	8	-	-	F	-		
	60-178		5	5 1/2	3	8	-	-	F	-		
	60-179		5	5	5	8	-	-	F/S	-		
	60-182		5	3x5 1/2	-	8	-	-	F/S	-		
	60-187P		5	3x5 1/2	3	8	-	-	F/S	3 1/2 x 3 1/2 x 7 1/2		
	60-189		15	5	10	8	-	-	F/S	-		
	60-257B		8	5x7	3	8	-	-	F	-		
	60-269B		8	6x9	3	8	-	-	F	-		
60-270B		12	6x9	10	8	-	-	F	-			
60-282B		-	3	-	-	-	-	F	-			
60-290B		8	4x10	3	8	-	-	F	-			
METRO SOUND	MS-69-202-3X	14.95	69.95	35	6x9	20	4/8		T	F	wedge	
	MS-69-120	16.95	20	6x9	12	4/8		C	F			
	MS-69-200		35	6x9	20	4/8		C	F			
	MS-525-120		26.95	20	5 1/2	12	4/8		C	F		
	MS-525-202		29.95	35	5 1/2	20	4/8		C	F		
	MS-514		18.95	20	5 1/2	12	4/8		C	F		
	MS-516		25.95	35	5 1/2	20	4/8		C	F		
	MS-712		20.95	20	4	12	4/8		C	S		
	MS-452		19.95	20	5 1/2	12	4/8		C	S		
	MS-830		19.75	45	8	30	4/8		C	S		
NEOSONIC CORP. OF AMERICA	SPR-12		26.95	10	3 1/2	5	4	100-16		S	4 1/2 Dia.	Filtered for CB use
	FS-10	14.95	10	3 1/2	5	8	300-4		S	3 1/2 x 4		
PANASONIC	EAB-151	19.95	N/A	3x5	N/A	8	N/A	-	S	rear speaker rear speaker door speaker door speaker		
	EAB-551	19.95	N/A	5	N/A	8	N/A	-	S			
	EAB-303	19.95	N/A	5	N/A	8	N/A	-	F			
	EAB-751	19.95	N/A	6	N/A	4 or 8	N/A	-	F			
	EAB-755	29.95	N/A	6	N/A	8	N/A	-	F			
	EAB-951	19.95	N/A	6x9	N/A	8	N/A	-	F			
	EAB-752	34.95	-	20W max.	6x9	20	4	N/A	C		F	
EAB-753	49.95	20W max.	5 1/2	10	4	N/A	C	F				
(Continued)	EAB-754	57.95	20W max.	5 1/2	20	4	N/A	C	F			

The Precision Decision. We made it. Now it's your turn.



QL-7

We believe that precision is the most important factor in turntable design and performance. Which is why we've built such a high degree of precision into our advanced new line of turntables. So you'll need a whole new set of reasons to choose the one that's right for you. And when it comes to value, all seven will play second to none.

Take our new QL-7 Quartz-Locked and JL-F50 Fully Automatic direct drive, shown above. They're both unusually close when it comes to some important specs, but what will surprise you most is that they're also both in the same price range.

For instance, the JL-F50 checks in with 0.03% wow and flutter (WRMS); 70dB signal-to-noise ratio (DIN B). And it offers a host of convenience features as well, with most controls up front so you can operate them without lifting the dust cover. Its fully automatic operation gentles your favorite records, and lets you repeat them from one to six times - or infinitely. A built-in strobe makes speed adjustments easy and accurate. And the JL-F50's locks are in keeping with its precision design.

The QL-7's looks are equally great. And in its electronic heart, it's a tiger. All business, with the incredible accuracy only a Quartz-Locked machine can boast. Truly for a perfectionist, the QL-7's wow and flutter measures only 0.025% (WRMS); S/N is more than 74dB (DIN B). Figures that no other QL turntable we've seen in its category can touch. It's totally manual, with strobe speed indicator, and priced less than any other QL machine on the market.

The way we see it, you're left with a superb decision: our JL-F50 at less than \$250*, with all the convenience and performance most people could ever want, or our QL-7, the finest under \$300* turntable available today for the discriminating audiophile.

Either JVC you choose, you'll
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JL-F50

have made the right decision.

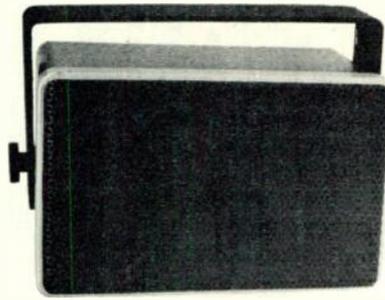
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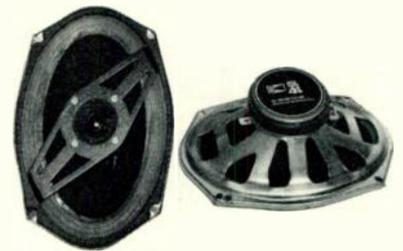
*Approximate retail value.

JVC

We build in what the others
leave out.



Visonik D-30MO



Rogersound Labs RSL-44

Car Speakers

52

MANUFACTURER	Model	Price \$ (if sold individually)	Price \$ (if sold in pairs)	Recommended Power, Watts	Driver Size, inches?	Magnet Size, Oz.?	Impedance, Ohms?	Frequency Response, Hz to kHz ± 3 db	Ceasing (C) or Tri-Axial (T)?	Flush Mount (F) or Surface Mount (S)?	Overall Dimensions	Notes
PANASONIC (Continued)	EAB-771	19.95		20W max.	6x9	10	4	N/A	-	F		rear speaker
	EAB-772	29.95		25W max.	6x9	20	4	N/A	-	F		rear speaker
	EAB-773		37.95	20W max.	5 1/2	10	4	N/A	-	F		door speaker
	EAB-774		44.95	20W max.	5 1/2	20	4	N/A	-	F		door speaker
PIONEER	TS35		36.95	40	5 1/2	5	4	80-13k	-	S	N/A	
	TS22		36.95	8	4, 2 1/2	4	4	100-15k	-	S	N/A	
	TS5		19.95	8	5 1/2	3	4	70-10k	-	S	N/A	
	TS570	17.95		20	5x7	10	4	50-16k	D*	F	N/A	*dual cone
	TS571	24.95		20	5x7	10	4	50-18k	C	F	N/A	
	TSM2		38.95	20	2 1/2	3	4	450-20k	-	S	N/A	tweeter
	TS120		29.95	8	5 1/2	3	4	80-16k	-	F	N/A	thin type
	TS167		59.95	20	6 1/2	10	4	30-20k	C	F	N/A	exponential horn on tweeter
	TS165		54.95	20	6 1/2	20	4	30-16k	C	F	N/A	
	TS164		44.95	20	6 1/2	10	4	40-16k	C	F	N/A	
	TS161		32.95	20	6 1/2	10	4	40-16k	D*	F	N/A	*dual cone
	TS101		25.95	8	4	7	4	60-14k	-	F	N/A	
	TS160		29.95	20	6 1/2	10	4	40-16k	D*	F	N/A	*dual cone
	TS100		21.95	8	4	7	4	60-14k	-	F	N/A	
	P16L		19.95	8	6 1/2	3.7	4	50-10k	-	F	N/A	
	P10L		16.95	8	4	3.7	4	100-10k	-	F	N/A	
	TS894		34.95	20	6x9	20	4	35-18k	C	F	N/A	
	TS893		29.95	20	6x9	20	4	40-18k	C	F	N/A	
TS892		24.95	20	6x9	20	4	35-16k	D*	F	N/A	*dual cone	
TS891		19.95	20	6x9	20	4	40-16k	D*	F	N/A	*dual cone	
TS890		9.95	10	6x9	10	4	50-16k	D*	F	N/A	*dual cone	
POLK AUDIO	Mini Monitor	89.95		5-30	4 1/2 bass mid 4 1/2 sub bass 1 dome		5	60-25k ±2			15 1/2 x 6 x 4 1/2	
ROGERSOUND LABS	RSL44		60.00	10	6x9	10	8	50-22k	C	F/S	6x9x3 1/2	
ROYAL SOUND CO., INC.	RS-705		52.00	10	4 & 2	5	4	80-10k	C	S		
	RS-805		64.00	10	6 1/2	10	4	80-10k	C	S		
	RS-6040		200.00	30 max.	4 2 1/2	4	4-8	50-22k	C	S	6 1/2 x 4 1/2 x 4 1/3	
SPARKOMATIC CORPORATION	SK-6922T	59.95		20	6x9	20	8	30-20k ±3	T	F	9 1/2 x 6 1/2 x 3 1/2	
	SK-622T	49.95		15	6	20	8	55-20k ±3	T	F	6 1/2 x 2 1/2	
	LC-100			20	6x9	20	3	40-18k ±3	C	F	9 1/2 x 6 1/2 x 3 1/2	
	SK-313	11.95		5	3	3	8	100-8k ±3	with amp.	S	4x4x4	
	SK-6920C	49.95		20	6x9	20	8	40-18k ±3	C	F	9 1/2 x 6 1/2 x 3 1/2	
SK-620C	29.95		15	6	20	8	55-18k ±3	C	F	6 1/2 x 2 1/2		
SK-520C	39.95		10	5	20	8	60-18k ±3	C	F	4 1/2 x 2 1/2 x 5/8		
UTAH ELECTRONICS	CS5JFC-W	19.66	-	10	5	10	4-8	-	-	S	5x2 1/2	whizzer
	CS57JC-WCR	21.14	-	10	5x7	10	4-8	-	-	S	5x7 1/2 x 2 1/2	whizzer
	CS2JC-WFR	20.30	-	10	5 1/2	10	4-8	-	-	S	5 1/2 x 2 1/2	whizzer
	CS6JC-W	21.23	-	10	6	10	4-8	-	-	S	6 1/2 x 2 1/2	whizzer
	C69JC-W	21.14	-	15	6x9	10	4-8	-	-	S	6 1/2 x 9 1/2 x 3	whizzer
	C69JC-WCR	21.85	-	15	6x9	10	4-8	-	-	S	6 1/2 x 9 1/2 x 3	whizzer
	C69JC-CR3	29.69	-	15	6x9	10	4-8	-	C	S	6 1/2 x 9 1/2 x 3	whizzer
	C69LXC-WFR	34.22	-	30	6x9	20	4-8	-	-	S	6 1/2 x 9 1/2 x 3 1/2	whizzer
	C69LXC-WFR	44.75	-	30	6x8	20	4-8	-	C	S	6 1/2 x 9 1/2 x 3 1/2	
	C69RC-FR3	75.86	-	50	6x9	39	4-8	-	T	S	6 1/2 x 9 1/2 x 4	
	SP410CPS-B	15.12	-	8	4x10	1.73	4-8	-	-	S	4 1/2 x 10 x 2 1/2	Alnico replacement type
	SP410CPS-BA	15.12	-	8	4x10	1.73	4-8	-	-	S	4 1/2 x 10 x 2 1/2	Alnico replacement type
	SA52-10P	50.49	-	10	5 1/2	10	8	-	-	S	5 1/2 x 2 1/2	
	SA69-10N	58.30	-	12	6x9	10	8	-	-	S	6 1/2 x 9 1/2 x 3	
	SA69-10N/T	66.29	-	12	6x9	10	8	-	C	S	6 1/2 x 9 1/2 x 3	
	SA69-20N	72.62	-	30	6x9	20	8	-	-	S	6 1/2 x 9 1/2 x 3	
SA69-20N/T	100.24	-	30	6x9	20	8	-	C	S	6 1/2 x 9 1/2 x 3		
SA-H100	54.32	-	10	5 1/2	10	8	-	-	F	7 1/2 x 6 1/2 x 3		
VISONIK OF AMERICA	David 30 MO	115.50	231.00	8-30	3 1/2 woofer 3/4 tweeter	4-8	55-25 k ±3		2-way	S	6 1/2 x 4 1/2 x 4 1/2	

“ ‘Super’ FM tuners are usually priced from \$1000 up. Sansui’s new model TU-9900 tuner, at (under) \$450*, matches (their) performance..., at least in the most important respects”.

Julian Hirsch, Hirsch/Houck Laboratories

These are excerpts from the Julian Hirsch test report on Sansui’s new Model TU-9900 as it appeared in Popular Electronics, January 1977.

“The Model TU-9900 ... is an ideal mate for the highest quality amplifiers and speaker systems [It is] esthetically impressive The S/N at 65 dBf (1000 μ V) was 74 dB in mono and 71.5 dB in stereo while distortion measured an incredible 0.021% and 0.052% respectively. (These figures ... leave no doubt that the tuner has stretched the capabilities of our test equipment to its limits) Image rejection was unmeasurable, exceeding the 100 dB range of our test equipment Stereo channel separation was almost as unbelievable as the distortion figures, exceeding 60 dB from 60 – 600 Hz The alternate

channel selectivity [narrow mode] was unmeasurable (greater than 100 dB) and the adjacent-channel selectivity of 17 dB was one of the best we have ever measured on a tuner ...

“Clearly, the Sansui Model TU-9900 tuner is a very superior performer ... [and] any untoward sounds heard via this tuner originate from the FM station In sum, this separate tuner excels in virtually every area of FM performance It’s a top value unit.”

Visit your nearest Sansui franchised dealer today for a demonstration of the TU-9900 or any of the other models in Sansui’s impressive line of amplifiers and matched tuners, the AU/TU series.

A whole new world of beautiful music.



SANSUI ELECTRONICS CORP.

Woodside, New York 11377 • Gardena, California 90247

SANSUI ELECTRIC CO., LTD., Tokyo, Japan

SANSUI AUDIO EUROPE S.A., Antwerp, Belgium • In Canada: Electronic Distributors

*Approximate nationally advertised value. The actual retail price will be set by the individual dealer at his option.

EnWorld Radio History Service Card

V-Fets are the new generation of transistors.



And you know how hard it is to understand the new generation.

Remember the phrase "generation gap"? Well it's not only true for generations of men, but generations of machines, too.

V-Fet devices are a major advancement, needing major explanation. And nobody is more equipped to offer it, than Sony.

Sony pioneered the first generation of transistors, some 25 years ago.

Today, Sony is predictably innovative again, being: the first to offer V-Fet equipment commercially. And the only ones to bedazzle you with a whole line of it.

So with these credentials behind us, we will begin our explanation of the new generation.

First came the Fets.

The new generation really began many generations ago. Fets—or field effect transistors—were first conceived in the 1920's. But the concept was so far ahead of its time that nobody quite knew how to execute it.

Fet's work quite differently than the bipolar transistor; the transistor you're familiar with. The bipolar transistor works by conducting a small amount of current, which then induces a high level of current. With the Fet a small amount of voltage (rather than current) controls the high level of current.

This bestows a Fet with high speed reaction time. Regular transistors have a delay in reaction time, creating problems like notch distortion and TIM (transient intermodulation) distortion.

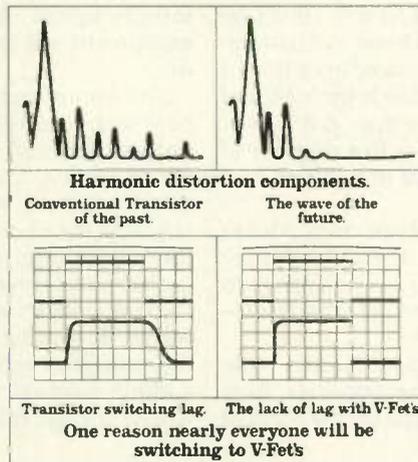
This high speed reaction means also that Fets are extremely efficient and accurate in the high frequency range. Therefore they allow more precise and stable nega-

tive feedback, and minimal distortion.

And, to heat up the argument, a Fet will never be afflicted by thermal runaway. High temperature does not induce the self-destructive current surge that you'll find in the regular transistor.

V-Fets. Or, bye, bye, bipolar.

Wondering why Fets have not taken over, with the transistor



becoming a part of history?

Well, for one reason, a Fet will not allow high currents to pass through it. And today's loud-speakers demand high currents to drive them.

Enter the V-Fet. Vertical field effect transistor. In this structure, thousands of Fets are ordered in a parallel orientation. The current passes through the silicone chips vertically.

Thus, the ability of the V-Fet to handle a lot of current is many times greater than that of small signal Fets—like the kind found in FM tuners and pre-amps.

Sony made it possible for this complex network to be mass produced, by devising the "Selec-

tive Oxidation Process." A new technology originally developed for manufacturing large scale integrated circuits.

Sony's V-Fets.

A full line, from A to V.

Sony makes both integrated amps and power amps with V-Fet circuitry. The TA-4650, TA-5650, TA-8650, TAN-5550 and TAN-8550.

But if you rest your purchase decision on specs alone, V-Fets will disappoint you.

For example, Sony makes two amps, one V-Fet, one not, with identical specs. Yet the V-Fet amp costs more than a spec more.

Obviously, the true measure of V-Fets can't be measured by anything except the human ear.

Now that you've listened to us, really listen to us.

So go ahead and measure it! Bring your favorite record to your V-Fet dealer. Ask him to play it. You'll find your favorite record will become even more of a favorite, as the sound opens up to you like never before.

And, if you want to open up a brochure on V-Fets, we'll send you one. Write to SONY, 9 West 57th Street, New York, New York 10019.

We have one note to add. V-Fet equipment is not cheap. So if you've appreciated our explanation, you'll find that a little knowledge can be an expensive thing.

SONY® V-FETS

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Three Car Components

TESTED

1

Fosgate Electronics Model PR-7000 "Power Punch" Audio Amplifier

The quest for higher audio power and better fidelity on the road (in cars, vans, trailers, boats and even trucks) has prompted a good many manufacturers to come up with separate audio amplifiers that can be added to any vehicular sound system operating from a standard 12-volt car battery. Fosgate Electronics, Inc., of Phoenix, Arizona offers a line of such amplifiers, the more powerful of which is their Model PR-7000 Power Punch, shown here. More than just a two-channel power amplifier, the unit provides five degrees of bass boost and five degrees of treble boost in addition to a flat response setting.

The front panel of the PR-7000 contains two rocker switches, one for power on-off switching, the other for selecting radio or tape inputs. Six-position rotary switches to either side of these switches take care of the aforementioned equalization or boost positions.

The rear panel of the PR-7000 is equipped with a slide switch which varies input sensitivity of the amplifier, high and low impedance inputs for radio and tape (in the form of

standard phono tip jacks for the high impedance inputs, and screw terminals for the low impedance inputs) and speaker output terminals. The two types of inputs are provided so that a user who does not wish to "tap into" the earlier stages of an existing car radio or tape machine can connect directly from the "speaker" output terminals of those program sources to the low-impedance inputs provided on the PR-7000. Of course, doing so (as Fosgate mentions in their manual) will result in poorer fidelity, since the higher-distortion signals appearing at the output of your present equipment will be fed as an input voltage to the new amplifier.

The entire underside of the Fosgate PR-7000 is one giant heat sink to dissipate the heat produced by the high-level outputs this unit is able to deliver. The mathematically inclined reader, having noted the power output specifications of this product, may be wondering how it is possible to obtain 20 watts of output across an 8-ohm load, using a 12-volt car battery supply. After all, the rms voltage corresponding to that power level equals 12.65 volts which means the peak-to-peak voltage must be able to reach a value of approximately 30.4 volts! The answer is that Fosgate uses a d.c.-to-d.c. converter type of power supply which includes a super-audible frequency power oscillator (operating at 35 kHz), whose voltage is then stepped up and rectified to provide a



MANUFACTURER'S SPECIFICATIONS

Fosgate Electronics Model PR-7000 "Power Punch" Audio Amplifier

Maximum Continuous Power Output @ 1 kHz: 20 watts, 8 ohm load; 35 watts, 4 ohm load.

Distortion: 0.3 per cent, 20 Hz to 20 kHz at half-power; 0.75 per cent, 20 Hz to 20 kHz at full power, 8 ohms.

Frequency Response: Within 0.5 dB, 20 Hz to 20 kHz at half-power into 8 ohms.

Load Impedance: 4 to 16 ohms.

S/N Ratio: 65 dB below full output.

Input Sensitivity: High impedance, 0.25 V; low impedance, 3.0 V.

Maximum Equalizer Boost: +18 dB @ 55 Hz, +12 dB @ 20 kHz.

Power Requirements: 12 to 14.5 V d.c., negative ground.

Current Drain: 3 amperes "average listening level," 11 amperes, full output, both channels @ 4 ohms.

Input Impedance: Low, 47 ohms; High, 10 kilohms.

Dimensions: 5 3/4 in. (14.6 cm) x 5 (12.7 cm) x 2 1/2 in. (7.3 cm) H.

Price: \$199.95.

J.I.L. Model 615CB/AM/FM/MPX Radio/Stereo Cassette Player

Cassette & Amplifier Section

Power Output: 6 watts rms per channel, 4 ohms, 10 per cent THD.

Frequency Response: 50 Hz to 10 kHz.

Cassette Playback THD: Less than 3.0 per cent.

S/N Ratio: 50 dB.

Separation: Cassette, 35 dB.

Wow & Flutter: Less than 0.35 per cent.

AM/FM/MPX Tuner Section

Usable Sensitivity: Less than 10 dB.

Stereo Separation: 25 dB.

AFC Holding Range: ± 350 kHz.

CB Receiver Section

Frequency Range: 29.965 to 27.405 MHz (40 channels).

Sensitivity: 1.0 μ V for 10 dB S/N.

Selectivity: -6 dB @ 4 kHz.

Adjacent Channel Rejection: 65 dB.

Audio Output: 5 watts @ 10 per cent THD.

Audio Fidelity: 400 Hz to 2 kHz.

Squelch Sensitivity: 1.0 μ V.

Spurious Response: 65 dB.

CB Transmitter Section

Frequency Range: 26.965 to 27.405 MHz (40 Channels).

R.F. Output: 4 W maximum.

Modulation Capability: 90 per cent.

Spurious Suppression: 60 dB.

Frequency Accuracy: ± 0.005 per cent.

General Specifications

Current Drain: 3 amperes.

Power Requirements: 11.0 to 16.0 V d.c.

Loudspeaker Impedance: 4 to 8 ohms.

Dimensions: 7 1/2 in. (19 cm) W x 2 in. (5 cm) H x 7 in. (17.8 cm) D.

Price: \$369.95.

Clarion Model PE-666A Cassette/ AM/FM Car Stereo

Radio Section

Maximum Sensitivity: AM, better than 20 dB; FM, better than 12 dB.

Selectivity: AM, 20 dB.

Image Rejection: AM & FM, more than 40 dB.

I.F. Rejection: AM, 45 dB; FM, 65 dB.

Stereo Separation: More than 20 dB.

"Electrical Fidelity": AM, -12 dB @ 4 kHz; FM, -15 dB @ 7 kHz.

Tape Section

S/N Ratio: Better than 40 dB.

Wow & Flutter: Less than 0.44 per cent.

Crosstalk: Less than 30 dB.

Playback Frequency Range: 50 Hz to 10 kHz.

Amplifier Section

Maximum Output: 5.0 watts per channel.

"Effective Maximum Output": 3.5 W/channel @ 10 per cent THD.

Load Impedance: 8 ohms x 4.

General Specifications

Dimensions: 7.09 in. (18 cm) W x 1.97 (5 cm) H x 5.51 in. (14 cm) D.

Weight: 3.97 lbs (1.8 kg).

Power Requirements: 10.8 to 15.6 V d.c. (14.0 V nominal), less than 1.5 amperes at maximum output (less than 5 amperes during program switching).

Price: \$229.95.



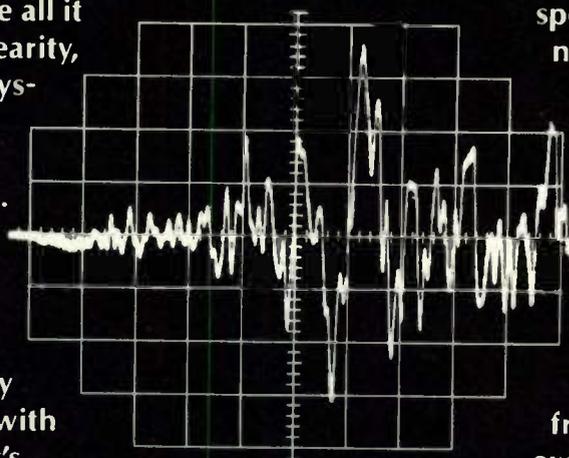
Technics knows there's more to Linear Phase than staggered speakers.

If staggered speakers were all it took to achieve phase linearity, other staggered speaker systems would sound like ours. But Technics knows it takes more. Much more. Like a phase-controlled crossover network that takes into account the phase characteristics of each driver. Like extremely wide-range drivers, each with a frequency response that's as flat as it is wide. And finally, aligning the acoustic center of each for the optimum acoustic position.

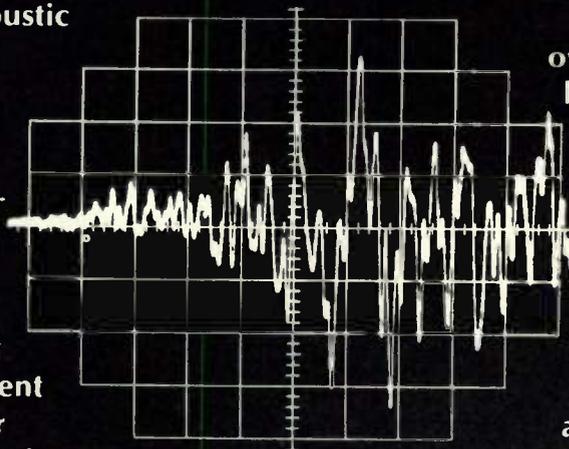
But just as important, Technics knows that to achieve phase linearity as well as a wide and flat frequency response is also to achieve the ultimate in high fidelity: waveform fidelity. With it the output waveform of any component or speaker will be a mirror image of the waveform put into it. And that sounds better than good. It sounds live.

And if seeing is believing, look at the waveforms. On top is the oscilloscope reading (the fingerprint) of a live piano waveform. The other, the piano as reproduced by Technics Linear Phase SB-7000A. That's waveform fidelity you can see, as well as hear.

How did we do it? By designing a crossover network that would provide an overall linear phase characteristic for the entire



Live Piano Waveform.



Piano Waveform
Reproduced by SB-7000A.

speaker system, while simultaneously compensating for the different acoustic pressures of the individual drivers.

When we finished we ended up with a unique phase-controlled crossover network consisting of 6 dB and 18 dB/octave cut-off slopes. It not only eliminates "audible dip" at the crossover frequencies, but also assures excellent localization of the original sound source within the acoustic field.

But as important as the crossover network is in achieving linear phase, so are the individual driver units. That's why we designed and manufactured the speaker drivers with the flattest amplitude, widest frequency response and lowest distortion possible. A goal we achieved only after exhaustive amplitude and phase studies in anechoic chambers.

Our final step was aligning the acoustic center of each driver in precisely the same vertical plane. But it took more than anechoic chambers. Technics had to develop a new time-delay system using BBD (Bucket Brigade Device).

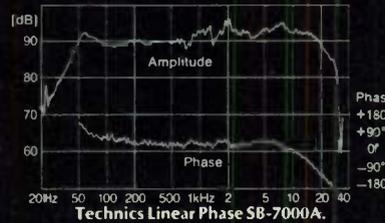
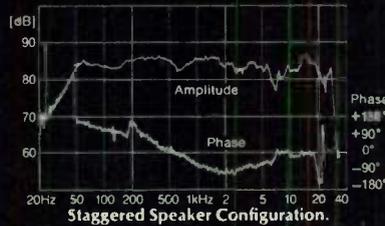
Only then could we locate the optimum acoustic position for each driver. In addition, each unit is positioned vertically for the best horizontal dispersion and then spaced as

Much more.

closely as possible for the best vertical dispersion of all audio frequencies. What's more, after alignment each unit is fine-tuned to assure precise linearity.

The result, with the SB-7000A for example, is an overall phase response, linear between $0^\circ \pm 45^\circ$ between 100Hz and 15kHz. A figure that's virtually flat and definitely unsurpassed by any other multi-range speaker system.

As the graphs prove, even staggered speaker systems with seemingly "linear phase" characteristics show moderate to



severe phase shifts at different frequencies. But as you can see, the Technics SB-7000A has an unprecedented flat amplitude/frequency response and linear phase response.

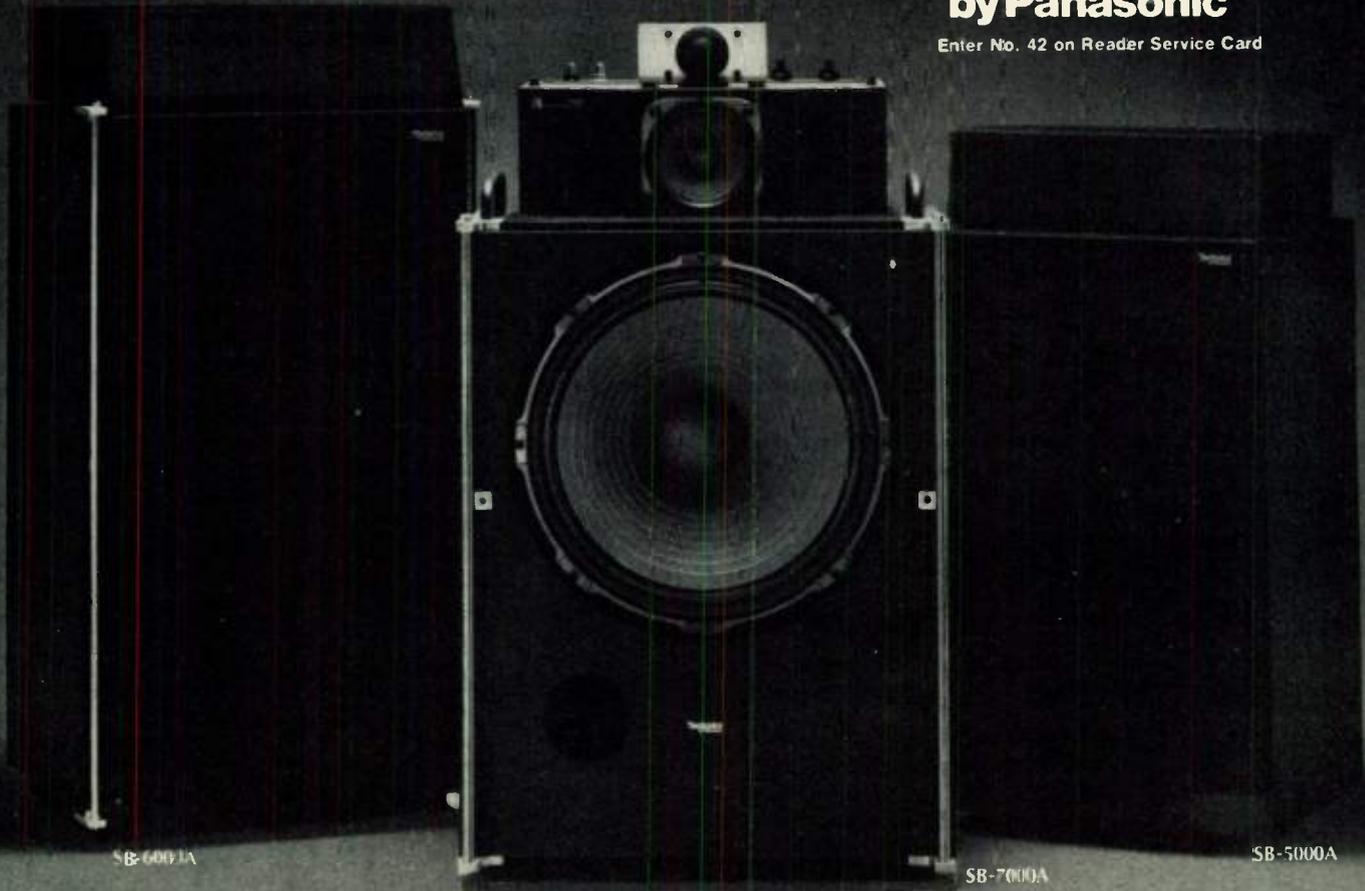
But we don't expect you to buy any speaker system based on how good it sounds on paper. Audition the world's most linear phase speaker systems: the Technics SB-7000A, SB-6000A, SB-5000A. You'll find out just how much more there is to Technics

Linear Phase than staggered speakers.

Technics

by Panasonic

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SB-6001A

SB-7000A

SB-5000A

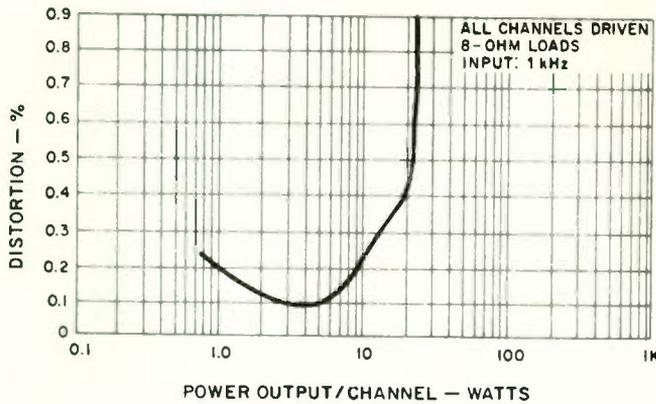


Fig. 1—Harmonic distortion characteristics of the Fosgate "Power Punch," all channels driven with 8 ohm loads at 1 kHz.

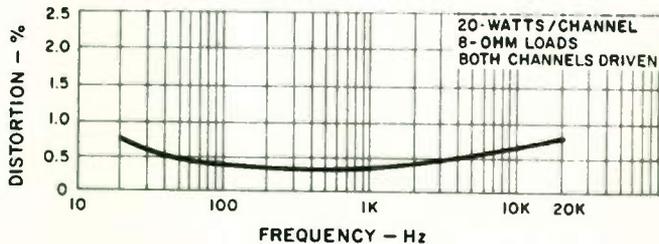


Fig. 2—Distortion vs. frequency.

dual-polarity 21 volt powering source for the output stages of this compact unit.

Laboratory Measurements

The use of this high-frequency power supply, as well as certain grounding considerations of the PR-7000 (which would pose no problem when used with actual loudspeaker loads, each of which is separately wired) made it impossible for us to use our distortion analyzer in the usual manner. Fortunately, we were able to measure outputs and distortion by substituting our spectrum analyzer and interpreting distortion components indirectly. As shown in the graph of Fig. 1, at 20 watts output, into 8 ohm loads, the amplifier exhibited a distortion level of 0.4 per cent. The 1.0 per cent THD level was reached with an output of 22.0 watts, both channels driven. At 4 ohms, output was 37 watts for the same 1.0 per cent THD level. All of these measurements were, of course, made with the equalizer switches set to their "0" or flat response positions.

Figure 2 is a plot of distortion versus frequency for 20 watts output into 8 ohm loads. While Fosgate chose not to specify their rated power output in FTC-approved terms (evidently, the FTC power rule does not apply to amplifiers not intended for "home use"), it is obvious from this graph that they might well have done so, for the distortion at any frequency within the audio spectrum did not exceed 0.75 per cent at this 20-watt power output level.

We referred earlier to the influence of the high-frequency power supply on our test measurements. In carefully examining the sine-wave output waveforms monitored by our 'scope, we noted that there was a small amount of 35 kHz switching voltage present in the waveform. Since this high frequency signal is not audible, it in no way affects the quality of sound reproduced using the PR-7000, but its presence did set a bottom "floor" or limit on distortion readings using a conventional meter-type distortion analyzer. To determine the amount of residual 35 kHz present in the output, we altered the sweep mode of our spectrum analyzer so that it sweeps linearly from 0 to 50 kHz. In Fig. 3, the tall spike at the left represents a full-output audio signal, while at the right of the 'scope face we see the switching-frequency content, some 48 dB lower in amplitude (each vertical division on the scope face equals 10 dB and upper frequency notations should be ignored, as they apply to log-sweep mode).

For the Fig. 4 'scope photo, we returned to our usual log-sweep mode, applying frequencies from 20 Hz to 20 kHz to the input of the PR-7000. Successive sweeps were made using the six available equalization settings (including the "flat response" setting) of the bass and treble switches on the front panel of the PR-7000. Note, that unlike ordinary bass and treble tone controls found on most home hi-fi equipment, the turnover points of these bass and treble equalizer controls are set far away from the mid-range area and are designed to compensate for the roll-off at the frequency extremes encountered with most car speaker systems. The 36 possible combinations of settings permits you to tailor overall response of your car system so that lows, middles, and highs will be heard in their proper perspective at a variety of listening levels.

Summary

The PR-7000 is extremely simple to install under the dashboard and is suspended by means of a single supplied bracket. While it naturally draws a considerable amount of current from your car battery when operated at high levels, under no-signal conditions, current drain was about 1/3 of an ampere. By itself, the unit had a signal-to-noise ratio of 65 dB as claimed, far better than most program sources that

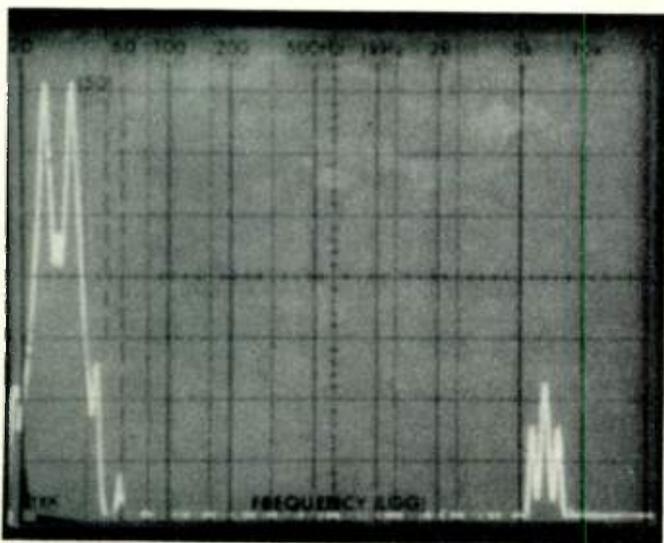


Fig. 3—Spectrum analysis shows presence of power supply switching frequency (35 kHz) in audio output signal.

You've got to be serious.

If you're interested in Phase Linear, you've got to be serious. Serious about music. Serious about enjoying the most realistic sound possible from a home stereo system. Serious about acquiring quality state-of-the-art components built to deliver a lifetime of top performance.

The three components featured here represent the very finest technical achievements of the Phase Linear Corporation:

The Phase Linear

5000 FM Tuner: An advanced tuner with a Dynamic Range Expander that restores FM broadcast signals to rival your records and tapes.

The Phase Linear 4000 Preamplifier: An incredibly sophisticated preamp and control center that actually compensates for limitations inherent in the recording and playback process through noise reduction and dynamic range expansion.

The Phase Linear 700B Power Amplifier: The most powerful, most dependable stereo amplifier you can buy, at any price.

Phase Linear manufactures a complete line of amplifiers and preamplifiers, a noise reduction unit, and a speaker system. Ask your dealer for an audition. If you're serious.

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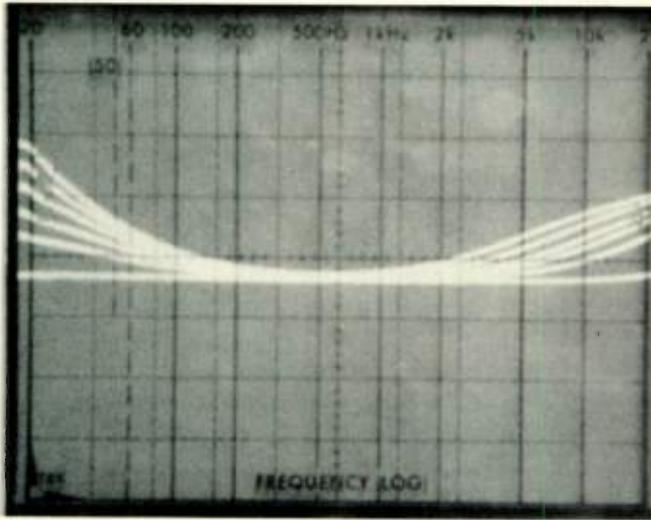


Fig. 4—Composite plot of possible response curves available with the Fosgate PR-7000 auto amplifier.

would be connected to it. This noise (disregarding the 35 kHz switching component) is primarily of a random nature and, as might be expected from a d.c. operated device, totally free of hum components.

While the orders of distortion produced by the PR-7000 are not nearly as low as those produced by home high fidelity amplifiers, they were far better than those observed on most mini-powered all-in-one car stereo units. If you crave good, big sound in your car or van or boat, this high powered amplifier can deliver it. Fosgate claims that in the close environment of a car, SPL levels of 115 dB have been obtained using the PR-7000. Much, of course, will depend upon the quality of associated speakers used with the amp and with their ability to handle such levels of power. Given a good set of speakers and reasonably good program sources, even with the equalization controls set for full boost (in most cases you won't need that much compensation), mid-range average sound levels of 100 dB should be obtainable without taxing the power output capability of the PR-7000—and that's really quite a lot of sound when you're on the road.

Leonard Feldman

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2

J.I.L. Model 615 CB/AM/FM/MPX Radio/Stereo Cassette Player

62

Sooner or later, someone was bound to combine an AM/FM stereo radio-cassette car unit with a 40-channel CB transceiver in a single, compact, behind-the-dash unit for car use, and the distinction of having accomplished that feat belongs to J.I.L. Corporation of America, whose broad line of auto electronic products is probably well known to readers of this magazine. Even more amazing is the fact that all of these electronic goodies are contained in a cubic volume no greater than that occupied by ordinary AM-FM cassette car units. Like so many other late-model CB units which include all of the newly approved CB frequencies (now totalling 40), the hand-held microphone serves many important functions other than just being a transducer. A thumbwheel at the right of the microphone assembly changes channels,

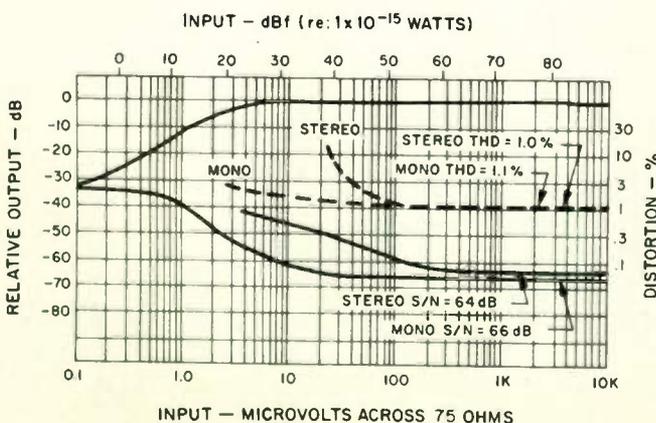
whose numbers are displayed on the front face of the mike by means of illuminated LED digital readouts. A push-to-talk switch is located on the left of the microphone case, and above it is an r.f. gain control. Needless to say, there's a pretty thick cable running down from this microphone assembly to the chassis proper but that cable terminates in a multi-pin plug so that it can be easily disconnected and stored when not in use, or removed from the car to prevent possible theft. The chassis proper, intended for behind-the-dash permanent mounting, features dual concentric controls at either end of the front panel. The pair of controls at the left turn on the unit and control volume, and serve as a tone control. Those at the right take care of station tuning and left-right speaker balance. A cassette cartridge door flap is centered above the stationary dial scale area and permits insertion of a cassette tape only when it is properly oriented. At the left is a fast-forward tape transport button which also serves as an eject button for the inserted cassette. To the right of the cassette/dial scale area is a continuously variable squelch control used to eliminate noise when no CB channel is being received. Below the dial area, to the right, are the AM/FM selector button, a mono-stereo selector button, and a special standby switch which activates an unusual circuit developed by the people at J.I.L. and patented by them. With this button depressed, if you are listening to music via any of the available program sources and a CB signal is received on the channel you have selected, the circuit automatically switches over to CB reception, returning to your previous program source once the received signal goes off the air!

Additional features at the lower left of the panel's center area are a CB button (depressed for continuous CB operation), a "transmit" light, and a dual-purpose indicator light that illuminates when CB signals are received (so long as squelch is overcome) or, in the case of FM reception, when a stereo FM signal is tuned to. Another indicator light centered below the dial area tells you that you are listening to a tape cassette program. All of this on a panel surface that measures only 2 in. by 7 1/2 in. wide!

Circuit Highlights

A complete schematic diagram is supplied in the owner's manual accompanying the J.I.L. 615CB and, while it does not

Fig. 1—FM quieting and distortion characteristics of the J.I.L. 615CB.



Credentials Like These Are Worth Reading



When you're buying speakers, you want to talk specs. And we don't blame you. In fact, we encourage it. Because when you invest your good money in a pair of speakers, you want more than just a pretty cabinet.

Consider the new Jensen Spectrums. These good sounds didn't just happen. They're the result of extensive engineering efforts and exhaustive testing. Testing that ranged from exacting measurements in laboratory "live" rooms and anechoic chambers to in-depth consumer surveys.

Examine our Spectrum Model 540. It's an excellent example of the superb specs you'll find throughout the Jensen Spectrum Series.

The Spectrum 540 is a 3-way, 4 element system that is so efficient it can be driven with as little as 10 watts continuous power. Its maximum power rating is 75 watts continuous.

The woofer is a 12" long-throw, high compliance design. Special acoustic suspension and infinite baffle enclosure give you extremely low distortion. And a high temperature voice coil affords high power handling. Magnet structure weight is a hefty 4½ lbs. with a Gap Flux Density of 10,000 Gauss.

Two 3½" cone midranges give excellent power handling and eliminate break-up in the critical midrange region. Tuned isolation chambers control response at the low end of the midrange spectrum. They also provide acoustical isolation in the cabinet between the midranges and the woofer. An edge damped rim suspension with specially treated molded cone offers sharp, clear, midrange reproduction.

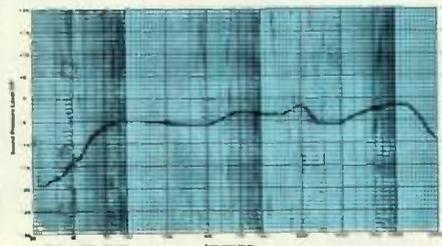
A 1½" Mylar® rear damped hemispherical dome tweeter offers a disper-

sion of 170°. Its large, lightweight voice coil gives high power handling, yet maintains a low mass for good high frequency reproduction.



Tweeter and midrange controls allow you to adjust your Spectrum System to room conditions and listening preferences; controls are front mounted for convenience, continuously variable, calibrated in db attenuation from a maximum, or flat, response.

FREQUENCY RESPONSE



About as flat as you can get... and that's good. The Frequency Response Range is an admirable 25 to 25,000 Hz.

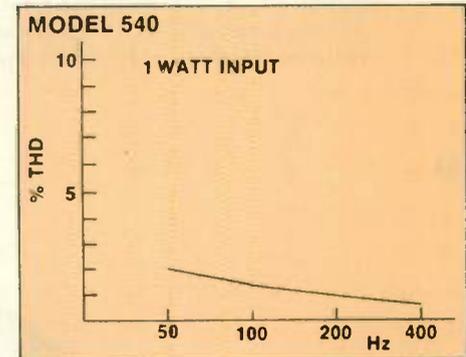
TONE BURSTS



"Blurring" and "Overshoot" are reduced to a minimum in this acid test of transient response. The Spectrum 540 re-

produces each waveform accurately with low distortion.

TOTAL HARMONIC DISTORTION



Distortion is kept to a minimum in Jensen Spectrum Speaker systems.

The cabinet is built with solid walnut front moldings and walnut veneer on wood composition panels. All walnut surfaces are hand rubbed for a rich luster and beauty. The baffle is finished in an attractive, durable black pebble grain.

In short, Jensen Spectrum speakers aren't designed to put out the most amount of bass or the most amount of treble. They're designed to put out the right amount. We consider them to be the best speakers we've produced in 50 years. Simply because when it comes to sound reproduction, they're extraordinarily accurate. And that's what specs are all about.

For further information and name of your nearest authorized Spectrum Dealer, write to: Jensen Sound Laboratories, Dept. AM-774136 United Parkway, Schiller Park, Illinois 60176.

JENSEN

SOUND LABORATORIES

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detail construction of the FM front end of the unit, we did note that the i.f. section uses an IC amplifier, plus a second IC limiter-quadrature detector circuit followed by an IC phase-lock-loop multiplex decoder section. The AM circuitry uses three bi-polar transistor stages in a fairly conventional circuit arrangement. Tape head signal pre-amplification is accomplished by means of a single dual-channel IC, while the main amplifier module contains a pair of IC power circuits, one for each speaker channel plus two additional voltage amplifier bi-polar transistor stages. The novel tone control arrangement used in this amplifier circuit combines the action of a conventional treble control with that of bass-boost loudness compensation, so that rotation of the control clockwise (when the volume control is at less than maximum settings) results in simultaneous bass boost and treble attenuation. A separate module board is used for the CB transmit circuitry with another p.c. assembly used for the CB-receive section. CB frequencies are determined by the now-popular phase-lock-loop method which requires only a pair of quartz crystals, one cut to a frequency of 9.785 MHz, the other tuned to 10.240 MHz. Total solid state complement of the 615CB includes 10 IC's, 33 transistors and 31 diodes.

FM Section Measurement

Figure 1 details mono and stereo FM quieting and distortion characteristics of the FM tuner section of the 615CB. At strong signal levels, THD in both mono and stereo were virtually identical, at around 1.0 per cent. Mono usable sen-

sitivity measured 2.5 μV (15.2 dBf) while in stereo (largely because of increased levels of distortion), usable sensitivity was 40 μV (43.3 dBf). The 50 dB quieting point in mono occurred with an input of 3.0 μV (4.7 dBf) and in stereo the corresponding signal strength measured 50 μV (45.2 dBf). Distortion in mono was governed by the inability of the detector circuit to handle full, 100 per cent modulation in a linear fashion. For our separation and distortion versus frequency measurements we therefore "backed off" the signal generator to 75 per cent modulation and results are plotted in Fig. 2. Note, that with this slight reduction in deviation of the audio modulating signal, mono THD decreased to 0.6 per cent at 1 kHz, a not unreasonable figure in a unit of this type. Frequency response (upper curve of Fig. 2) conformed nicely to the required 75 microsecond de-emphasis curve from around 100 Hz to 8 kHz, but rolled off a bit too quickly beyond those limits. Stereo switching threshold takes place with a signal input of 3.0 μV (20.76 dBf) but considerably stronger signals are needed before stereo listening becomes completely acceptable.

Overall frequency response (including FM de-emphasis) in FM, at extreme settings of the front panel tone control, are plotted by means of a spectrum analyzer in the 'scope photo of Fig. 3.

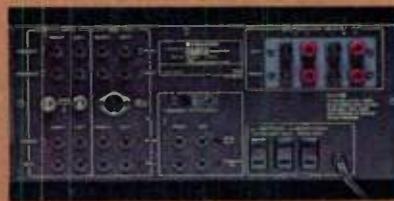
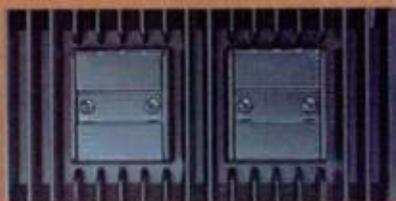
Amplifier Measurements

In view of the low power output claimed for the amplifier section of the 615CB, instead of plotting a curve of distortion versus power output, we measured power output capability





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Gone is phase distortion. Gone is time-delay distortion.

The Kenwood KA-9100 Integrated DC amplifier is here.

Its response is flat down to 0 Hz. It has three power supplies. The Total Harmonic Distortion is 0.03% over the full frequency range of 20-20k Hz. The Signal-to-Noise ratio is 83 dB at 2.5 mV. It has the best phono sensitivity (0.8 mV) of any integrated amplifier. For better heat dissipation, the KA-9100 has large heat sinks on either side.

It is an amplifier so advanced even the pre-amp has its own power supply.

It is the next generation Kenwood. The unit all others will be measured against. Just as they were when we pioneered dual power supplies.

The KA-9100 integrated DC amplifier. With 90 watts per channel, minimum RMS, at 8 ohms from 20 to 20,000 Hz with no more than 0.03% Total Harmonic Distortion.

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*Suggested retail price. Actual prices are established by Kenwood dealers.

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World Radio History

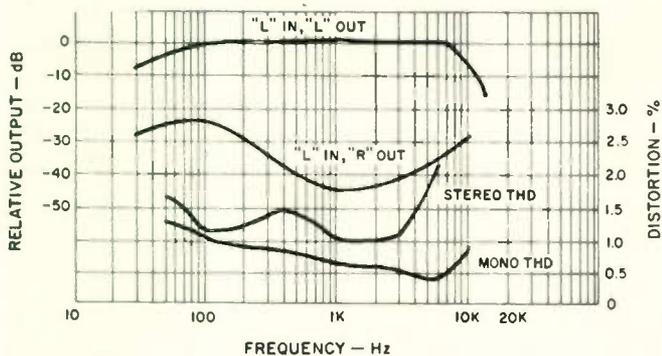


Fig. 2—Stereo FM separation and distortion vs. frequency. (Distortion measurement at 75 per cent modulation.)

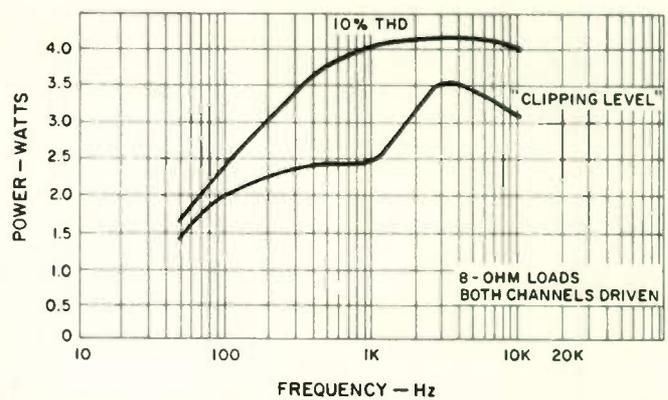


Fig. 4—Power output vs. frequency.

for 10 per cent THD and for clipping level at a variety of audio frequencies and plotted results in Fig. 4. At mid-frequencies, the unit delivered 4.0 watts per channel, both channels driven, into 8 ohm loads before the 10 per cent THD level was reached. Evidence of clipping was seen at considerably lower power levels, as plotted in the lower curve of Fig. 4.

Cassette Section Measurements

Using our test tape prepared on a reference Nakamichi 1000 cassette deck, at -20 dB recording level, we plotted playback response of the cassette section of the 615CB. Results are shown in Fig. 5, and response was off by 3 dB at 60 Hz and 9 kHz. Wow-and-flutter measured an acceptable 0.18 per cent W rms. If J.I.L. had had a bit more room in this compact model, a fast-reverse tape transport mode would have been a welcome addition to the features incorporated for the cassette playback section of the product.

CB Tests

Since our laboratory is not equipped to perform definitive measurements on CB equipment (and such tests are available in publications devoted to CB equipment), all we could do regarding the CB section was put it through its paces and listen to signals picked up on the various channels. There were plenty of these, even with only a rudimentary whip-

antenna hooked up to the CB-antenna connector, including music re-broadcast from a radio (illegal), a fair amount of profanity (illegal) and even one or two serious conversations which were obviously intended primarily for communication between citizens in our immediate area (legal). Since we are totally against illegal use of CB, our attempts to transmit were limited to a quick call, using our self-assigned call letters (KLF-11023) as instructed on the "temporary license form" provided with the unit. After establishing contact with a youngster down the block, we were satisfied that the CB portion of the 615CB was, indeed, operative in both modes. Fearful of possible wrath from the FCC, that concluded our base-station operation for the evening.

Summary

J.I.L.'s 615CB offers a great deal of entertainment-on-wheels for its not unreasonable price. Since its FM tuner section is a cut above the average units found in "car radios" and its cassette deck section is certainly no poorer than those offered by most of the competition, the incorporation of CB in this all-around unit makes it an extremely attractive package for those who want to communicate while driving and still want to enjoy a bit of music without having to usurp all available under-the-dash leg room by the addition of separate add-on boxes.

Leonard Feldman

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Fig. 3—Frequency response in FM (including deemphasis) at extreme settings of combination tone control.

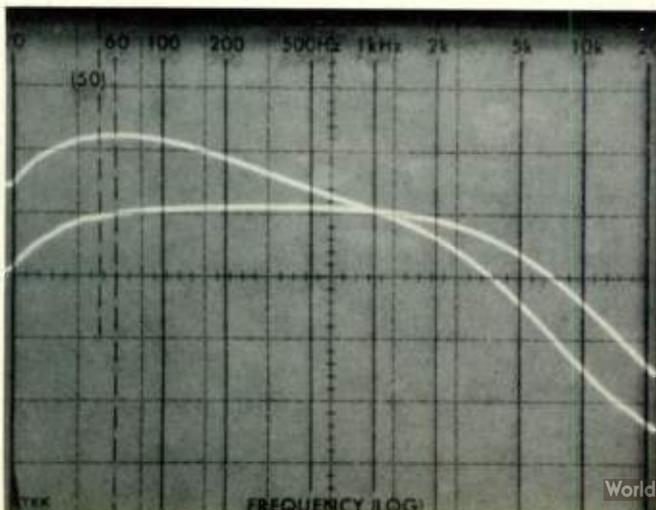
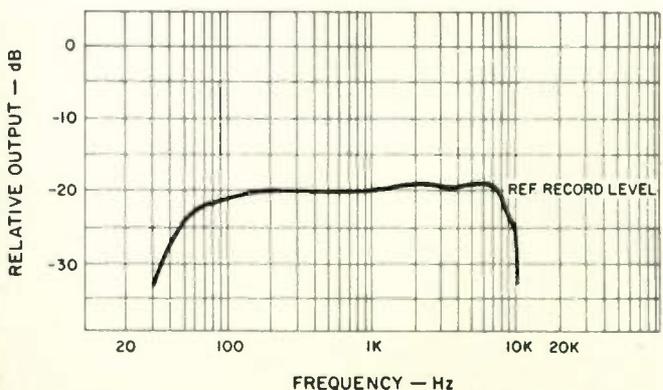


Fig. 5—Playback response for the cassette section of the J.I.L. 615CB.



*Now we've mastered
a Scotch® cassette for every switch position.*



Introducing the Master™ Series. Three totally different tapes. Each developed to deliver the truest, clearest sound possible at each tape selector switch position.

Our Master I cassette is for normal bias recording. It features an excellent dynamic range, low distortion, uniform high frequency sensitivity and output that's 10 dB more than standard tapes.

Our new Master II replaces chrome cassettes and is designed for use on hi-fi stereo systems with chrome bias (70 microsecond equalization). It features some spectacular performance characteristics, including a special coating that gives it a 3 dB better signal-to-noise ratio at low and high frequencies than chrome cassettes, yet it's less abrasive.

Our new Master III is for the ferri-chrome setting. It's formulated with the most advanced technology available, giving a 3 dB output improvement at low frequencies and 2 dB at high frequencies. And the unique dual layer construction increases both low and high frequency sensitivity over chromium dioxide and ferric oxides.

All this, plus unique inner workings you can actually see. Our new Master line has a special bonus feature. A precision molded clear shell that allows you to monitor the inner workings of the cassette. You can actually see the recorder head penetration and the unique roller guides in action. Look closely at the transparent shells above and you'll see the water wheels which were specially designed to move the tape evenly across the head, reducing friction and noise. And two radially creased shims insure smoother wind, improved mechanical reliability and reduced wow and flutter.

Enough said. Now it's time for you to take the true test. Match up the right Master cassette with the bias you prefer. Then just listen.

You'll find that whichever switch position you use, a Scotch Master is the way to get the most out of it.



**Scotch Recording Tape.
The truth comes out.**

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3

Clarion Model PE-666A Cassette/AM/FM Car Stereo

68

Here is another of those multi-function, add-on, behind the dash-board, AM-FM cassette units, this one by Clarion. The published specifications shown above are reproduced here exactly as shown on that company's single-sheet "owner's guide," and if you don't understand all of them, well, you're not alone. We will, however, check the unit out in accordance with our accepted procedures, so you can judge against our usual "standards."

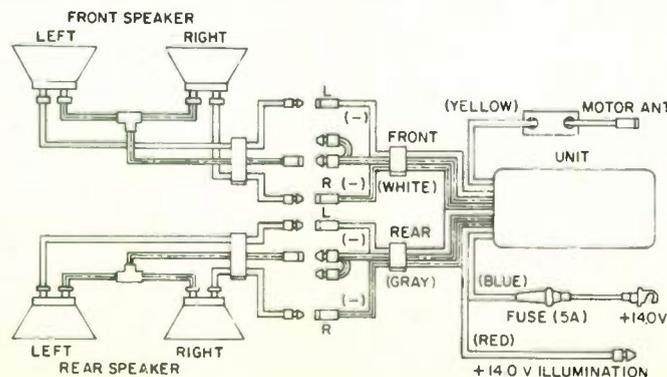
The front panel of Clarion's PE-666A features dual concentric knobs at each end, one pair for volume/power and tone control, the other for station tuning and speaker fading (front to rear pair). A push of the volume control reverses tape direction, and the unit also features automatic reversal of cassettes at end of play (as indicated by a pair of illuminated arrows near the volume control). A fast forward/rewind lever is located below the dial area, but its lever must be manually held to engage the fast transport modes. The dial area and pointer swing away to permit insertion of the cas-

sette which then drops into correct positioning, and can only be ejected by means of an eject button located at the upper right, near the dial area. A stereo indicator light and an FM/AM band switch complete the front panel layout. The connection diagram of Fig. 1 illustrates how front and rear stereo speaker pairs may be wired to the PE-666A, and necessary leads and hardware are supplied with the unit.

Circuit Features

The FM front end of the PE-666A is inductance tuned and utilizes bi-polar r.f., mixer and oscillator stages. Four bipolar transistors are used in the FM i.f. section, followed by an IC multiplex decoder. The AM tuner section utilizes a total of four transistors and is also inductively tuned. ICs are used to amplify low-level tape signals as well as for the power amplifier sections of the unit, which connect, via the fader control, to the pairs of speaker terminals. A power board containing four transistors is used to drive the d.c. tape transport motor. A separate illumination lead can be connected to the car's dash illumination system so that the PE-666A's dial can be dimmed with the rest of the dash illumination. Powering a motorized car antenna is also made possible by connecting it to yet another lead emanating from the PE-666A.

Fig. 1—Speaker wiring diagram for the Clarion PE-666A car stereo unit.



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may well be the
finest speaker
on the market
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top few.”**

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If you'd like to find out what hi-fi experts from all
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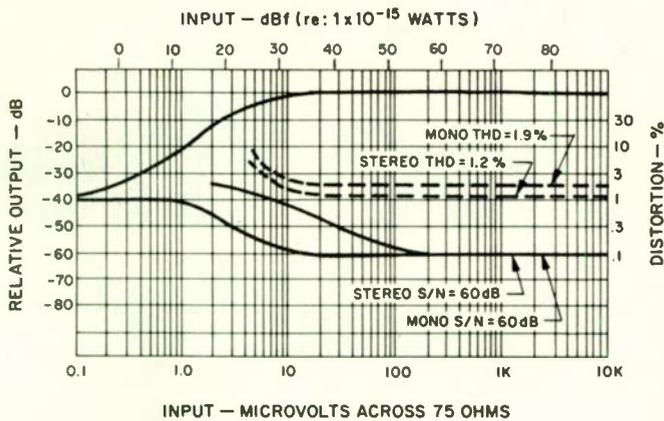


Fig. 2—FM quieting and distortion characteristics, showing their "soft limiting" illustrated by the large rise in signal strength and mild drop in noise level.

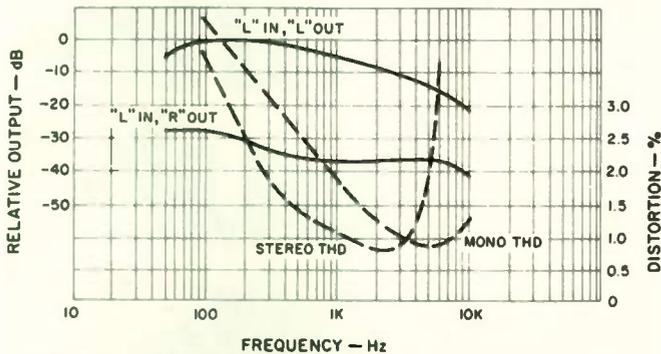


Fig. 3—Separation and distortion vs. frequency with tone control at "flat."

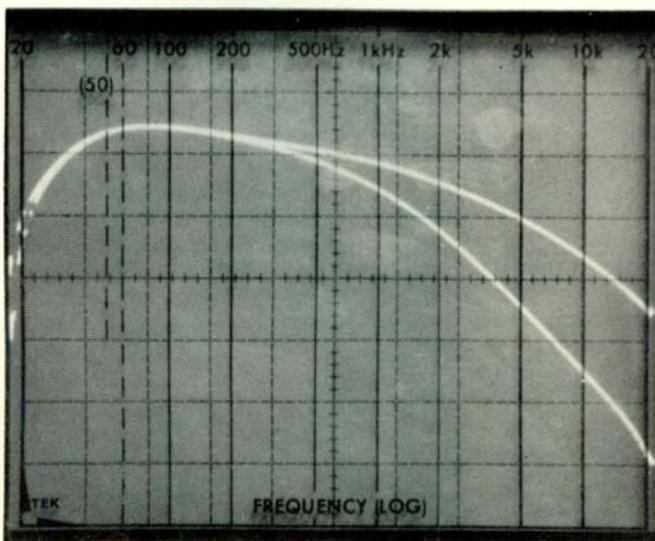


Fig. 4—FM frequency response (including de-emphasis) at two extremes of the tone control setting.

Tuner Section Measurements

Figure 2 shows quieting and distortion characteristics of the FM tuner section of the PE-666A. Usable sensitivity in mono was $9.0 \mu\text{V}$ (30.3 dBf), while in stereo it measured a superior $6.5 \mu\text{V}$ (27.5 dBf). The reason for this seeming disparity is that distortion in mono was actually worse than in stereo—and of course, distortion as well as noise enters into the "usable sensitivity" spec. As for quieting, the 50 dB point was reached with $5.0 \mu\text{V}$ (25.2 dBf) in mono and $50 \mu\text{V}$ (45.2 dBf) in stereo. Best quieting (with strong signals) in both mono and stereo measured 60 dB.

Even with the tone control set flat, response in FM deviated from the normal 75 microsecond de-emphasis characteristic so that the net roll-off at 10 kHz was approximately -6.0 dB. At 50 Hz, response was about -1.5 dB away from flat. In Fig. 3 we have plotted FM response in stereo (including de-emphasis) for the "desired" and undesired or crosstalk channel. Separation at 1 kHz was just a bit better than 30 dB, dropping to 22 dB at 50 Hz and 20 dB at 10 kHz. Distortion versus frequency, also plotted in Fig. 3, rises sharply in both modes at the low frequency end of the spectrum, and at the high end (mostly because of "beats") in stereo. At 1 kHz, THD measured 1.9 per cent for mono; 1.2 per cent for stereo. Figure 4 illustrates overall response in FM (including de-emphasis) for extreme settings of the treble roll-off type tone control provided on the PE-666A. From these curves we were able to ascertain that the tone control offers up to 16 dB of attenuation at 10 kHz. The same would apply during tape listening.

Amplifier Section Measurements

Since there are no external inputs to the Clarion PE-666A, amplifier measurements were made using controlled FM signals. Obviously, this meant that the inherent distortion of the recovered audio was present at the "input" of the amplifier section, but since the end user would be listening to the entire system in this manner we felt that the approach was justified. We also lowered modulation level to reduce the distortion to well below that previously observed for 100 per cent modulation in the FM section tests. These precautions were not really so vital, since we soon noted that the tuner section was not the only limiting factor in this product. Plotting harmonic distortion for such a low powered amplifier versus power output would be fairly meaningless, so instead, we decided to measure maximum (10 per cent THD) output at various frequencies, as well as power output for clipping level (around 1 per cent THD). Results are plotted in Fig. 5. While the amplifier was able to deliver a fairly constant level of output above 200 Hz or so, its output capability diminished rapidly as we approached the low frequency end of the spectrum. It should be noted that throughout our tests we were careful to maintain a supply voltage of 13.8 volts. Decreasing the voltage below that point (as is often the case under actual use conditions in a vehicle) would have resulted in significantly lower power output and/or higher distortion levels.

Cassette Section Measurements

In order to test the frequency response (in playback) of the cassette section of the Clarion PE-666A we prepared a test tape on our reference Nakamichi 1000 cassette deck, using a TDK Audua C-60 tape. The recording of all test tones was made at a record level of -20 dB and the tape was played back on the PE-666A. Results are plotted in Fig. 6. The tone control on the PE-666A was set to its most clockwise position. If we ignore the rise in response below 100 Hz, overall re-

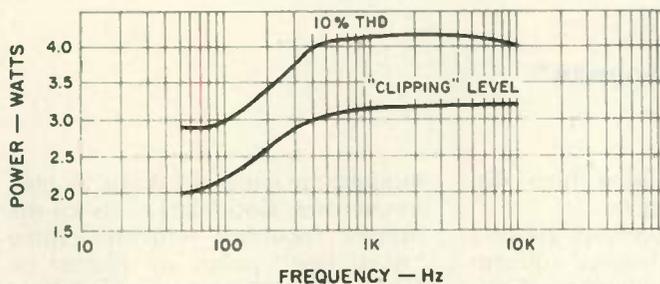


Fig. 5—Power output vs. frequency for 10 per cent THD.

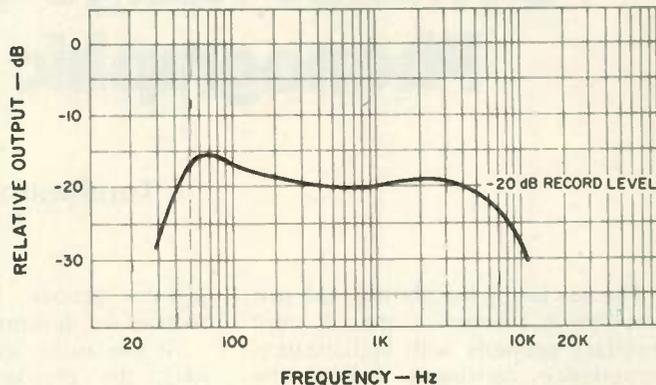


Fig. 6—Playback response for the cassette section of the Clarion PE-666A, which matches Clarion's published curve.

sponse between the -3 dB roll-off points extended from 35 Hz to 7 kHz (referencing 1 kHz as "flat"). Wow and flutter measured 0.25 per cent W rms or 0.4 per cent when measured without weighting.

Summary

Certainly, the Clarion PE-666A offers more than the usual "built-in" or factory-equipped AM/FM cassette units with which many Detroit-built automobiles are supplied, and its cost is somewhat lower than the list prices charged by automotive dealers for the same sort of equipment. If you want

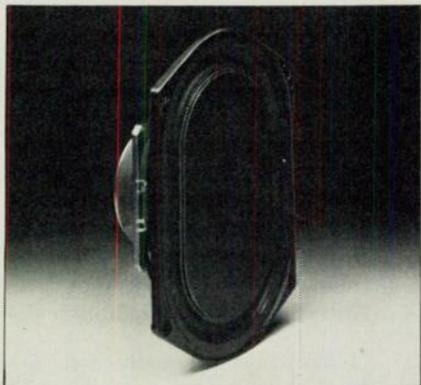
the ability to play your favorite hi-fi cassettes while driving or traveling and would rather not add a separate cassette player as an under-the-dash accessory to existing equipment, the Clarion PE-666A can solve your problem in that it can be neatly installed behind-the-dash of your radio-less car or van. One can't, of course, expect the kind of fidelity from this unit that you are accustomed to in your home listening, but on the other hand, I'm willing to bet your home receiver & cassette deck cost substantially more than \$230.00.

Leonard Feldman

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B139.

The world-famous KEF bass unit, approaching perfect-piston performance right down to 20Hz.



Flat, light-weight expanded polystyrene diaphragm, aluminum-laminated, suspended on a special neoprene roll-surround. Acoustically dead, non-resonant, no chance of 'cone-edge break-up'. Hear it to perfection in the Cantata.

Cantata.

Our elegant, high-performance, 150W speakers in mirror-image matched pairs.

The cabinet is tall, to cut floor reflections; deep, to cut rear wall reflections; narrow, to permit good sound dispersion; and mounted on castors to cut floor resonance.

Note the special drive unit positions, with the mid unit above the treble, giving equal sound paths to the listener, with no inter-unit time delays. And the mid and treble units are both placed off-centre, to cut side wall reflections.

Both mid and treble units have acoustic balance controls and both also have fuses to prevent damage, even under fault conditions.

Altogether, the Cantata is a superb example of KEF's computerised 'target function' design approach, in which the cabinet, drive units and acoustic Butterworth dividing networks are developed together, with the electronics tuned to the other elements, to bring the overall system response function as close as possible to the theoretical ideal.

May we send full details?



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Dynamic Range Requirements of Phonographic Preamplifiers

Tomlinson Holman*

The task facing the phonograph preamplifier is a complex one.¹ It must interface properly with high source-impedance cartridges, follow the RIAA equalization curve precisely, and be immune from overload and nonlinearity from any signals present at the input, singly or in any combination. Over the last several years detailed information has become available on the range of signals to be expected from cartridges, and both musical signals and undesired warp and distortion signals have been quantified.^{2,3} Consequences of the undesired signals on the program material may now be studied analytically and criteria set for phonograph preamplifiers. At the other end of the range, noise present in the system has received increasingly more sophisticated treatment, so that now a psychometrically correct comparison may be made between the noise level achieved by design and the theoretical limit.

Sonic Range Signals

In the low audio frequency range from 20 Hz to 800 Hz, the maximum allowable groove velocity is set by the physical amplitude of the groove width.⁴ The criteria is set for LPs by the cutterhead's standard two-mil excursion, which is mechanically limited by stops and practically determined by playing time requirements. When played with a conventional cartridge having 1 mV/cm/sec sensitivity through an RIAA equalized preamplifier with 40 dB of gain at 1 kHz, the output overload level varies with frequency as shown in Fig. 1. For other sensitivities or gain, the curve may be translated up or down as appropriate.

In the range from 800 Hz to ultrasonic, the maximum velocity is set by the geometry of the cutting stylus. If the maximum velocity limit were exceeded in this range, the back facet of the stylus (required for a smooth groove wall) would interfere with the

just-cut groove, causing high distortion by deforming it.

At the audio frequencies above 2 kHz, the playback stylus' dimensions become the dominant mechanical limitation. The maximum curvature of the groove wall cannot exceed the contact radius of the stylus for low distortion. Two curves are shown for this region. For spherical stylii with 0.7 mil diameter, curve 2 applies, and for elliptical stylii of 0.2 mil minor diameter, curve 3 applies. The maximum undistorted playback velocity at high frequencies is extended by the elliptical and other special stylii. Special stylii developed for CD-4 have smaller contact radii with the groove wall and consequent greater high frequency tracking capability—all other things being equal.

The curve in figure 1 then gives the sine-wave low-distortion power response of the cutterhead and cutting stylus, cartridge, preamplifier combination. That is, no single-frequency component of program material may exceed the limits for low reproduced distortion. But, because overload is a peak phenomenon for which all frequency components instantaneously add, the actual spectral output of the preamplifier must run substantially below the sine-wave limit line. The amount below is determined by the frequency and phase characteristics of the program material; since the energy distribution of orchestral music falls off with increasing frequency, it is less likely to produce high frequency overload than modern popular or jazz recordings, with their increased high frequency energy content.⁵ The overall record level should be adjusted downwards so that every peak fits under the curve if low distortion is important. In such cases, the overall record level may need to be lowered so much that noise becomes apparent, or the disc plays back at a noticeably lower level than others. Since these are not commercially acceptable alternatives, peak levels beyond the

modulation limits do occur at high frequencies. Good data exists for the highest recorded velocities—some "worst case" points are plotted on Fig. 1.⁶ The 105 cm/sec peak is from a Woody Herman recording, Verve V-8558, side 1, band 2. The 40 cm/sec peak is from the Sheffield Pressure Cooker recording; it is the sibilance on the beginning of side 1 with a center of 11 kHz. Notice that the 80 cm/sec peak imposes a more severe output requirement than the 105 cm/sec peak due to its lower frequency and consequent greater amplification. From this and earlier studies one may draw the conclusion that this high frequency stylus limit called curvature overload is a dominant one to dynamic range with modern program material.

"Low distortion" keeps repeating itself above as a criteria. Small, infrequent high-frequency overload of the system probably goes unnoticed since the high-frequency components are often broad-band, which offers built-in distortion masking. For example, sibilance or cymbal crashes to some degree contain their own source of distortion masking by their nature. Taken too far, however, sibilance overload can turn a clean "s" sound into one akin to rubbing two blocks of sandpaper together; "tish" becomes "tush." Although low distortion reproduction is limited by the cutter and playback stylus' mechanical overload, the preamplifier should be capable of reproducing these overloads (and their corresponding distortion components) cleanly without intermodulation.

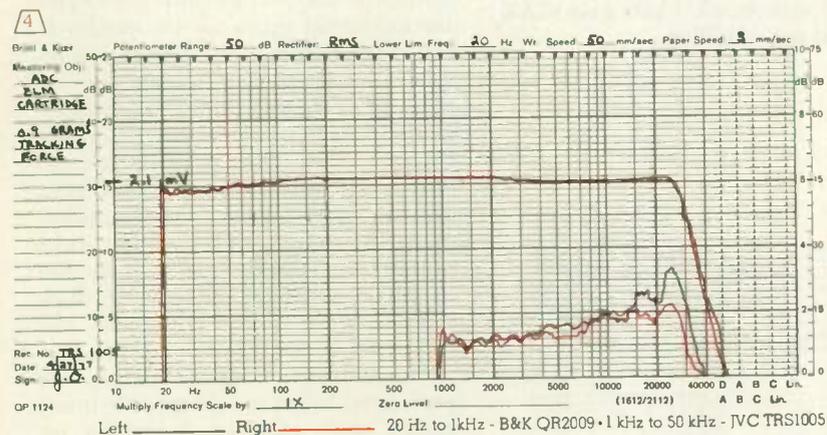
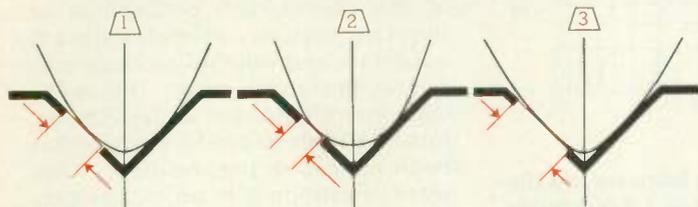
Ultrasonic and Infrasonic Signals

In the ultrasonic spectrum, a wide survey of peaks from records has not yet been made. Recently however, information has become available on one well-known "hot" record. The ultrasonic range output is shown in Table 1 and plotted on Fig. 2. A moving-coil cartridge was used for this measurement, since moving-magnet cartridges driving cable capacitance in

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1976: ADC CLAIMS THE XLM MK II SHOWS "NO PERCEIVABLE WEAR OVER THE LIFE OF A RECORD." AND PROVES IT.

1977: ADC CLAIMS THE NEW ZLM WITH THE ALIPTIC™ STYLUS HAS EVEN LOWER WEAR AND BETTER PERFORMANCE. AND PROVES IT AGAIN.



Introducing the ADC ZLM cartridge with the ALIPTIC ¹ stylus. It's a revolutionary new cartridge design that has taken the state of the art a giant step closer to the state of perfection.

Because of last year's XLM MK II record wear test results, we confirmed our thinking on how to design the perfect stylus tip shape. It combines the better stereo reproduction of the elliptical ² stylus shape with the longer, lower wearing, vertical bearing radius of the Shibata ³ shape. The result is our revolutionary new ALIPTIC stylus.

And that's only the beginning. The ALIPTIC shape is polished onto a tiny .004" x .008" rectangular nude diamond shank, which has reduced the tip mass of the XLM MK II by an incredible 50%. This tiny stone is mounted on our new, tapered cantilever, which reduces effective tip mass even further.

The XLM MK II tests also proved the importance of tip polish in reducing record wear. So the ZLM is polished with a new, more expensive, more effective patented polishing method.

The ADC XLM MK II has long been known for its uncolored, true sound reproduction. The ZLM goes even further. Sound reproduction is completely open and spatial. And individual instrument placement can now be identified with even greater ease.

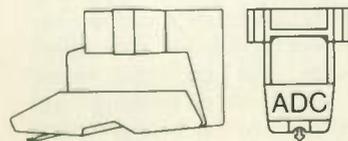
The ZLM tracks between 1/2 and 1 1/4 grams. Frequency response is ± 1dB to 20kHz and is flat to even higher frequencies; out to 26kHz ± 1 1/2dB.

As you can see, by reducing the tip mass even further, we've come closer to the ultimate in pure sound reproduction. To prove it, every ZLM comes with its own individual frequency response curve ⁴, signed by the ADC technician who tested it.

This means that the ZLM cartridge will reach every sound lying dormant in your records, transmitting them faithfully through your hi-fi system without altering the sound or the health of your records.

Not only do we think the ZLM is one of the most exciting cartridge designs to come along in years, but we can prove it.

Superior performance we can prove.



CARTRIDGES

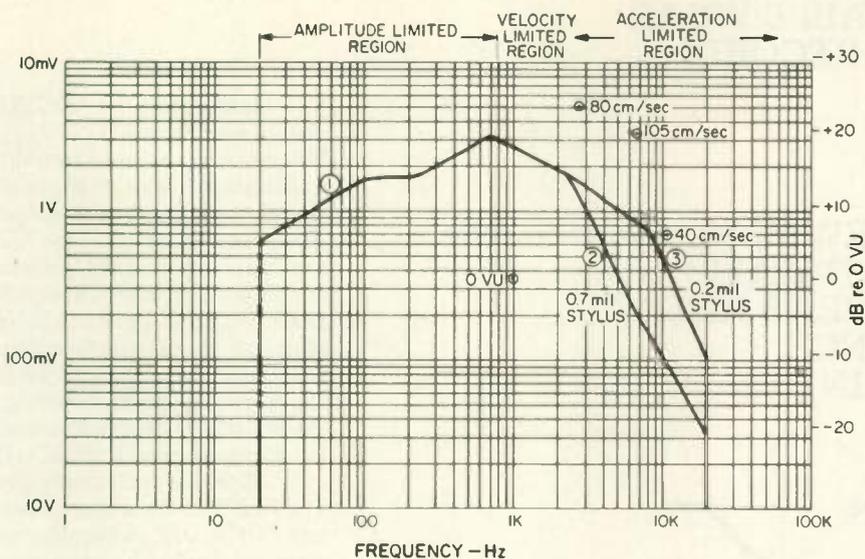


Fig. 1—Sonic cutting limits for low distortion playback. Uses 1 mV/cm/sec cartridge with 40 dB/1 kHz gain RIAA equalized preamplifier.

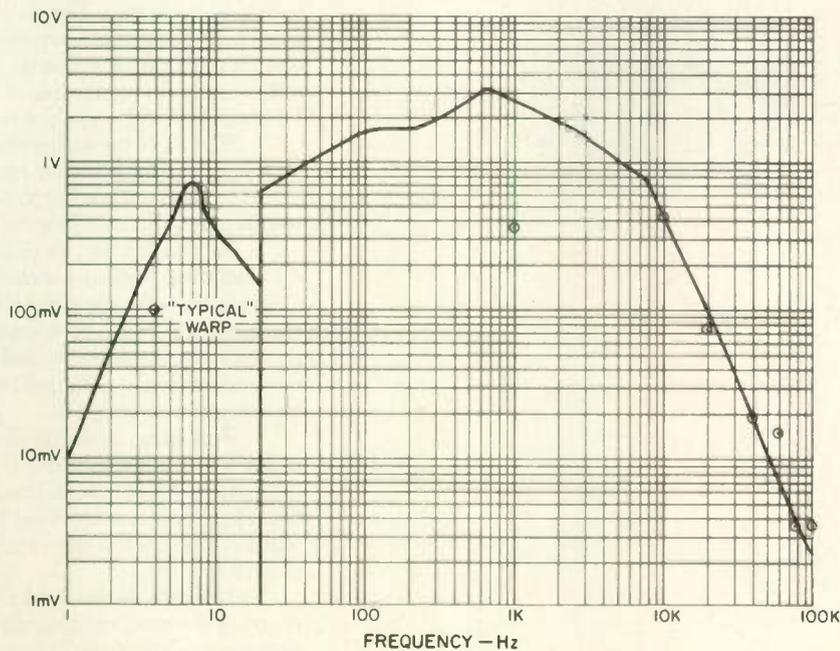


Fig. 2—Ultrasonic and infrasonic range signals measured from records (same conditions as Fig. 1). No infrasonic rolloff in preamp. Average tone-arm/cartridge combination, $f = 7$ Hz, 5 dB peak. Worst warp envelope shown.

parallel with the input impedance of phonograph preamps form a low-pass filter which attenuates response in the ultrasonic range.⁷ The low source impedance of moving-magnet cartridges provides flat electrical response throughout the ultrasonic region. While it may be argued that the output from a cartridge at these frequencies probably consists of distortion products that need not be reproduced cleanly, difference tone intermodulation, i.e., distortion products appearing as $f_2 - f_1$, may become audibly important. Any nonlinearity in the phonograph preamplifier at these frequencies and levels will act as a detector and will thus produce output in the audio range. Difference tone intermodulation of two strong, inband signals to produce a third has been noticed in preamplifiers. "One word of caution is in order. The preamplifier used to amplify the reproduced signal must be an extraordinarily good one. Even some highly respected amplifiers were found to introduce sufficient IM with high-level signals to partially obscure the contribution of the pickup."⁸ Ultrasonic signals could produce similar problems. The ultrasonic output voltage requirement is ameliorated by the RIAA equalization; still, the preamplifier should clearly be capable of handling signals shown in the table with low distortion.

The infrasonic range signals are generated by warps on records interacting with tone-arm/cartridge resonance. Fortunately, a large amount of data is available characterizing the warps which occur on commercially acceptable records which met the 1964 N.A.B. standards for record warp.⁹ The records in the survey were not particularly badly warped. Instead, they were from a conventional collection of records. The effect of much more severely warped records has not been included because of the inherent difficulties of playing such records, e.g. tracking them and their severe warp-induced wow. Most warps occur below 5 Hz (70 per cent) with 95 per cent occurring below 8 Hz. The envelope encompassing all the measured warps, corrected for cartridge sensitivity and preamplifier gain and equalization, is shown in Fig. 3 as curve 1. This maximum envelope has not been corrected for the effect of tone-arm and cartridge mass/cartridge compliance peaking and roll-off. Also shown is a single warp at 4 Hz with a peak amplitude of 0.003 in. which was chosen from the data to illustrate a "typical" warp. This

warp will be used to project the practical consequences of average warps on system performance. Also shown in Fig. 3 are the overall response of two tone-arm/cartridge systems. The two systems chosen represent quite reasonable best and worst case tone-arm/cartridge systems—the “good” system has a resonant frequency of 10 Hz with a Q of 3; the “bad” system has a resonant frequency of 4 Hz with a Q of 3. The criteria of “good” and “bad” are set by the fact that having a resonance where there are few disturbances with a rapid rolloff below is preferable to a resonant system having a peak coincident with many disturbances. Since many more warps lie around 4 Hz than around 10 Hz, the difference in the maximum peaks do not tell the whole story—the statistical distribution of warps must be considered as well. The plotted points above and below the “typical” warp show the range of possible responses to that warp from the best system upwards to the worst. This shows that a 4 Hz warp may be reproduced over a 24 dB span by the range of available tone-arm/cartridge combinations. Another interesting phenomena is seen in the difference between undamped systems and ones with pivot or arm damping, such as has been advocated among audiophiles. In the case of the 10 Hz, $Q = 3$ system, damping of the arm motion relative to the turntable base is seen to substantially increase the output on warps below resonance, even though this moderate degree of damping does not cause the system to mistrack warps.¹⁰ Since this form of damping increases the output in the warp region, it is causing the arm to behave rigidly and therefore there is net motion between the stylus and the cartridge body; the arm is no longer following the warps. This can lead to frequency and amplitude intermodulation effects in the cartridge. Therefore, damping of optimum systems is not recommended; it may, however, prove useful in a system with resonance in the 4 Hz region. For the composite whole range curve of Fig. 2, an average tone-arm/cartridge system has been used with the typical resonant frequency of 7 Hz with 5 dB peaking.

An example of cartridge/arm limits is given in Fig. 4. The overall playback system trackability has been modified by the frequency response of the tone-arm/cartridge system and by the gain and equalization of the pre-amplifier. The upper curve shows the capability of this arm/cartridge combination. The lower curve shows the

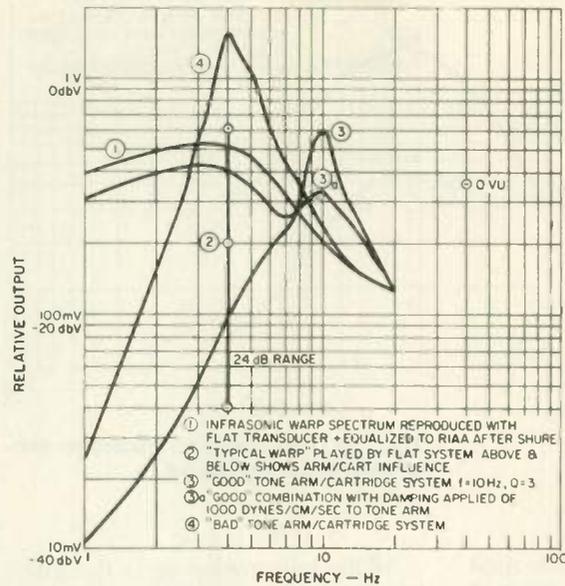


Fig. 3—Infrasonic region responses.

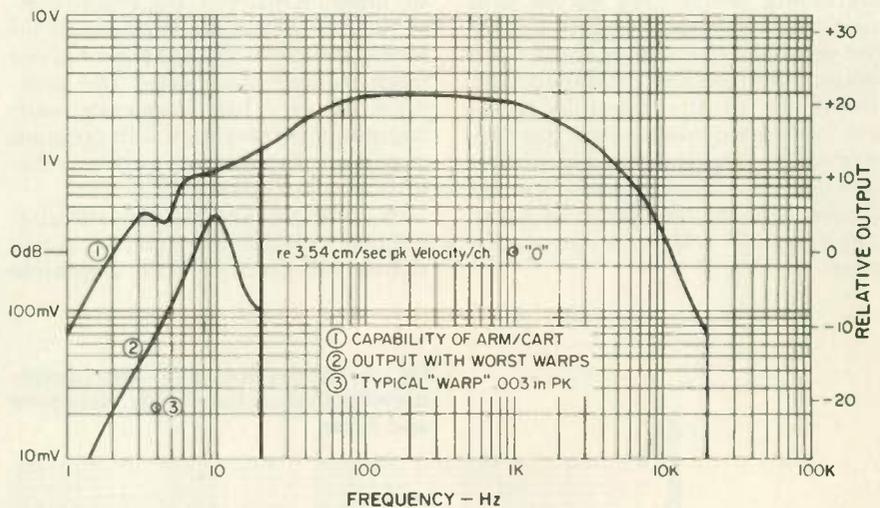


Fig. 4—Trackability vs. frequency referred to output of RIAA equalized preamp. No infrasonic cutoff. Adjusted for 0.7 mV/cm/sec cartridge sensitivity with 40 dB/1 kHz gain preamp. Example: Shure V-15 III.

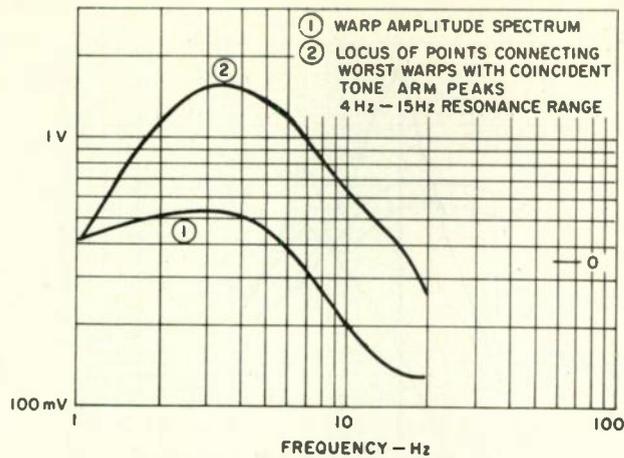


Fig. 5—1 mV/cm/sec cartridge sensitivity, RIAA equalized.

maximum output of this combination from the worst warps. Once again, it should be remembered that there are statistically far fewer warps at 10 Hz than at 4 Hz. The plotted point represents the response of this overall system to our "typical" warp.

Figure 5 gives the warp amplitude spectrum from Fig. 3 as curve 1 while curve 2 represents the maximum output possible at each frequency by combining worst case warps with tone-arm/cartridge systems peaks. The capability of handling these warp signals from records combined with the range of the possible tone-arm/cartridge peaks is a clear-cut performance requirement for phono preamps. And these signals must be handled in the presence of sonic range signals without cross-modulation.

All the information up to this point has assumed no electrical low frequency roll-off in the system. Previous work has shown the usefulness of infrasonic rolloff.¹¹ The degree of rolloff was set empirically by observation of loudspeaker cones while playing moderately warped records. Once the criteria were set, group delay effects associated with such rolloff were studied¹² and were shown to be inaudible on program material. The system consequences of passing warp range information to the loudspeakers has not been studied analytically. The presence of very low frequency warp components coincident with program material is expected to produce distortion in loudspeakers.

A loudspeaker driven simultaneously with mid-band and infrasonic signals will produce both amplitude

and frequency modulation sidebands around the mid-band signal. Although a spectrum analyzer will read both kinds of modulation equally, the ear is much more sensitive to frequency modulation distortion than amplitude modulation distortion. Figure 6 shows the average threshold of subjects listening to slow piano music played in rooms to pitch and amplitude fluctuations.¹³ Note that the pitch fluctuation threshold is lowest in the range of 4 to 10 Hz, which unhappily corresponds to the range of warps and tone-arm/cartridge system peaks. Also, the threshold for amplitude modulation is more than an order of magnitude greater than for frequency modulation in this range.

Frequency modulation distortion arises from the Doppler effect. Although the audibility of F.M.D. is debatable on low-frequency program material cross-modulating with high frequency material,¹⁴ the effect of warp range signals with their attendant high excursions intermodulating with mid-range material is worth study.

A simple equation for F.M.D. exists:¹⁵

$$d.f. = 0.033 A_1 F_2 \quad 1)$$

where A_1 = amplitude of cone motion, each side of rest, in inches; F_2 = modulated frequency, and d.f. = distortion factor in per cent. Since this distortion arises from cone motion and is not due to acoustic output, the relationship should hold for infrasonic signals present at the woofer. It has been shown that the predicted F.M.D. occurs in loudspeakers by separate measurements of AM and FM sidebands.¹⁶

Since this problem quickly becomes overpowering if one tries to examine all possible combinations of loudspeaker, playing level, system rolloff, etc., a reasonably chosen example seems in order. A good acoustic suspension, two-way loudspeaker, with a 10 in. woofer, was set up in an ordinary listening position in a 2,000 cu. ft. living room. One-third octave noise, centered at 800 Hz, was fed the loudspeaker, and the drive level was adjusted to produce an average 90 dB sound pressure level in listening positions. The noise was then removed and replaced by an 800 Hz sine wave at the same drive level. Various frequencies and amounts of infrasonic signals were superimposed on the 800 Hz tone, representing a range of possible warp conditions assuming no electrical rolloff in the system. The results are given in Table 2. The woofer displacements corresponding with the warps were measured and are

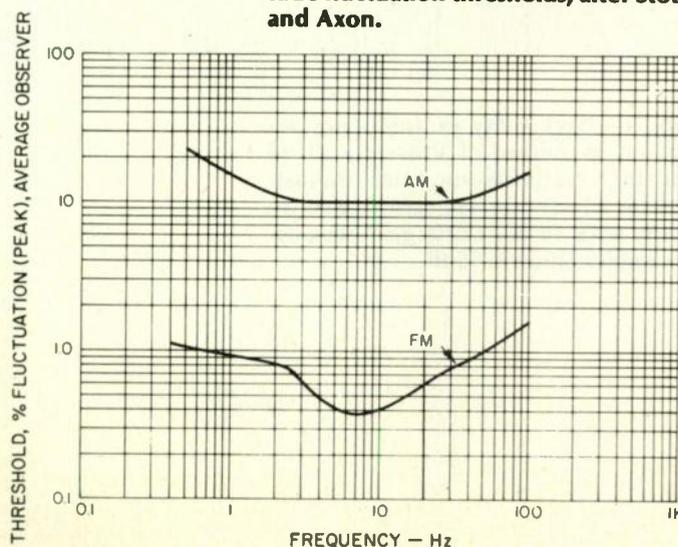


Fig. 6—Subjective pitch and amplitude fluctuation thresholds, after Stott and Axon.

Table 1—Ultrasonic content from a record. Moving-coil cartridge playing cymbal crash on opening of Sheffield Vol. 3, Lab 1. Ref. 3.54 cm/sec peak velocity = 0 dB. Direct measurement of cartridge output before RIAA equalization. Measurement made by Dave Hadaway of DB Systems.

1 kHz.....	0dB
10 kHz.....	+16dB
20 kHz.....	+6dB
40 kHz.....	0dB
60 kHz.....	+2dB
80 kHz.....	-7dB
100 kHz.....	-5dB

shown in the table. Distortion was measured with a spectrum analyzer, and under one set of conditions the AM and FM distortions could be separated due to a sideband null. Equation 1 checked for these conditions indicating that Doppler distortion was present in the amounts predicted by theory.

The percentage of distortion arising from these cone motions on the 800 Hz tone are given in the table. These percentages correspond to the same phenomena as flutter in tape recorders or turntables, but because of the multiplicity of flutter standards in use, they may not correspond with the specified flutter numbers. Specifications weighted to the DIN peak standard should correspond fairly well, however. The threshold for flutter is given in Fig. 6. At 4 Hz, where the worst warp velocities occur, the threshold for an average listener is about 0.4 per cent peak. Setting a critical flutter standard at two standard deviations from the mean, so that fewer than 5 per cent of listeners will perceive the flutter, yields a criteria of 0.14 per cent peak flutter at 4 Hz. These two flutter criteria are represented in Table 2 by the amount of attenuation required to meet the stated limit.

In order to make the problem manageable, one set of conditions was analyzed to produce the numbers in the table. While this set of conditions represents a reasonable average, different amounts of distortion will occur under other conditions. As the playback level is raised, the cone amplitude increases while the modulated frequency stays constant so the distortion will increase and vice-versa. A one-way speaker will be more susceptible since a wider spectrum will be handled simultaneously and the modulated frequency goes up; conversely,

a lower crossover from the woofer to a midrange or tweeter driver will ameliorate the effect. Piano music threshold represents a practical worst case, in other real-world instruments, vibrato in the production of sound will more or less mask flutter sources in the system. In addition, the random nature of warp-induced flutter superimposed on complex musical signals, where the influence of the flutter stops at the top end of the woofer's range, complicates the problem further.

The built-in stochastic nature of the problem, along with these difficulties, prevents an absolute solution to the problem. As may be seen in Fig. 3 and Table 2, the tone-arm/cartridge system has a strong influence on the performance of the system. Infrasonic fil-

should be suspected for their distortion contribution.

It is clear from Table 2 that some amount of infrasonic attenuation is desirable in nearly every circumstance. Larger amounts of attenuation are useful to limit the modulation distortion generated in loudspeakers. However, the practical upper limit on infrasonic attenuation is set by the group delay characteristics of the filter in combination with the tone-arm/cartridge system. Ideally, the group delay should be a small fraction of the audible limits. Figure 7 gives the data on limits of audibility and on the standards of the Federal German Post Office and West German broadcasting companies.^{16A} Also shown is the group delay of the infrasonic filter with and without the influence of a

Table 2—Consequences of Infrasonic Drive on F.M. Distortion generation by loudspeakers. Conditions: Midband output 90dB SPL in 2,000 cu. ft. room; acoustic suspension 2-way loudspeaker with 1.5kHz crossover.

Warp Freq./Amplitude Arm resonant frequency, peaking in dB	4Hz, typ.		4Hz, max.			
	10Hz/ +10dB "best"	7Hz/ +5dB "typ"	4Hz/ +10dB "worst"	10Hz/ +10dB "best"	7Hz/ +5dB "typ"	4Hz/ +10dB "worst"
± displacement, inches	± 0.008"	± 0.022"	± 0.090"	± 0.022"	± 0.055"	± 0.170"
Flutter, % peak due to loudspeaker at 800Hz.	0.21%	0.6%	2.4%	0.6%	1.4%	4.5%
Attenuation@4Hz required to suppress flutter to threshold of 50% of population (0.4% peak)	none	3.5dB	16dB	3.5dB	11dB	21dB
Attenuation@4Hz required to suppress flutter to threshold of 5% most critical listeners (0.14% pk)	3.5dB	13dB	25dB	13dB	20dB	30dB
Flutter, % peak due to loud- speaker with 3-pole infra- sonic filter @ -3dB = 15.5Hz; 4Hz, -36dB	0.003	0.009	0.04	0.009	0.02	0.07

tering should not be used as a "band-aid" for bad tone-arm/cartridge systems since the bad system is likely to be producing modulation distortion in the cartridge, which no filter can take out. Still, even the best tone-arm/cartridge system requires 13 dB of 4 Hz attenuation to make the warps from the survey produce inaudible flutter for 95 per cent of the population.

It had been previously supposed that vented box loudspeakers, unloaded below resonance, would exhibit worse distortion on warps due to longer cone excursions on warp signals. This theory was tested on one vented box design. The unit tested had distortion at about the same level as the acoustic suspension design due to a quite stiff driver suspension. Speakers that exhibit long, uncontrolled motion visible on warp signals

worst case tone-arm/cartridge system. At 50 Hz the group delay of the playback system is about one-fortieth of the audible limit on program material.^{17,18} This makes mental sense if one remembers that events happening at low frequencies take a relatively long time by definition. The "low-frequency transient" is practically a contradiction in terms. Furthermore, low-frequency group delay is unavoidable in high-fidelity systems; the low-end rolloff of the loudspeaker system, combined with the response of the room, will always cause a delay. However, even most of the vented-box system alignments, with their relatively long delays, fall under the limit of perception even when aligned to the relatively high frequency of 50 Hz.¹⁹ And the high-quality acoustic-suspension design used in the distortion experiment adds only about 4 mS of 50

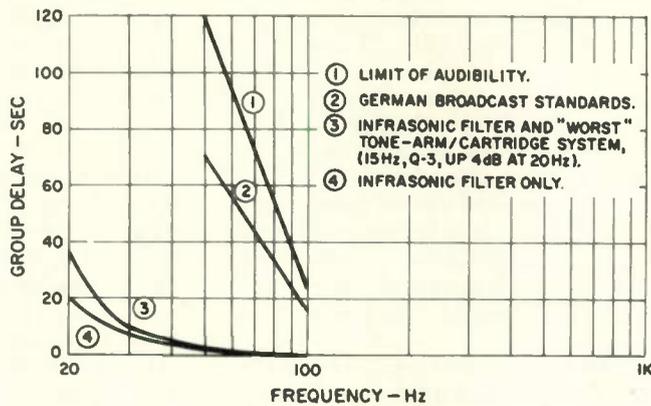


Fig. 7—Group delay.

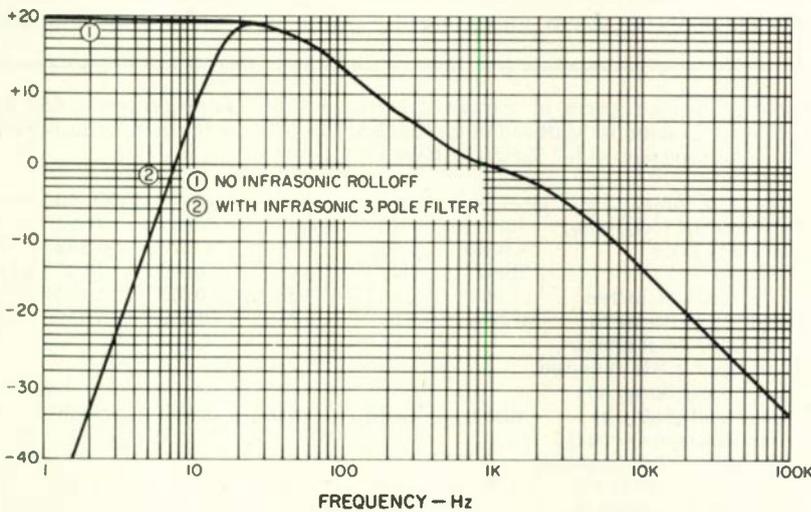


Fig. 8—Extrapolated RIAA range.

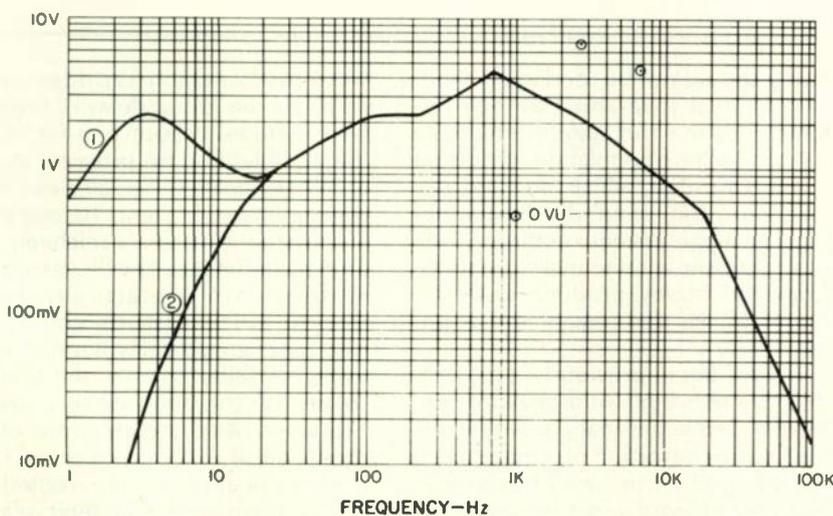


Fig. 9—Worst case analysis, conditions: 0.3 mV/cm/sec cartridge with 1:7 transformer, 36 dB gain @ 1 kHz. Worst case tone-arm/cartridge curve 1; curve 2 as 1 but with infrasonic 3-pole filter.

Hz delay. Combined then with the tone-arm/cartridge system, the pre-amplifier filter, and the loudspeaker response, the overall delay is 7 mS at 50 Hz, still more than an order of magnitude below the experimental perceptual limit.

Noise

A fundamental physical limitation occurs at the other end of the dynamic range, the thermal noise of the cartridge. Thermal or Johnson noise as it is called arises from the random nature of vibrations of the charge carriers in conductors. It is very similar to the Brownian motion of particles.²⁰ Recently the problem of characterizing the noise contribution of the cartridge has been solved.²¹ The cartridge source impedance, the load capacitance and resistance, RIAA equalization, and psychometric weighting for the effect of noise on human listeners have all been given consideration.²² From the results, the fundamental noise limit of the circuit due to the cartridge and its load may be compared with the actual noise. Such a comparison is called a noise figure measurement; it is a method of specifying how close a circuit approaches the theoretical ideal. The weighted noise for one cartridge characterized is equal to 84 ¼ dB below 10 mV input. Since high quality preamplifiers have noise levels of about 82 dB below 10 mV rms referenced to the input with a cartridge connected and weighted, the noise figure is about 2 dB—a very close approach to the ideal. Preamplifiers designed for low shorted-input noise may not be as good as those designed for cartridge connected noise when the cartridge is used. The use of such a noise figure comparison measurement is recommended since it provides the simplest means of stating what we would most like to know, how close does the device under test approach psychoacoustic perfection?²³

Conclusion

All signals known to be available from cartridges have been studied for their potential to cause distortion in preamplifiers and infrasonic signals have been studied for their effect on loudspeakers. The most stringent combination of conditions in each frequency band are plotted in Fig. 9. A moving-coil cartridge of the high output variety, combined with a step-up transformer, was used for this worst case analysis. In the infrasonic range, a series of resonant frequencies for the tone-arm/cartridge system was cho-

sen and added to the worst case reasonable warp at each frequency to produce a worst case requirement. The output requirement is eased by the infrasonic filter as shown in curve 2, although the signals must be handled linearly at the input even with the filter. Referenced to the input, over-load capability of 100 mV rms at 1 kHz will handle all the signals in the sonic range; however, if the pre-amplifiers' input overload curve followed inverse RIAA equalization precisely (which many do), it would overload at 10 mV rms input at infrasonic frequencies. In order to accommodate the worst set of conditions at 3 to 4 Hz, the input overload should be on the order of 35 mV rms minimum. And this strong infrasonic signal must be handled without intermodulating the program material.

At the other end of the dynamic range, the notion that noise in pre-amplifiers should be specified as psychoacoustic noise figure for the most meaningful comparison has been introduced.

Acknowledgements

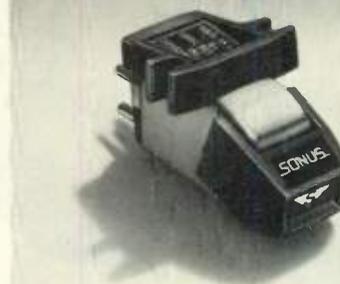
I wish to thank Bob Berkowitz and Jim Cates of Acoustic Research, Inc.; Al Groh of Shure Bros.; Andy Petite of Advent, and Dave Hadaway of DB Systems for their help. The group delay audibility experiment with clicks reported in the February article in *Audio* was conducted by Mark Davis of M.I.T. 4

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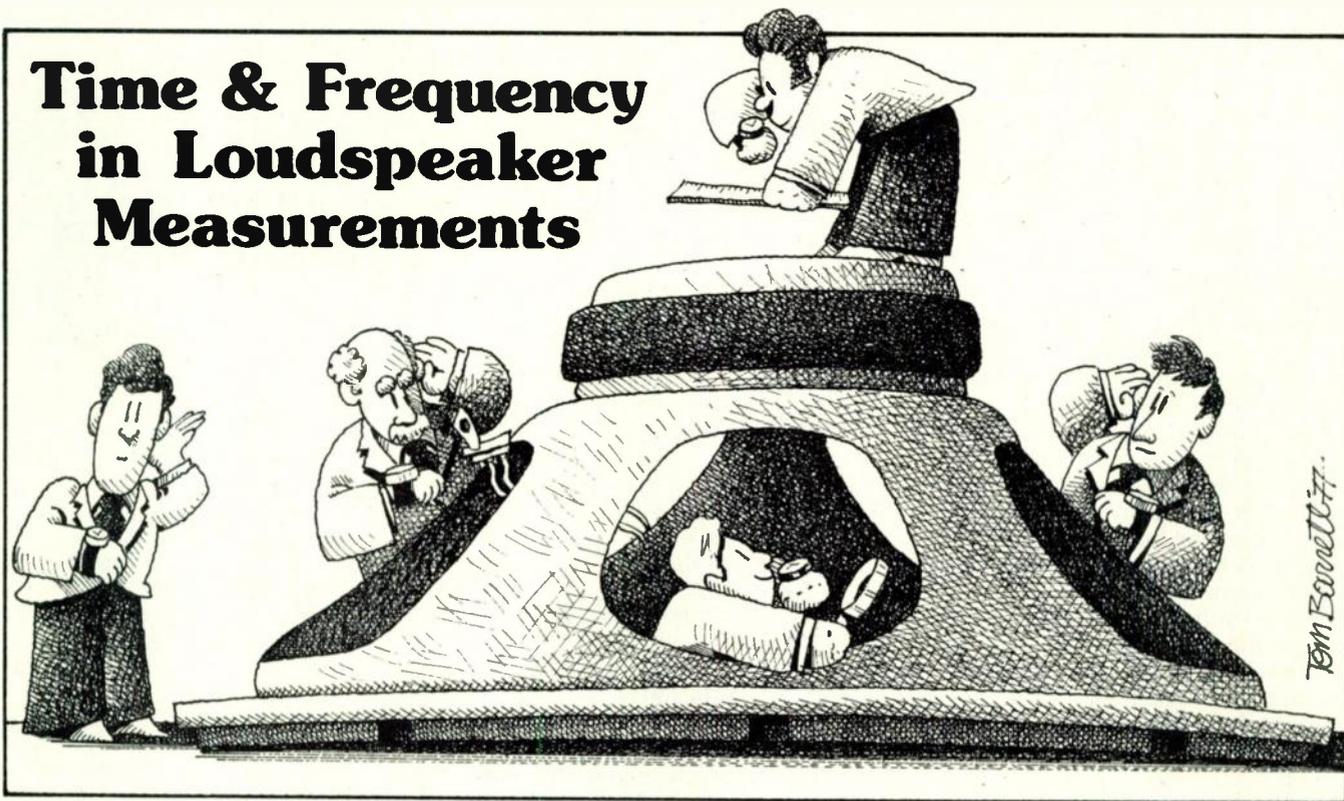
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High Definition Phono Cartridges

Time & Frequency in Loudspeaker Measurements



80

Richard C. Heyser

I claim that it should be possible to measure audio systems and have those measurements correlate with what we hear out of those systems. We are not doing that now. Our measurements are more precise than ever, but our understanding of what those measurements mean to the way a system "sounds" is still hazy.

I further assert that we are locked into that dilemma because we do not truly understand the meaning of those technical concepts which we now use. I don't think I can be more blunt about the matter.

OK. So having shot my mouth off, what am I going to do about it? Well, what I would like to do is present the readers of *Audio* with my personal view of the meaning of some of the more important terms we use in audio. These are some of the results from my own continuing research into the problem of finding out how to bring subjective and objective audio together. What I present here is my own work. I'm laying it out, in a put up or shut up fashion.

But I am not asking you to accept these things blindly. Question it, think about it, because what we really need to do is dig down to these underlying principles, the philosophy of the

problem. In these discussions we go below the equation's mechanical formalism and question what the meaning is behind the equations. Then when we come up to the equations of audio we find that, while there may be no change in form, we often have a completely new perspective on just what they mean, not only to the pedestrian task of measuring components, but to the possible link with subjective perception.

In a previous article, I started out at ground zero and gave my interpretation of the meaning behind a technical term that is commonplace in audio, the term we call frequency. In this article I would like to carry this point further and apply it to the interpretation of certain loudspeaker measurements.

But before I get technical, let me put one thing into perspective. The end product of this whole multi-billion dollar audio industry is the listening experience. It is what we "hear," in the abstract sense of this word, that is important.

It is not the oscilloscope pattern but the listener's perception that is paramount. This does not mean that we should reject technology... quite the contrary. We know that most persons have the same general impressions of the realism and quality of a performance when listening to identical sound reproduction. There is some-

thing that is used by all of us in making our judgment, and that something is tied to the ingredients making up the reproduced sound. If this something is there but not specifically outlined in our present technical measurements, then we need to get even more technical and find out why. We need a Renaissance out of what may prove to be the "middle ages" of audio. The winner, if there is to be a winner, would be the listener, for we would know how to make his enjoyment of sound far better.

In my last article, I pointed out that when we do become very technical and poke around at the precise meaning of terms, a startling fact emerges. Even as fundamental a term as *frequency* turns out to have a meaning quite different from that which most of us employ in audio.

It is a subtle thing, but sometimes subtle things topple kingdoms. Let me recap. We know that at present there are two major ways of describing an audio signal. There is a time-domain representation and there is a frequency-domain representation. The time-domain representation and the frequency-domain representation are Fourier transforms of each other.

Now what the heck is a Fourier transform? A conventional textbook answer to that question is to write out a certain hairy integral equation and state... "that is a Fourier transform."

Simply writing down some equation, as though it were a Machine of the Gods, doesn't answer anything. Nature does not solve equations, people solve equations. Nature works in spite of us, and at best the equation is some sort of model for the way in which nature works.

In the previous article, therefore, I suggested a different approach. Suppose we have a signal which we agree is a legitimate time-domain representation. And suppose we ask ourselves what form that signal will take if it is observed by a being who uses some other coordinate instead of time. In particular, what would the form of that signal be if it has the same dimensionality but is somehow measured in units that are the reciprocal of the units of time we use?

Remember, we would both be seeing the same signal, but would be using different frames of reference.

Pursuing the point further, we asked what recipe we could use to take our time-domain view and see it within the framework of this other being's coordinate system. We derived the recipe, which turned out to be the Fourier transform. And the coordinate system which this other being uses turned out to be the parameter we call frequency. Exactly the same equation you will find in a textbook, but with a totally new interpretation.

The thing we call time in audio measurements and the thing we call frequency are different coordinates for describing precisely the same signal.

Subjective Descriptions

Oh, yes. . . ho hum, technicalia. But if we begin to think what this means to audio it gets a bit exciting, because this means that frequency and time are only two out of an infinite number of coordinate systems we can use to characterize a signal. We don't have to go just from time to frequency, we can go from time to some other coordinate. And even more stunning is that since we can have *either* time or frequency, but never both together in a meaningful description, this means that those properties of sound which we perceive and relate to the

words "time" and "frequency" are *not those parameters at all*.

Now, think for a moment about those words we often use to characterize the sound of imperfect reproduction. Words such as "grainy" and "forward." These words do not seem to fit in with either an exclusive time description or frequency description. Is it possible that these words belong to some other, as yet unrecognized, coordinate system which is a legitimate mathematical alternative to time and frequency? I claim the answer to this question is yes.

Putting it in blunt language, if we measure the frequency response of a system, and do it correctly, then we know everything about the response of that system. We have all the technical information needed to describe how that system will "sound." But the information we have is not in a system of coordinates that will be recognizable by a subjectively oriented listener. Everything is there, but the language is wrong.

That is the root cause of the continuing fight between subjective and objective audio. It is *not* that *either* is more correct than the other. . . rather it is due to the fact they do not speak the *same language*. And when I say language, I do not mean just the descriptive words, but the very frame of reference upon which these words are based.

Sticking my neck out further, I assert that the reason technical people (and I am one of them) did not recognize the root cause of this problem was due to the fact we did *not* realize there *could* be other meaningful frames of reference besides time and frequency.

And, as a matter of fact, not too many technical people are aware that time and frequency are themselves alternate frames of reference, rather



"And, as a matter of fact, not too many technical people are aware that time and frequency are themselves alternate frames of reference..."

than just two terms to be applied haphazardly to measurement.

There! How's that for tipping over icons?

Loudspeaker Tests

As a reader of *Audio*, you've probably noticed that our loudspeaker reviews have been a bit more technical than is normal industry practice. There's a reason for this. These tests are a first attempt to relate measurement to subjective perception. The various tests we perform did not just happen; each is in some way related to simple mathematical results in the type of geometric structure which we might use in perception. It is a first attempt, and very crude at that. But somebody's got to start the process, so let it be here.

In the remainder of this discussion I would like to explain the technical aspects of spectrum sampling and apodization as they relate to the loudspeaker tests we perform in *Audio*.

Let me begin by recapping a very important concept which I flogged to death in the previous article. That is this mysterious and seemingly sinister thing called the uncertainty principle. There is nothing mysterious about the uncertainty principle at all. It is not something nature does to us, but something we do to ourselves through the definitions we give things.

Here is the point. It makes absolutely no difference whether we start out by defining parameters as being related by the Fourier transform, or somehow discover well along the road that two properties happen to be related through Fourier transformation: when two properties are Fourier transforms of each other, they represent different ways of describing the same thing and hence cannot be thrown together into one common description. The Fourier transform is a map, you see, which converts one coordinate system into another coordinate system.

It is a property of changing from one view to another that each part of one view becomes somehow spread over the entirety of the other view. In particular, the Fourier transformation takes a single coordinate location in

"Nature's clocks always run forward; at least, the most diligent searching has failed to reveal any experimental results to the contrary."

one view and makes it into a very special geometric figure in the other view, a figure which we call a wave and which extends over the entire range of coordinates in the other view. If we try to take a restricted range of coordinates in both views, we cannot do so and be precisely accurate. But what we can do is ask what the minimum ranges of coordinates are in *both* views such that "most" of the same information is contained in each. The form this takes for a popular measure of "mostness" is such that the product of these two ranges is greater than or equal to some number. This is called the uncertainty principle.

Let's see what this means in audio terms. Suppose we are testing a loudspeaker. We kick it with a voltage and the loudspeaker produces some sort of sound. Let's pick that sound up with a microphone and convert it back to voltage. Now let's put a switch in the output of the microphone. Suppose the switch is initially open, so that we do not have any sound signal to analyze. Some time after the loudspeaker puts out a pressure wave, we close the switch for one second and then open the switch.

What do we have? In the coordinate of time we have a signal that only has a sound-related value over a period of one second. We have created a one-second chunk of time... a time-domain representation.

Imagine, if you will, how that voltage would appear to some being who does not live in a coordinate called time, but whose frame of reference is something we call frequency.

In fact, if we want to see what he sees, we can convert to his coordinate system by making what we call a spectrum analysis. In order to do this, we have to give up the thing we call time. Time will show in this frequency spectrum, but it will be in the form of the relationship of phase and amplitude of waves in the frequency spectrum.

When we look at the frequency representation, we will see that there is some energy spread over the whole of the frequency coordinate. But the effect of having taken a frequency spectrum from a small chunk of time is that the frequency spectrum will be



very slightly out of focus. The edges will not be sharp, but somehow smeared. The amount of this smear will be on the order of one Hertz, which is the name we give to the unit of measurement in this other being's coordinate system.

If we had only closed the switch for one-thousandth of a second, and then seen what our frequency-domain friend saw, we would find that the smear was of the order of one thousand Hertz units (I'm only talking in ballpark figures).

That is the manifestation of what is called the uncertainty principle. In performing *Audio's* loudspeaker tests, I use a 13-millisecond time window to make the three-meter or room test. I want to find out what spectral components are found in that important time period which can establish some measure of timbre or tonal balance of the sound heard from that loudspeaker when placed in a room. This time duration derives from psychoacoustic tests. I cannot legitimately present any frequency measurements focused to an accuracy of better than about 100 Hz, including the range from d.c. to 100 Hz, because of the chunk of time which the data represents. To be safe, therefore, I only give data from about 200 Hz upward.

Apodization

Now there's this problem called apodization, which literally means "the process of removing feet."

When we hack off sharp edges, such as closing and opening a switch on a voltage, the equivalent transformed view will be blurred in a most unpleasant manner. There will be foot-like appendages, or sidelobes, which extend outward from each place where there should be a solitary frequency value standing apart from its neighbors.

Again, I must stress this is not due to some caprice of nature, it is due to our definition. If we hack off edges, and if we take a Fourier transform view, then we will find sidelobes. And I don't give a darn whether we measure the equivalent frequency response with sharp filters or with a computer FFT, our definition requires they be there. The theory determines what we will observe.

In order to minimize (we can never remove) them, it is necessary to do some sort of blurring or defocusing in the hacked-off parameter. The process of removing spectral feet by operating on the original data is called apodization. There are an infinity of apodization processes available, depending upon the type of corresponding blurring we are willing to tolerate in the apodized spectrum. Apodization usually consists of smoothing the sharp edges by using more of what is in the middle of the hacked-off distribution than at the sharp edges. *Audio's* loudspeaker data is apodized with a nearly raised-cosine weight function when frequency response is plotted, and with a Hamming weight function when time-domain response is plotted.

Time Measurements

Nature's clocks always run forward; at least, the most diligent searching has failed to reveal any experimental results to the contrary. Where we poor humans get into trouble is when we start out from a frequency measurement and compute the corresponding time-domain response. If we have a *chunk* of frequency response, for example if we have no data above 20 kHz, then the time-domain response will be blurred.

In nature, the sharpest edge of all is at "now." A computed time-domain response will therefore spread before and after "now." The computed time-domain response will appear to predict the future... that is not really a prediction, but a blurred edge.

The energy-time loudspeaker measurement we make is a computation from the anechoic frequency response. We band limit from zero frequency to 20 kHz. In order to get the sharpest definition of discrete signal arrivals, such as due to diffraction

from the edge of the enclosure, with the least amount of predictive "feet," we use an apodization function called Hamming weighting. Our measured sidelobes are actually down close to 40 dB below the peak giving rise to them. But you will still see what appears to be a predictive risetime prior to extremely sharp pulses.

As a matter of professionalism, we also check the loudspeaker impulse response by using a raised cosine pulse of voltage that has a 10 micro-second half-width. The loudspeaker impulse response is viewed on an oscilloscope and compared against the computed energy-time response to make sure all is kosher.

The reason for this belts-and-suspenders approach is due to a fact of apodization that, unfortunately, very few professional people seem to be aware of. Apodization, or a weight kernel, or whatever you choose to call it, has all the properties of the data to which it is applied. This includes the properties of amplitude and phase. In fact, we could take a converse view that the data is actually a weight kernel on the apodizing function.

Now, you know what happens when we take a Fourier transform of a product of two functions in frequency. The result is a time-domain convolution of what would have been the time-domain representation of each by themselves. They get all mixed up.

They get tangled up in phase as well as amplitude. And quite often a messy data signal will "unsmooth" even a good apodizing function. In short, this means that sometimes the computed response is lumpier than we think it should be. But, and computer people take note, unless you have a cross check or precise knowledge of the amplitude and phase of the data being transformed, you don't know it happened.

The geometry of this is too lengthy to go into here, but most apodizing functions used in Fourier transform analysis are non-minimum phase. Mostly they change the amplitude without changing phase. This includes Hamming, Hanning, and the rest. Historically, this is because the interest usually lays in the power spectrum (phase, what's that?). That works swell when the data is minimum phase. But when the data (in our case loudspeaker frequency response) has a maverick phase term, it can unsmooth a good apodizing function. Look at it this way, the effect is as though the loudspeaker response was minimum phase and the excess phase term was thrown into the weight kernel.

I realize that such talk might be highly confusing if you're not in the FFT business, but computer people ought to know what I mean. Other than my own comments in technical journals, I don't believe this fact has been pointed out before.

What it boils down to is that *Audio* makes every effort to be technically accurate, even if we are not terribly popular among some manufacturers when we do so.

Wrap Up

Let me wrap up this little discussion with two observations. First, if we real-

ly want to bring subjective and objective audio together, we need to get down to the fundamentals which can be highly technical. Second, with the editor's permission, I am trying an experiment with these discussions—in using words rather than mathematical symbolism, but I am not watering down the technical level.

Audio's readership covers the full range of involvement in the sound industry, from listener to researcher. Reader survey cards (yes, we do read them) indicate that many of you want more technical articles. And you like straight talk. All right, this was a trial balloon. Want more? **A**

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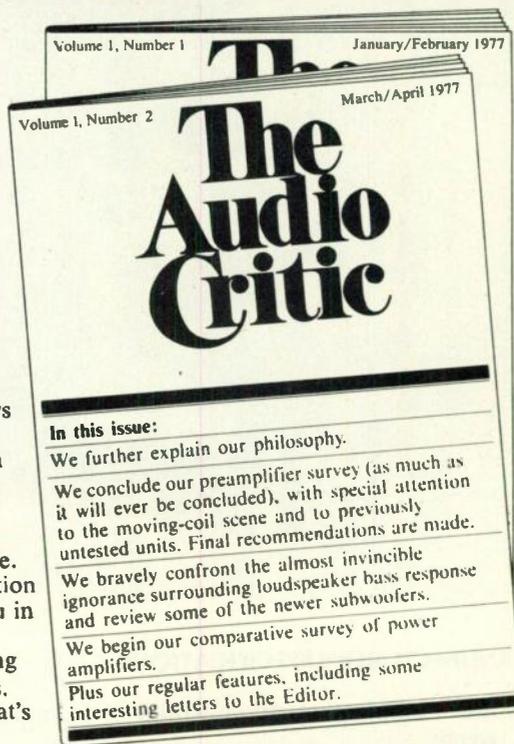
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Equipment profiles

Jensen Model 530 Three-Way Loudspeaker System



84

MANUFACTURER'S SPECIFICATIONS

Speaker Complement: 10-in. woofer, 3-in. mid-range, 1 1/2-in. tweeter.

Frequency Range: 27 Hz to 25 kHz.

Impedance: 8 ohms, nominal.

Crossovers: 1&5 kHz.

Dispersion: 170°.

Minimum Power: 10 watts.

Maximum Power: 60 watts.

Dimensions: 24 1/2 in. (62.2 cm) Hx 14 in. (35.6 cm) Wx 12 in. (30.5 cm) D.

Shipping Weight: 42 lbs (19 kg).

Price: \$189.95 (west of the Rockies \$199.95).

The Jensen Model 530 is a three-way loudspeaker system using a 25 cm (10-in.) woofer, 9 cm (3-1/2 in.) cone mid-range, and a 4 cm (1-1/2 in.) dome tweeter. Mounted in an attractive walnut finished enclosure measuring 35.5 cm (14 in.) by 31 cm (12-1/2 in.) by 62 cm (24-1/2 in.), this system reproduces the audio range from 50 Hz to 18 kHz.

The sound may be balanced, to user satisfaction, by means of midrange and tweeter level controls, which are reached by pulling off the front grille. After adjusting these controls, the grille may be re-attached by simply pressing it back in place.

Electrical connection is made to binding posts mounted in a recessed cavity at the rear of the enclosure. Instructions supplied with the system, while not overly detailed, are sufficient to allow proper setup with little chance for mistake.

Technical Measurements

The magnitude of the impedance which the Jensen Model 530 presents to a power amplifier is shown in Fig. 1. In this measurement the two front-panel equalizer controls, which set the middle and high frequency balance, are adjusted to their mid-rotation values. Following a bass rise at 58 Hz, the

impedance reaches a second peak near 1 kHz. The lowest impedance is reached at around 10 kHz and lies slightly over 6 ohms.

A polar plot of the impedance for the same equalizer settings is shown in Fig. 2. The nature of this plot indicates a smooth impedance variation throughout the audio frequency range. There is, however, a potential problem which some amplifiers may have when driving this loudspeaker near their peak limit. The phase angle of impedance has a 42 degree lag at 1.8 kHz with a net impedance around 12 ohms. While this impedance should cause no problems with quality amplifiers, it could possibly trigger the protection circuitry of some amplifiers into audible distress when these amps are driven near their limit on musical material with wide dynamics such as voice and piano. The solution is to use quality amplifiers with the Jensen 530.

Measurements made on the frequency response demonstrate that the equalizer controls have a strong influence. Figure 3 is a plot of the one-meter axial response for three equalizer positions: both at maximum, both at minimum, and both at a halfway position, shown as -10 on the calibrated panel markings. There is very little effect below 1 kHz, but substantial influence above that frequency.

Bass response extends down to 55 Hz, then falls uniformly below that frequency. Midrange is relatively smooth, with a broad peak around 600 Hz, while the response above 1 kHz is most uniform only for the maximum equalizer positions.

Figure 4 is the phase plot corresponding to the maximum equalizer measurement of Fig. 3. The Jensen Model 530 is a three-way loudspeaker system, and the acoustic time delay is different for each driver comprising this system. For this measurement, as with the anechoic test, the microphone is always placed one meter in front of the loudspeaker front panel and directly on the system's central axis. Three measurements were made to show the complete phase response of this system. A time delay corresponding to a path length of 1.028 meters is needed to give the measurement corrected for the tweeter acoustic position. The midrange measurement from 200 Hz to 20 kHz is made with a path length of 1.05 meters. And the lowest frequency needs a path delay of 1.40 meters to yield the phase plot shown here. In short, this means that the sound from the three drivers arrives at the listening location at slightly different times.

The woofer and tweeter are in phase with the voltage waveform, while the midrange unit is shifted 190 degrees. A positive-going speaker voltage applied to the speaker terminal indicated by the red post will arrive at the listening location as a pressure increase when the sound is due to the woofer and tweeter.

Fig. 3—Magnitude of sound pressure level, anechoic response one meter on axis with one watt average drive.

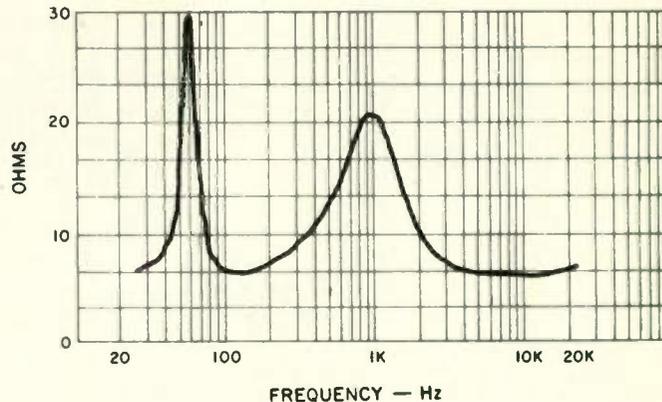
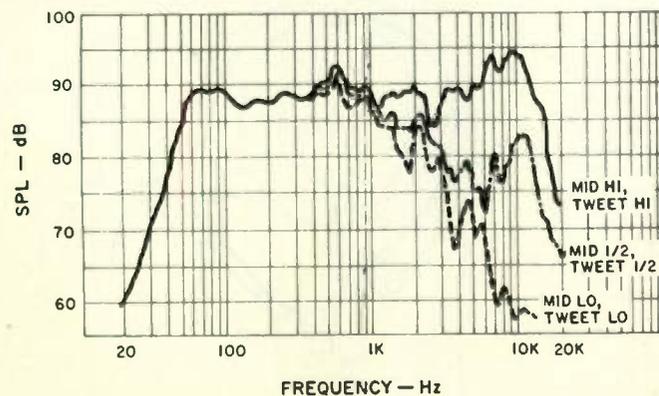


Fig. 1—Magnitude of impedance.

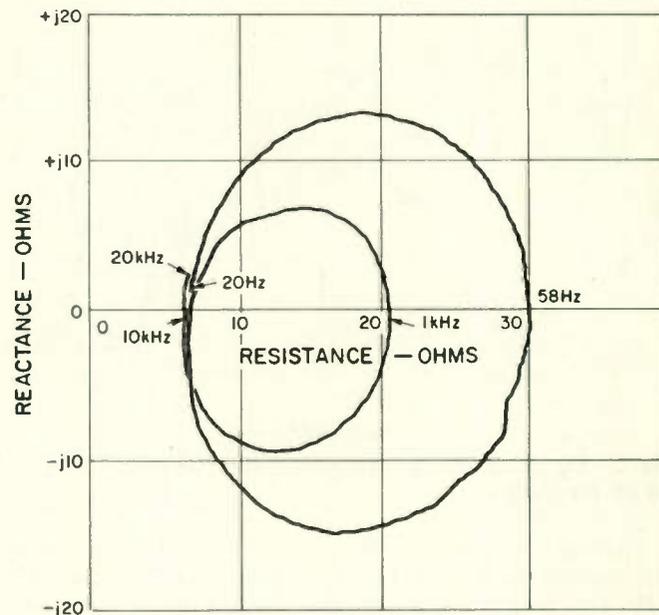


Fig. 2—Complex impedance.

The acoustic crossover frequencies are indicated to be around 600 Hz and 11 kHz by this phase measurement. In general, the response due to each driver is of minimum phase type, although the complete system must be classed as nonminimum phase due to the time delay differences.

The three-meter room test is shown in Fig. 5. This is the spectral distribution for the first 13 milliseconds of sound which is heard when the Jensen Model 530 is placed in a room. The physical placement of the speaker for this test is against a wall and raised off the floor by an amount which places the center of the enclosure one meter from the floor. The measurement position is one meter above the floor and three meters away from the front of the speaker. The room has a floor-to-ceiling height of 2.5 meters, and there's a rug on the floor. No furniture reflections are allowed within the time window of this measurement, which is mathematically changed (apodized) to prevent clipped transients interfering with the frequency measurement. The speaker is placed directly in front of the microphone for one measurement and 30 degrees to the left of the microphone in the other measurement to simulate probable stereo listening locations. Both the tweeter and midrange controls were placed in their maximum clockwise position for this measurement.

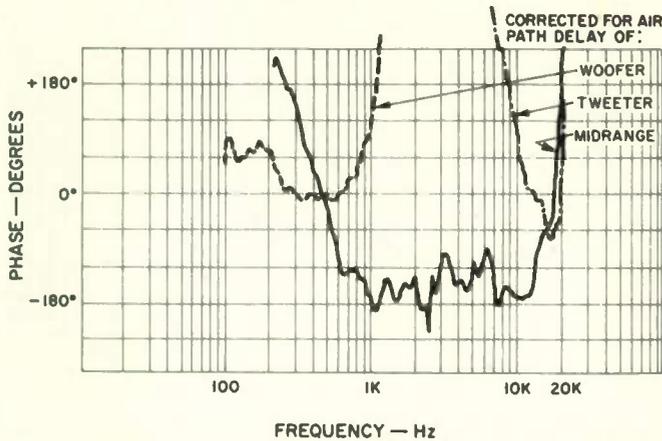


Fig. 4—Phase of sound pressure level.

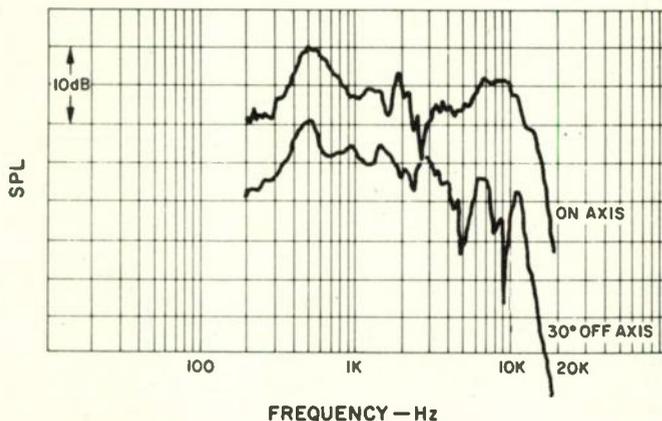


Fig. 5—Three-meter room response, plots displaced 10 dB for clarity.

The room response is similar to the anechoic response in that there is an emphasis of frequencies around 500 Hz and 9 kHz. This measurement indicates that the speakers should be rotated toward the listening position for a more uniform balance of high frequency energy.

The polar energy response is shown in Figs. 6 and 7 for the horizontal and vertical dispersion of sound around the Jensen Model 530. This is a measure of the total energy in the full 20 Hz to 20 kHz band, and five equalizer positions were used for each measurement.

The most uniform polar response is obtained with the midrange set *Low* and the tweeter set to its *High* position, with other combinations of equalizer position resulting in some polar "fingering" which indicates a change of sound timbre with seating position. The polar measurements verify the suitability of rotating the speakers toward the listening area. The strong upward projection of sound energy indicates that the Model 530 should not be placed immediately beneath a ceiling or shelf that projects beyond the front of the enclosure and this speaker will sound best placed in an open unconfined space.

The measured harmonic distortion for the musical tones E1 (41.2 Hz), A2 (110 Hz), and A4 (440 Hz) is shown in Fig. 8. This type of distortion is moderately low in the Jensen for the middle and upper tones but rapidly rises with increasing drive power for extremely low bass.

Intermodulation distortion is plotted in Fig. 9 for the effect of E1 on A4, or 41.2 Hz on 440 Hz, mixed one to one. At 10 watts average power, the modulation of A4 by E1 amounts to 4 degrees peak-to-peak phase modulation and 3

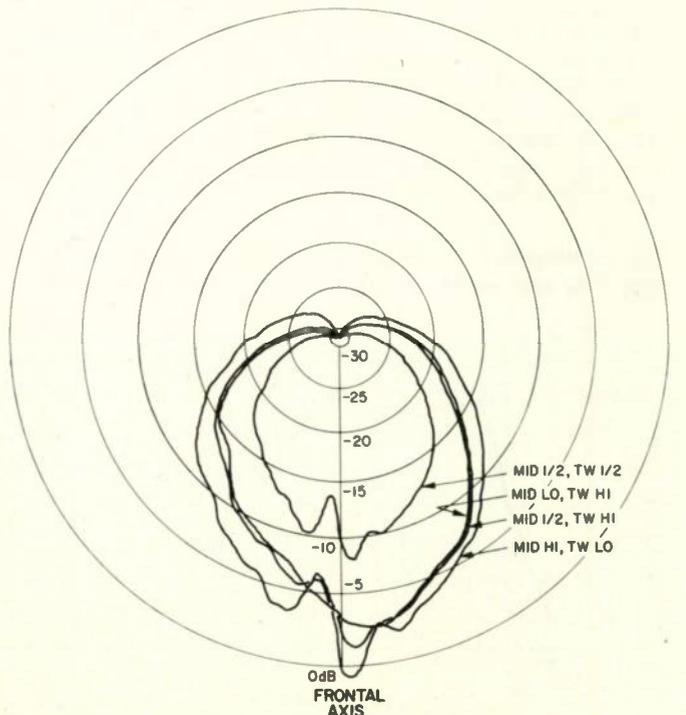
per cent amplitude modulation. As with all loudspeakers, there is a small but measurable migration of the cone away from its rest position when signal is applied. This is a d.c. effect which shifts the average position of the acoustic source. For the Jensen Model 530, the mean average position of the woofer moves inward by an amount corresponding to 4 degrees phase shift of 440 Hz when 10 watts average drive is sustained with combined E1 and A4. Percussive bass will therefore cause a small time smear of the higher musical frequencies carried by the woofer.

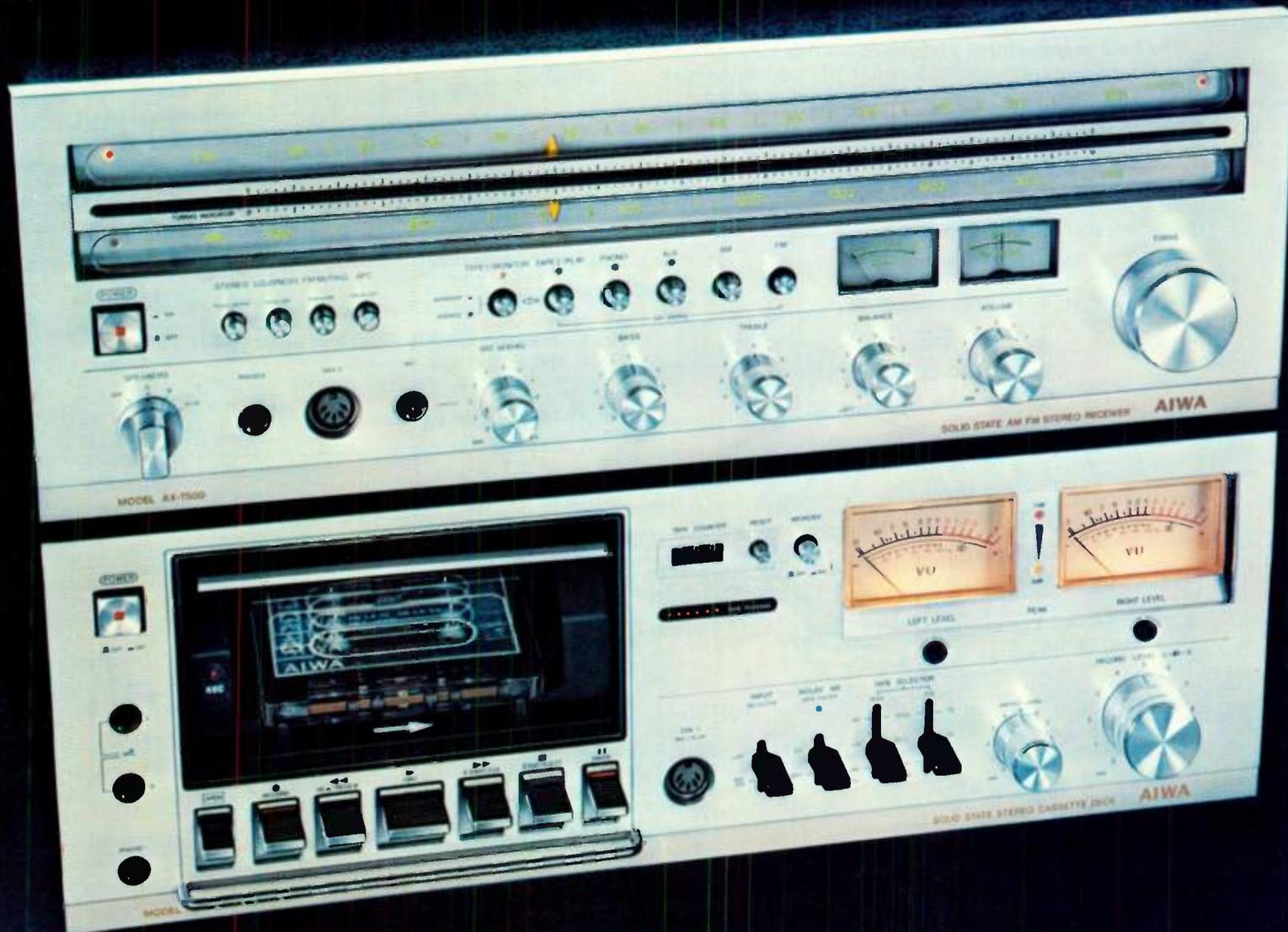
A perfect loudspeaker will cause an increase in sound pressure level which precisely matches the increase in electrical drive causing that sound, hence a one dB increase in drive should cause a one dB increase in sound pressure. In the real world, however, no loudspeaker is perfect. This transfer function linearity is measured by starting from a reference level of 0.1 watts and measuring the sound pressure level change as drive power is stepped upward. The amount by which the sound pressure level is greater or less than what it should be at a given power is a measure of transfer linearity.

The musical tones of A2, middle C, and A4 (110, 261.6, and 440 Hz) were used for checking the transfer gain of the Jensen. Relative to 0.1 watt, the gain first increases above unity by a small amount as power increases, then drops below unity for the two lower tones. The higher frequency of A4 (440 Hz) does not behave in this manner but gradually drops in gain with increasing drive. The greatest spread in gain occurs at 10 watts average drive with unity gain for A2, negative 0.3 dB for middle C, and negative 0.8 dB for A4. This indicates there will be a small change in timbre as a function of drive level with higher partials becoming relatively reduced.

In the crescendo test neither middle C nor A4 were changed by greater than 0.5 dB when incoherent signals 20 dB larger were superimposed, even up to peak power levels of 250 watts. Thus, the Jensen Model 530 can be rated as handling massed sounds very well.

Fig. 6—Horizontal polar energy.





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World Radio History

The final measurement performed on this speaker is the plot of total sound energy as a function of time following excitation by an impulse. This is the envelope of impulse response, and the measurement is shown in Fig. 10. The equalizer controls were both set to their high position.

The first large peak is due to the sound arriving from the tweeter, while the energy extending out to 4 milliseconds is principally due to the midrange speaker. Some evidence of diffraction scattering is seen in this measurement and this is

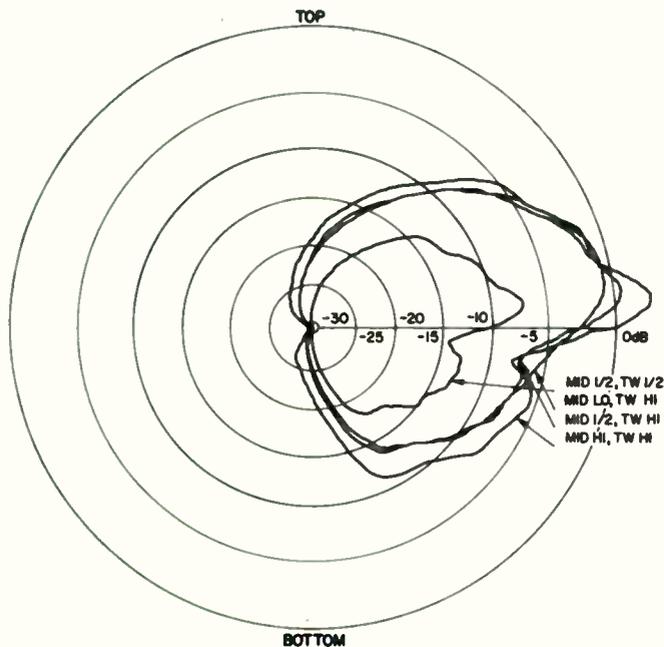


Fig. 7—Vertical polar energy response.

Fig. 8—Harmonic distortion for the tones E1 (41.2 Hz), A2 (110 Hz), and A4 (440 Hz).

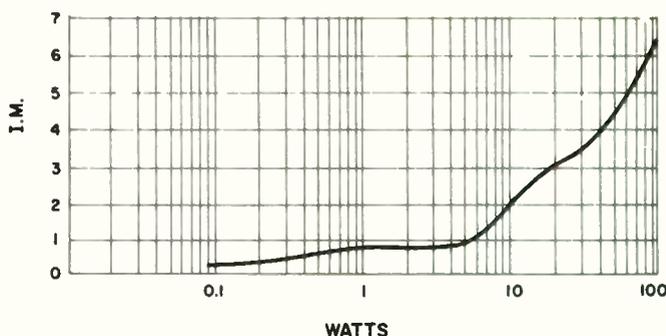
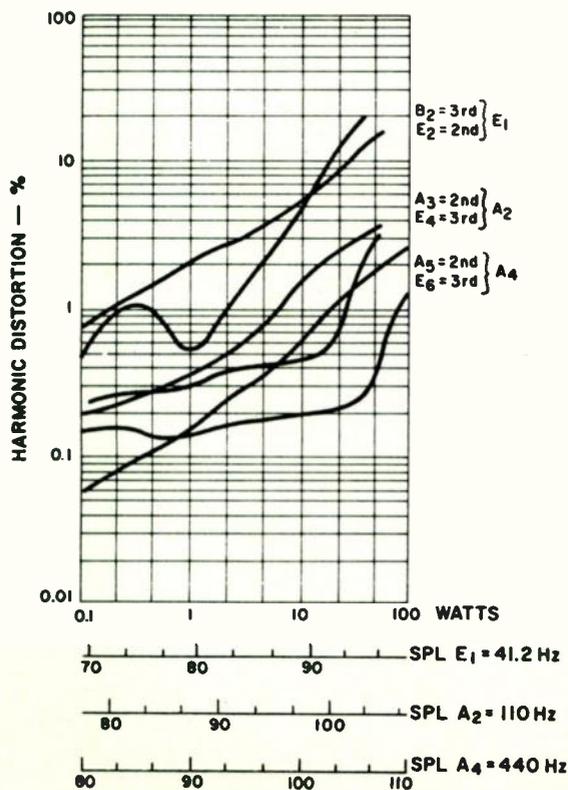
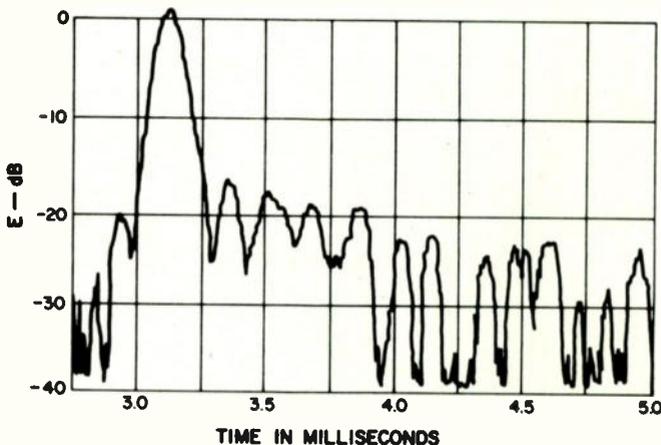


Fig. 9—Intermodulation distortion of A4 (440 Hz) by E1 (41 Hz) mixed one-to-one.

Fig. 10—Energy time response.



possibly due to the physically attractive, but acoustically difficult wood structure on the front of the enclosure. An otherwise good transient response appears to be marred by some time delay and acoustic scattering effects.

Listening Test

The Jensen Model 530 was auditioned against a wall and clear of the floor by about 2/3 meter (2.2 ft). This, to my personal tastes, gave a more balanced sound than other positions I tried.

One problem I found on setting up this system was that both the tweeter and midrange potentiometers were intermittent. Fortunately a standard solution exists—you rapidly rotate the shafts back and forth to burnish off the contact corrosion. This worked with the Jensen, and I recommend it be done as the unit is set up, particularly in this area. Use off-station FM receiver noise, at low level, and listen to the speakers as the pots are turned.

My personal preference on balance was that the midrange potentiometer be set to the mark indicated as —5 and the tweeter set to its maximum position.

My overall impression of the sound of the Jensen was that there was no super low bass, there was coloration at the bottom end, and the top end needed some boost with preamp tone controls. I also found that I preferred having the speakers rotated towards my listening area.

With the human voice, I had the impression that some vocalists were farther back from the stereo stage center than they should be, and I was not particularly pleased with reproduction of the piano, which is, of course, a very difficult instrument to make sound lifelike.

On the positive side, I felt that electronic music sounded pretty good on the Jensen.

Richard C. Heyser

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The column



Sweet Forgiveness: Bonnie Raitt
Warner Bros. BS 2990, stereo, \$6.98.

Sweet Forgiveness is one of Bonnie Raitt's best albums despite some flaws. Bonnie is in terrific voice, and Paul Rothchild's down-to-basics production lets the band play without cluttering the tracks with frilly horns or any more backing vocals than needed.

The album allows a place for all the different Bonnie Raitts. Funky Bonnie shines on *About to Make Me Leave Home*, *Boy* and Eric Kaz's *Gamblin' Man*. Driving, thoughtful Bonnie's outlets are a Little Feat oldie *Takin' My Time* and Daniel Moore's *Sweet Forgiveness*. Good-time Bonnie rocks out on Don Covay's *Three Time Loser* and a lively new version of Del Shannon's *Runaway*. Soft Bonnie does Paul Siebel's *Louise*, new friend Kara Bonhoff's lovely *Home* and old friend Mark Jordan's *Two Lives*. The surprise killer track is a definitive version of Jackson Browne's *My Opening Farewell*, beautifully textured by Bonnie's finger-picked electric guitar and played loftily by her band.

As a whole *Sweet Forgiveness* is a fine, engaging album that took a lot of obvious effort. It comes closest to the spirit Bonnie exudes in concert since her second album *Give It Up*. A primarily spontaneous artist, one who does not sing a song the same way twice, she's often had a rough time in a studio getting the precision the situ-

ation demands without sacrificing her personal touch. This is still true on the new album, though less so than most of her earlier efforts. Additionally on *Sweet Forgiveness* Bonnie's voice is quite far back in the mix which leaves a vaguely icy feel in the sound.

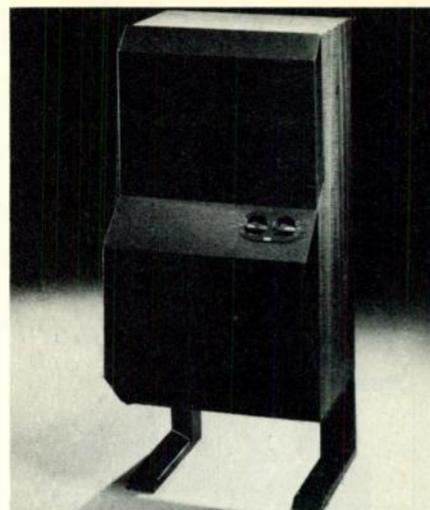
Talking with Bonnie about the material, she said that to find the 10 songs on the album, she sifted through more than 400, and still wound up at the same sources she often has in the past, a Kaz, a Mark Jordan, an old Browne, an old Siebel, Little Feat, Bonhoff, and Dan Moore, all close-to-home sources. Clearly, finding songs from new sources has been a problem, but it is to Bonnie's taste that the album still sounds fresh and lively and free of annoying *déjà vu*.

Bonnie Raitt's is a genuine and very real talent. She breathes life into songs with the very best. The big public response is still to come and is long overdue at that. If it doesn't come this time, it may well the next. *Sweet Forgiveness* may have flaws but they only result from the rare combination of conscience, effort, and positive movement. You just can't ignore the lady forever. M.T.

Sound: B — Performance: A —

Hard Travelin': Ramblin' Jack Elliott
Fantasy F-24720, stereo, \$8.98.

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David Bromberg's enthusiastic notes along with the reprint of John Greenway's original notes for **Ramblin' Jack Elliott** give a vivid picture of one of the great characters in folk music, a veritable one-man treasure trove of Americana.

Hard Travelin' is way overdue, but it's finally out. M.T.

Sound: B+ Performance: A

Fundamental Roll: Walter Egan

Columbia PC 34679, stereo, \$6.98.

Surely, the co-production credit of Fleetwood Mac's Lindsey Buckingham and Stevie Nicks has gotten Walter Egan a whole lot of attention he'd not have gotten otherwise. They've also conspicuously added vocals and Lindsey's guitar, so if Egan's album sounds like a top-heavy version of Fleetwood Mac, it's no surprise. One thing very obviously missing is that big bottom Mick Fleetwood and John McVie give their namesake.

Egan's a far more American Big Mac with some dandy songs and some filler. *Only the Lucky; Won't You Say You Will; Yes, I Guess I Am*, and the Buddy Holly-like anthem *When I Get My Wheels* are fine stuff. Not too coincidentally, they are four of the five songs graced by the instantly recognizable voice of Stevie Nicks.

What **Fundamental** has in abundance is the right forms. His songs are very catchy and commercial so that even if there's very little beneath, it still sounds good. What the album lacks, though, is stick-to-the-ribs substance.

It's shaped right, played right, and it'll probably sell. The cover photography of Moshe Brakha (also of Boz Scaggs' **Silk Degrees**) of those young cheerleaders backsides won't hurt sales either. **Fundamental Roll** is calculated. M.T.

Sound: B Performance: B

The Beach Boys Love You: Beach Boys

Reprise MSX 2258, stereo, \$7.98.

As the first full album of Brian Wilson songs in many years, **The Beach Boys Love You** is good to see, the childlike genius was at least working again. Granted his appearances on TV on "Saturday Night Live" and "The Mike Douglas Show" were outright disasters, showing a once feathery voice gone to leather.

Give the album a chance, I says. I do but it confirms my worst expectations. Brian's new songs are turkeys, ill-conceived, not played too well, and even lacking the recording excellence that has always been a Beach Boys hallmark.

Despite the good intentions of dedicating the album to Brian, **The Beach Boys Love You** can only be interpreted as patronizing and disastrous, the kind of record to get out of a contract with. And that they have done. M.T.

Sound: D

Performance: F



Chirpin': The Persuasions

Elektra 7E-1099, stereo, \$6.98.

With **Chirpin'** the Persuasions return to what they do best, a *capella*, leaving behind the unfortunate studio backing their last several albums employed.

Chirpin' is a joy. The sound is very bright and present. The four voices just ring out. However, the bottom line is the songs; if they're good choices the album will likely be a good one. **Chirpin'** has good songs, from the Rivertons' *Papa oo Mow Mow* and Billy Ward & the Dominoes' *60 Minute Man* to their own *Women and Drinkin'* and the brilliant *capella* anthem *Looking for an Echo* the material is solid.

Down from five voices to four, the Persuasions have tightened up their singing more than ever. They carry on a tradition that's important in places like Philadelphia where I live, the great sound of street corner harmony in an expressway world. May they sing forever. M.T.

Sound: A

Performance: A

Full House: Frankie Miller
Chrysalis CHR-1128, stereo, \$6.98.

Somewhere around the time of the breakup of legendary British rockers Free, many were speculating as to whether Robert Palmer or one relatively unknown Frankie Miller would succeed Paul Rodgers as the premier soulful U.K. singer. As it turned out, Rodgers himself was not so anxious to give up his throne and continued as a major force, fronting Bad Company, while Palmer allowed his music to stray so far from rock music that he was no longer in the running. Mr. Miller, however, is not so anxious to deny his skin color, and though his music is r&b influenced to say the least, he retains the basic rock band on his latest album **Full House**. While the entire album is not a total success, there is at least one side's worth of *incredible* music here.

Most notable is Andy Fraser's song *Be Good To Yourself*, as Frankie's voice is the perfect instrument to sing the tunes written by Free's bassist, and Mr. Fraser is perhaps the best contemporary rock songwriter alive. Buoyed by Chris Spedding's guitar and the crystalline production of Chris Thomas, the song doesn't have a losing moment from start to finish. Also more than just listenable are *Love Letters* (but the final few notes are awful), John Lennon's *Jealous Guy* (fine keyboards), *The Doodle Song* (very Otis Redding but no less respectable because of it), and *Take Good Care of Yourself*. The band, which includes Chrissy Stewart (bass), Graham Deacon (drums), James Hall (keyboards), and Ray Minhinnet (guitar), is a bit laid back in their efforts to support Frankie, but plays crisp r&b-rock that feels good most of the time. Side two, which is made almost entirely of Frankie's own songs lags a bit, but for *Be Good To Yourself* alone the album is certainly worth your while, certainly a lot more satisfying than either of Robert Palmer's last two records. Hopefully, Frankie will soon find the audience which will be able to appreciate his music, and also find a suitable songwriting partner so that the original compositions will be as interesting as the covers. *J.T.*

Sound: A Performance: B+

Nite City
20th Century T-528, stereo, \$6.98.

Ray Manzarek has got to be the best writer of spooky, creepy, and spine-tingling rock music alive today; he consistently comes up with the most memorable melodies when it comes

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The course of cassette history was irreversibly changed four years ago with introduction of the Nakamichi 1000. It generated an unprecedented wave of reaction, from enthusiasm to outright disbelief. But today, the 1000 and the equally phenomenal 700 are standards of the industry, the logical choice of recording studios, independent testing laboratories, leading cassette tape manufacturers and discriminating audiophiles the world over.



to that sort of stuff that would be equally comfortable behind a Roger Corman film or somebody like, for example, Jim Morrison. The Doors have been emulated recently by performers such as John Cale and Iggy Pop, but none can equal The Door's legacy. Manzarek tried for years to satisfy the audience which The Doors had created before Jim Morrison's untimely exit, carrying the lead vocal chores himself though he wasn't quite adequately equipped to do it. Now he's part of this group which prominently features Ray's keyboards and musical compositions, but with the added plus of being a real band—there are five individuals contributing to what goes on in Nite City (at least), and the album is a highly impressive debut effort from this quintet.

Although, Noah James may have a few bridges to cross when it comes to onstage presentation—he has a hard time living in the shadow of Morrison—as a singer/poet he comes across on disc, especially on the title track and *Bittersky Blue*. The entire group, as a matter of fact, seems like a disciplined bunch of individuals who know well how to pool their talents into a cohesive meld, coming across

like gangbusters on *Caught in a Panic* and *Summer Eyes*. There is a trace of The Doors sound, but with all due respect to John Densmore and Robbie Krieger, their successors are far more able to play rock music—it's nice to have a bassist in the band as well.

All things considered, it would be no surprise to me if Nite City became one of the biggest groups to come out of America in the Seventies. Their intelligence never gets in the way of their visceral impulses, and they seem to know a great deal about how to present their songs in the most immediate way possible. They've got something to say and they know how to say it—I can only wish them all the best.

J.T.

Sound: A — Performance: A

Kate and Anna McGarrigle
Warner BS 2862, stereo, \$6.98.

Dancer With Bruised Knees: Kate and Anna McGarrigle
Warner BS 3014, stereo, \$6.98.

Kate & Anna McGarrigle's debut album was one of 1976's quiet pieces of brilliance. Each sister writes songs at once contemporary and sounding centuries old. Take Anna's *Heart Like a Wheel*, the first song she ever wrote.

The McGarrigles' version is far more sorrowful, far less melodramatic, simpler and much more emotional, than the brilliant Linda Ronstadt version. A common thread through their work is that uncharacteristically direct and honest emotion, as if the songs were tapped directly from the heart. Anna's *My Town* and *Jigsaw Puzzle of Life* and Kate's *Talk to Me of Mendocino* and *Tell My Sister* are wrenching experiences, all of them songs that deserve the attention of others, and will likely find cover versions. If *Kate and Anna McGarrigle* has a flaw, it is that it is so shy and understated an album, easily understandable for a debut album.



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Dancer With Bruised Knees corrects all that. It is both livelier and brighter. Anna's title track, with its unlikely spoken intro, is a touching account of a prospective ballet career that ended with a crash and "blue knees." Kate's *Southern Boys* is a striking, candid picture of a Northern girl's infatuation with Southern affectation. The track includes some outstanding bowed bass work by Richard Davis. Her *Come a Long Way* is another wonderful traditional sounding song. *Walking Song* is a disarming person-to-person appeal. Anna's *Be My Baby* almost aches to be a hit. Her *Naufragee du Tendre*, written with occasional collaborator Phillippe Tarcheff, is the unlikely combination of a song in French with a distinctive reggae beat.

The album's most soaring moments are during a pair of traditional French Canadian songs, the sorrowful tale of false love *Blanche Comme la Neige* and the rollicking *Perrine Etait Servante* are segued ingeniously, and the sisters' two-part harmonies are magical.

Dancer has an impressive support cast, including Davis, Dave Mattacks, Pat Donaldson and John Cale among others. Joe Boyd's production is high-

ly empathetic to the McGarrigles' songs.

Kate and Anna McGarrigle occupy a very special musical space. Their songs are devoid of funk and tricks, opting for the straightforward and true. Their two albums have yet to stray very far from my turntable. Their calm is a welcome treat. *M.T.*

Sound: B Performance: A

LIVE! Rough Trade **Umbrella UMB DD1**, stereo, \$12.95 (see text).

Rough Trade's album is one of the best *sounding* albums I can remember hearing. In fact, the sound is the star of the album. It was recorded direct-to-disc which means the way they played it in the studio is the way the record sounds. The process allows no overdubs or remixing. It has to be right or the whole side has to be recut. These results sound particularly spectacular in the bass end, and the process accounts for the record's remarkable presence and clarity. There are no in-between generations in which to lose sound.

The band itself is only a little better than average. Carole Pope's songs are good but not spectacular and the

band is game, so they make the most possible out of them. But as I said the raw sound is what matters most.

The record sleeve contains information about the direct-to-disc recording process used for this album. Copies of the disc may be obtained through Audio-technica dealers in the U.S. *M.T.*

Sound: A+ Performance: B

Rumours: Fleetwood Mac **Warner Brothers BSK 3010**, stereo, \$7.98.

The extraordinary breakout success of **Fleetwood Mac** in 1976 has made **Rumours** one of early 1977's most eagerly awaited items. That kind of expectation can lead to an anticlimactic let-down feeling once the disc is in your hands, but **Rumours** avoids that trap. Constructed very much like its predecessor, it delivers song after song of catchy, quality material. As with **Fleetwood Mac**, the blues band origins of the group several incarnations back has become completely obscured as they have evolved into a front-line pop band.

Stevie Nicks and Lindsay Buckingham, who joined up only last album, dominate **Rumours** just as they

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★ **WIDE RANGE PICKUP RESPONSE TEST RECORD STR 120** Makes possible the measurement of pickup response at frequencies far beyond the audible range, where elusive distortion elements can cause audible distortion. The low-frequency range includes glide-tones at twice normal level for the detection and elimination of arm resonance, loudspeaker cone and cabinet rattles. Other tests include: silent grooves for measuring rumble and surface noise characteristics; and standard level bands at 0 dB for overall system S/N measurements. This record is suitable for use with a graphic level recorder to provide permanent, visible records for precise evaluation.

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did the last one. Lindsay's *Go Your Own Way* is an unforgettable cooker, eminently hummable, and *Second Hand News* is another. While neither *Dreams* nor *Gold Dust Woman* has quite the impact of Stevie's chilling *Rhiannon*, they do convey that compelling aura of mystery. Christine McVie continues to mine the vein she has successfully tapped earlier as in *Heroes are Hard to Find* and *Say You Love Me* with *Don't Stop* and *You Make Loving Fun*, both appealing, pleading little songs.

The breakthrough of Fleetwood Mac with a bag of smooth, absolutely non-mediciney songs is very probably a serious indication of where the rock/pop of the late 70s and into the 80s will go, to songs of a pleasing and non-incendiary manner. Fleetwood Mac makes it so easy to swallow that you never stop to realize that it's really syrup after all. And they do it with nothing but quality and staggering consistence. *M.I.*

Sound: B+ Performance: A-

I'm Everyone I've Ever Loved: Martin Mull

ABC AB-997, stereo, \$6.98.

Garth Gimble is dead. He was the character Martin Mull played in the "Mary Hartman Mary Hartman" TV series, and he doesn't have a damned thing to do with Mull's new album which first appeared two weeks after Garth's demise.

I'm Everyone is the best studio album Mull has recorded. It's laced liberally with a biting humor, devastating yet understated. The bridges between the songs are loaded with guest stars; the breaks are clever and sharply cut. The songs between the bridges are acerbic and funny. They are well braced with the cynical, skeptical slant that Mull always uses, something he shares with producer Michael Cuscuna who has been *that way* since he and I were in college together.

Part of the album's concept is Mull's stated refusal to let himself be "bagged"—take my style, please. So his songs range from a token folkie of the mock sea shanty *Men* to a disco piece—"that's where the big money is"—*Get Up Get Down to Boogie Man's Philly Soul* to the cocktailated spirits of *Bombed Anyway* and *Buy Me a Drink*, and the erotic bossa nova of *The Humming Song*. The man somehow covers his bases, probably to his own surprise.

Mull's humor is, most of all, based on a very carefully constructed and warped yet thoroughly personal set of



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perceptions. I'm Everyone I've Ever Loved is simply more cleverly conceived and more fully realized than anything Martin has yet done. Besides it made me laugh. Often. M.T.

Sound: B+ Performance: A-

Something Magic: Procol Harum Warner/Chrysalis CHR 1130, stereo, \$6.98.

After nine albums and gradually diminishing returns it looked like Procol Harum had literally faded into some middle-aged shade of pale.

As a long-term devotee I can't escape the let-down feeling that **Something Magic** just doesn't cut the mustard. A fairy tale called *The Worm and the Tree* completely takes up side two. It is plenty majestic in the musical segments, but Gary Brooker's recital of Keith Reid's words only recall to me his comment in *In Held Twas In I* on the classic **Shine on Brightly**, "Tho the words I use are pretentious and make me cringe with embarrassment..." I may not have then, but I cringe this time.

The five songs on the first side are a downbeat collection, standard Procol but mostly lacking that magical transcendence they are capable of. The truly outstanding song is the one Brooker didn't compose music for, *Year of the Claw* with music by guitarist Mick Grabham. *Claw* sports a thoroughly menacing rape story in which the prisoner goes free to a screaming synthesizer solo.

They sound more confident than the withdrawn and uncertain unit of **Procol's Ninth**. With **Something Magic** Procol Harum serves notice that they don't intend to simply vanish. Flawed as it is *Something Magic* is not hey day Procol, but at least they are moving in the right direction. M.T.

Sound: B- Performance: C+

Wind and Wuthering: Genesis Atco SD 36-144, stereo, \$6.98.
Peter Gabriel Atco SD-36-147, stereo, \$6.98.
The Geese & The Ghost: Anthony Phillips Passport PP-98020, stereo, \$6.98.

The music of Genesis has always been highly plotted stuff. They've always told stories in song, often with more than a nod to the bizarre. Front man Peter Gabriel's departure didn't cripple the band as many expected. Instead the survivors regrouped around drummer Phil Collins' very Gabrielesque vocals, debuting their

new look with last year's **Trick of the Tail**, arguably Genesis' finest moment. The album sold very well, and the supporting tour was both an artistic and financial success. Somehow they manage to take their four or five not terribly visual members and, with well-planned lighting, keep the show from being a visual bore, even if it's without a focal point.

The second post-Gabriel album is a good one, but not a great one. Their production and presentation are much like **Trick**, but a shade less bright, and, of course, the first side's 28-minute length was bound to affect the recorded sound. Good work has gone into the new collection of story/songs. *Eleventh Earl of May*, the psychodrama of the young heir, has a melody more than a bit like the early segment of *The Battle of Epping Forest* from the **Selling England by the Pound** album. Michael Rutherford's ballad *Your Own Special Way* is simply gorgeous. *All in a Mouse's Night* is a delightful tale of extermination told from several views, from the alarmed human couple in bed, their hungry cat, and naturally, the unfortunate mouse's place on the floor. *Mouse* is Genesis at its most charming.

Ultimately, what **Wind and Wuthering** is about is Genesis' continued

dedication to the group format. They don't overlay strings and horns. They lean on their considerable battery of sounds available from guitars, keyboards and synthesizers. Their aims are at once ambitious and modestly self-contained.

Peter Gabriel's self-titled debut solo effort is a declaration of independence from exactly that group reliance. Clearly Peter felt a rest was needed after his long association with the band, particularly in the light of the mixed success of the show and album of **The Lamb Lies Down on Broadway**, his double-pocket Genesis swan song. His reappearance was produced by Bob Ezrin, long associated with the razzle dazzle show biz of Alice Cooper. Ezrin's work on Alice's **Welcome to My Nightmare**, Cooper's own escape from group limitations, was certainly an influence on Peter Gabriel. Ezrin lavishes individual attention to each song's arrangement, and Gabriel's album has even more extreme dynamics than does Genesis'. Gabriel ranges from the metallic *Modern Love* through the music hall antics of *Excuse Me* to the extra-soft *Humdrum*, which last gives an excellent example of the intricate nature of these arrangements. After a dreamy verse, backed mostly by soft Fender

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Rhodes piano, the song dances through four bars of bossa nova followed by an eight-bar jazz flute break before turning into a tarantella for the next verse. *Down the Dolce Vita* goes to the other extreme, effectively using the London Symphony Orchestra.

The band assembled by Gabriel and Ezrin is all-star quality. It includes guitarist Steve Hunter and keyboardist Josef Chirkowski from the **Nightmare** album's band, former King Crimson leader Robert Fripp and Larry Fast (aka Synergy) on synthesizers with the solid New York studio rhythm base of Allan Schwartzberg and Tony Levin. The production and sound are sterling. The only major fault with the album is the omission of a lyric sheet which would have made Gabriel's often murky intentions clearer. In all probability, much of Gabriel's clever wordplay is lost in this dense, complicated mix without printed lyrics.

Anthony Phillips was Genesis' charter guitarist. He left after 1970's **Trespass** album, just as the group began to take off in England. **The Geese & The Ghost** is his first recorded work since then, and not surprisingly it occupies a place in the musical landscape near that of his former compatriots. The first tipoff to this fact is the presence of Phil Collins for a pair of vocals, and Michael Rutherford on guitars and sundries as well as being cocreator of more than half the album, in addition to coproducing it. **The Geese & The Ghost** is mostly instrumental. The title suite and *Henry, Portraits from Tudor Times* are a pair of lengthy, sweeping, episodic works which dominate their respective sides, each without vocals, a musical mural with grandeur and abundant detail. Listening, I couldn't help drifting back in memory to the first time I heard Mike Oldfield's **Tubular Bells**. Phillips shares Oldfield's sense of the rustic.

Perhaps the most apt comment about the album came from Phillips himself in an interview when he observed, "Even if Genesis and I are miles apart, there is that same thread in our music." This thought applies equally to all three albums. *M.T.*

Genesis

Sound: B+ Performance: A-

Gabriel

Sound: B- Performance: A

Phillips

Sound: B+ Performance: B+

Shouts Across the Street: Alan Price Polydor 2383 410 (import), stereo, \$6.98.

Only occasionally meeting with commercial success in the United States, Alan Price's latest record is available only as an import, which means you'll pay a dollar more for it (at most) but get a better quality pressing and a flimsier cover. Spend the buck, record buyers, because Alan Price is one of the true original songwriters, and although I can't say that I like the entire album, he covers such a wide variety of styles that he's bound not to strike a resounding chord with everyone 100 per cent of the time. But when he connects, it's with a punch 10 times as effective as his peers.

A little background on Price: he was the original leader of The Animals, went off to make records with a strong r&b background, rose to fame by doing the soundtrack to the movie "O Lucky Man," and then quickly sank back into obscurity with rumors of an Animals reformation featuring Price and Burdon. This is the first studio album from Price in some time, and to tell you the truth, I didn't expect miracles. The cover credits Price with writing all the songs, playing all keyboards, all the lead vocals, and the production—quite a responsibility for an artist in this genre, because production is so important in a singer/songwriter album, and even people like Randy Newman, Harry Nilsson, Leo Sayer, and such don't do it themselves.

Side two is better than side one, with *The World's Going Down On Me*, a splendid tune performed exquisitely and a likely candidate for a single. Also appealing are rockers like *Cherie*, *I Just Got Love*, *Hungry For Love*, and a song which Roger Chapman could cover with ease, *The Wasteland*. There are some lighter, semi-acoustic tunes here which are pleasing to the ear, like *Leave It All To Me*, but the five I already mentioned to me seem the most immediate and stupefying. I highly recommend **Shouts Across the Street** to anyone who appreciates singer/songwriters, contemporary rhythm & blues, bar room brawls, or a night on the town without a whole lot of money to spend. Me, I'll take all of the above, especially the track *The World's Going Down On Me*, because it's one of the best records out all year. *J.T.*

Sound: A Performance: A

Jazz & blues



Heavy Weather: Weather Report

Musicians: Joe Zawinul, piano, Rhodes Piano, Arp 2600, Oberheim Polyphonic, etc.; Wayne Shorter, soprano and tenor saxes; Jaco Pastorius, bass, mandocello; Acuna, drums; Badrena, percussion, vocals.

Songs: *Birdland*, *A Remark You Made*, *Teen Town*, *Harlequin*, *Rumba Mama*, *Palladium*, *The Juggler*, *Havana*.

Columbia PC 34418, stereo, \$6.98.

Musically, *Weather Report* is and represents everything at once and yet nothing in particular. This is a compliment, however paradoxical, to a group of eclectic musicians who continue to dare comparison and defy categorization.

Birdland, for example, is a Zawinul composition that highlights this very asset. Energetic rhythms derived from rock, disco, Latin and who knows what else dominate the percussion. The recurrent theme is stated by soprano sax and polyphonic synthesizer. The broad and unique sound produced is no less than that of a full brass section, plus strings, in counterpoint with the solo sax. What makes this exciting is the sparing use of the effect, and the tasty big band-type entrances Zawinul sets up. Remember, this is all done with just a couple of keyboards. Incidentally, the vocals permeating the cut possess the soft Latin air captured so successfully by Shorter on his *Native Dancer* LP.

Tension without release is some-

thing that occurs too often within the repertoire and live performances of too many groups. Not here! Shorter, on tenor sax, leads the ensemble in a convincing performance of Zawinul's tender and serene composition *A Remark You Made*. Shorter's instrumental inflections and the mood of the melody itself are reminiscent of Keith Jarrett's timeless composition *In Your Quiet Place*. It's reassuring to know that *Weather Report*, which has a blizzard of electronics at their disposal, has regard for good taste, as evidenced by the inclusion of *Remark*, as an element to preserve from being snowed under.

Zawinul's talents on acoustic piano are given breathing space on Shorter's *Harlequin*. Here Zawinul's linear excursions, behind Shorter's introverted soprano work, clearly represent his most articulate playing on *Heavy Weather*. The end of *Harlequin* features the rhythm section building in rhythmic and electronic intensity, as Shorter's soul searching soprano voice serves as the ideal foil to this burst of energy.

Rivalling *Birdland* as the most memorable composition on this LP is Shorter's *Palladium*. Pastorius' throbbing melodic bass lines and the vivacious Latin rhythms which abound launch this indelible theme (as stated by Shorter on soprano in unison with Zawinul on Arp several octaves above) and Shorter's solo on a foot-stomping journey. My only qualm

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about this cut, as with the rest of **Heavy Weather**, is that there isn't enough of Shorter soloing.

Pastorius is a powerfully melodic bassist, whose solo concept within the ensemble is the ideal one for a group whose success is concerned with the dimension of space. While not a time-keeper, his directing melodies imply the time, allowing Zawinul to mix big, spacey, keyboard chord potions and concoctions as the drummer fills the time with multi-directional sounds, rhythms, and percussive offshoots. All of this is the case on Pastorius' *Havona*. Pastorius almost serves as another horn soloist while maintaining his role of steering the group into one storm and out another. Also, noteworthy here is Zawinul on acoustic piano again.

All in all, one listen to **Heavy Weather** is not enough. There is so much being vaulted at the listener, that only successive hearings will reveal the brilliant intricacies hidden deep within the group's core. Underlying basslines jump out and say, "here I am." The roots and origins and diverse experiences of each member rumble on the horizon. Perhaps, because there is so much in the music of WR that lies just below the surface, adding body to the whole, many "one-listen" listeners are not aware that this is much more than a group dabbling in electronics!

Eric Henry

Sound: A — Performance: A —

The Toughest Tenor: Johnny Griffin and Eddie "Lockjaw" Davis
Milestone M 47035, mono, \$7.98.

This is toe-tapping modern jazz full of zest and swagger. From the opening number, Count Basie's *Tickletoe* on side one, through swingers like *Funky Flute* and *Good Bait*, this two record set really moves. The two boss tenor men play music that gets you on your feet; you might want to even dance around the room a bit.

Honors are equally divided between Davis and Griffin who frolic through these 1960 and 1961 sessions like a couple of frisky sea otters. The selections are a potpourri of tracks from five out-of-print LPs on the old Jazzland label.

"Jaws" Davis' robust, driving sax style has never been heard to better advantage, and Griffin, playing with lightning speed and with a lighter tone, matches him chorus for chorus. Griffin's treatment of Monk selections

AUDIO • July 1977

in the collection like *Epistrophy* are of special interest; he attacks them in a straightforward, bluesy manner; never being intimidated by the Monk "mysterioso."

Backup personnel include pianists Horace Paran and the lively, strutting Junior Mance who almost steals the show on *Tickle Toe*, *Save Your Love For Me*, *Funky Flute* and *Good Bait* with tautly controlled, yet rollicking solos that build to peaks of intensity.

The sound is good, clean monaural, and it has been beautifully remastered by David Turner at the Fantasy studio in Berkeley. *John Lissner*

Sound: A Performance: A

The Jimmy Guiffre 3, Music for People, Birds, Butterflies & Mosquitoes

Choice 1001, stereo, \$6.98.

For some years, Jimmy Guiffre has been probing the jazz frontiers without much success. His jazz playing appears to be an aesthetic adventure and listeners can join in or reject it; Guiffre makes no effort to win them over.

Most of Guiffre's free jazz, recorded over the past 15 years, sounds more like modern chamber music than jazz. His most recent collection, recorded for Choice, a small Long Island label, does at least seem to have the feel of jazz; there appear to be tonal centers and established keys from which the musicians can improvise. Each selection is extremely well played, and the interaction and empathy between Guiffre, on flute or tenor sax, and bassist Kiyoshi Takunga and percussionist Randy Kaye, is impressive.

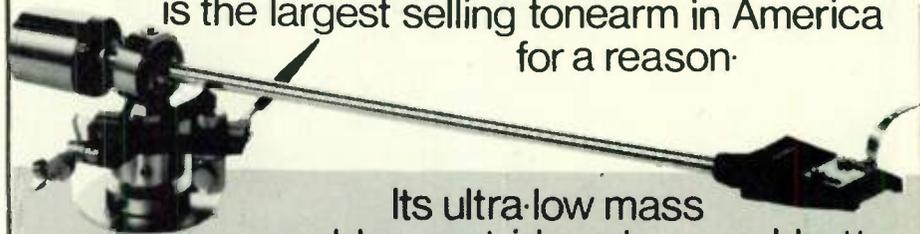
There are some interesting cuts, particularly the *Mosquito Dance*, *Night Song* and *Flute Song*, where Guiffre's solos take on the dreamy, hypnotic quality of Eastern music, or where Guiffre chisels probing, Sonny Rollins-like saxophone passages, yet the album lacks the particular kind of driving momentum and movement that makes for the very most satisfying jazz performance. Cleanly recorded, **The Jimmy Guiffre 3, Music for People, Birds, Butterflies & Mosquitoes** is, for this listener, an adventure in jazz esotericism and perhaps a bit of self-indulgence by a very gifted musician.

The album may be obtained from Choice Records, 245 Tilley Place, Sea Cliff, NY 11579. *John Lissner*

Sound: A Performance: A

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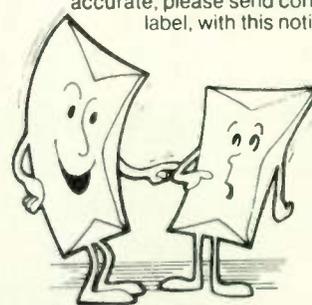
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Thelonious Monk in Person Prestige 47033, mono, \$7.98.

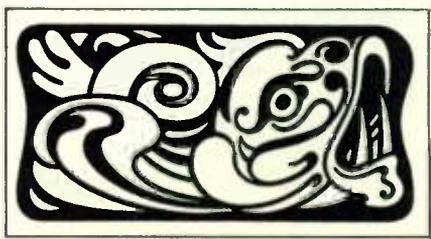
Prestige's *Monk in Person* collects the pianist's two live recordings from the old Riverside catalog, the 1959 Thelonious Monk Orchestra at Town Hall and sides made by his small band at San Francisco's Blackhawk club. The Town Hall concert was well received at the time, but it wasn't well received by this writer then and still isn't. I find much to admire in Monk's lean, spare, and usually swinging piano, but when his piano harmonies and solos are orchestrated for a full band as they were at this concert, the whole effect is sour and lumpy. It's a small big band with little rhythmic impact: trumpet, trombone, french horn, tuba, and three saxes. Each instrument was orchestrated by Hal Overton as if it were a finger of one of Monk's dissonant-tinged chords. The sinewy solos by trumpeter Donald Byrd and alto saxist Phil Woods on *Little Rootie Tootie* are very good.

More to my liking is the laid-back Blackhawk set. Outstanding is Monk's long-time tenor sax man Charlie Rouse, who blows with a hard jauntiness on *Let's Call This*, *Four in One*, and *Getting Sentimental Over You*; but trumpeter Joe Gordon's solos are over-oblique and unnecessarily shrill. Monk's piano is lively and tartly swinging; I was patting my feet throughout *Getting Sentimental*. *Round Midnight*, a Monk classic and the one slow piece in the Blackhawk set, is 12 minutes long and a tour-de-force for Monk who plays a sad, angular solo. Monk's strong chording on *Midnight* gives Rouse splendid support as the tenor man precedes the pianist with a choppy, introspective chorus.

Record two of the Prestige double-set is, indeed, very good Monk, probably the closest you can get to one of his legendary night club stands during the "Beat" era. The music is quirky, offbeat; so original it compels attention. The quality of this live recording is, unfortunately, somewhat murky.

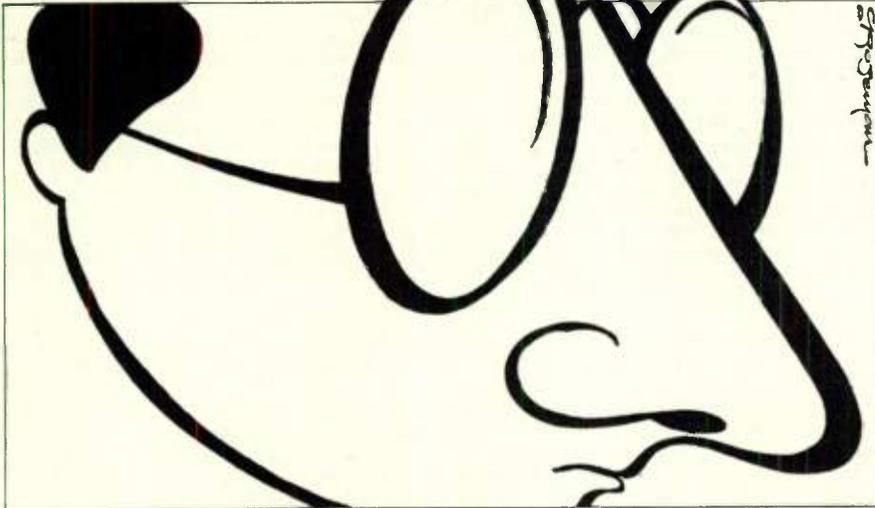
John Lissner

Sound: B Performance: A —



Classical reviews

Edward Tatnall Canby



Shostakovitch: The New Babylon (1928-29). Ensemble from the Moscow Philharmonic, Roshdestvensky.

Columbia-Melodiya X698, stereo, \$6.98.

Shostakovitch: Age of Gold Ballet Suite (1930). Glière: Red Poppy Ballet Suite. Rimsky-Korsakov: "Sadko" Suite. Seattle Symphony Orch., Katinis.

Vox Turnabout TV-S 34644, stereo, \$3.98.

I nominate *The New Babylon* as the recorded discovery of the year, even if we have several months yet to go in 1977. A superbly made recording from Russia of a hitherto unknown early Shostakovitch score which was produced for, of all things, a silent film. (Imagine the sync problems—a live orchestra and a film on the screen overhead!) It was actually used with the film but inevitably, as the talkies took over, it became outdated and vanished. What a loss! And what a gain, on recovery.

The music is all snazzy jazzy late-20s Shostakovitch in his early period, full of youth and enthusiasm, sardonic, satirical, but not yet either long-winded or introspective. If you have heard his delightful *First Symphony* of the same period, you know the approach (and a lot, of the well known *Fifth Symphony* a few years later). The pay-off, here, is that the film was set in Paris of 1871, the brief commune after the Franco-Prussian War, and though this is hardly a Westerner's idea of a

time for fun, it gave the Russians a fine chance to do the usual, make fun of Capitalism and French decadence (which, I suspect, maybe they liked just a wee little bit). So—marvelously slaphappy can-cans, all blatty and squawky and full of brass, cute French folk tunes, even the Marseillaise cleverly hinted at. And a quote or two from Offenbach himself. Such a delightful sound, and so perfectly adapted for recording in its spare, solo-instrument configuration! I've played the thing a dozen times already and all that has happened is that each playing brings out more subtlety and more sophistication.

After awhile, by the way, you will begin to recognize Shostakovitch himself, even as of his much later work. A very typical way of writing, and here at its most felicitous. I'd put this ahead of dozens of later scores.

A good companion disc is the Turnabout item, which includes the somewhat similar Suite from *The Age of Gold*, another Shostakovitch satire on Capitalism (gold, of course, meaning Wall Street). The familiar Polka, that zany, staggering, out-of-tune dance we all have heard, is here surrounded with a more substantial excerpting from the complete work. With it go Glière and Rimsky, these pieces in the easygoing pop Romantic vein even though Glière wrote as late as the post-revolution period. Recording is a bit distant for my taste, lacking sonic bite, the playing...straight-forward.



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Ace Audio.....	118	Discount Music.....	111
Catalog of Kits		Record Club	
Write Direct to Advertiser		Write Direct to Advertiser	
Acoustical Mfg.....	97	Dishwasher.....	2, 19
Hi-Fi Components		Record Care System	
Enter No. 1 on Reader Service Card		Write Direct to Advertiser	
ADC.....	73	Discracker	
Phono Cartridge		Write Direct to Advertiser	
Write Direct to Advertiser		Dixie Hi-Fi.....	96
Advent Corp.....	17	Audio Mail Order	
Loudspeaker Systems		Enter No. 10 on Reader Service Card	
Write Direct to Advertiser		Dokorder.....	43
Aiwa.....	87	Reel-to-Reel Tape Deck	
Hi-Fi Components		Enter No. 11 on Reader Service Card	
Enter No. 2 on Reader Service Card		Dolby Labs.....	11
Akai.....	15	FM	
Hi-Fi Components		Write Direct to Advertiser	
Write Direct to Advertiser		Dual (United Audio).....	27
Analog Digital Systems.....	98	Turntables	
Loudspeaker Systems		Enter No. 12 on Reader Service Card	
Enter No. 3 on Reader Service Card		Dynamic Specialties.....	113
Analog Engineering.....	45	Audio Store	
Loudspeaker Systems		Write Direct to Advertiser	
Enter No. 4 on Reader Service Card		Empire.....	4
Appalachia Sound.....	114	Phono Cartridge	
Recording Workshop		Enter No. 13 on Reader Service Card	
Write Direct to Advertiser		Garland Audio.....	115
The Audio Critic.....	83	Audio Store	
Publication		Write Direct to Advertiser	
Write Direct to Advertiser		Jensen.....	63
Audio Kinetics.....	102	Loudspeaker Systems	
Hi-Fi Components		Write Direct to Advertiser	
Enter No. 5 on Reader Service Card		JVC.....	51
Audio-technica.....	91	Hi-Fi Components	
Phono Cartridge		Enter No. 14 on Reader Service Card	
Write Direct to Advertiser		KEF.....	71
Bose.....	5	Hi-Fi Components	
Loudspeaker System		Enter No. 15 on Reader Service Card	
Write Direct to Advertiser		Kenwood.....	65
B&W.....	89	Amplifier	
Loudspeaker Systems		Enter No. 16 on Reader Service Card	
Enter No. 7 on Reader Service Card		Marantz.....	Cov. III
Celestion.....	49	Turntables	
Loudspeaker Systems		Write Direct to Advertiser	
Enter No. 8 on Reader Service Card		Maxell.....	23
Crown.....	12	Magnetic Tape	
Hi-Fi Components		Enter No. 17 on Reader Service Card	
Enter No. 9 on Reader Service Card		McIntosh.....	96
Custom Stereo.....	105	Catalog	
Audio Store		Enter No. 18 on Reader Service Card	
Write Direct to Advertiser		McK Sales.....	116
		Audio Mail Order	
		Write Direct to Advertiser	

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Advertising Index

ADVERTISER	PAGE	ADVERTISER	PAGE
Memorex	6	SAE	47
Magnetic Tapes		Impulse Noise Reduction System	
Enter No. 19 on Reader Service Card		Enter No. 32 on Reader Service Card	
Micro-Acoustics.....	99, 103	Sanyo	53
Phono Cartridge		FM Tuners	
Write Direct to Advertiser		Enter No. 33 on Reader Service Card	
Loudspeaker Systems		Schwann	100
Write Direct to Advertiser		Catalog	
Musical Heritage Society.....	39	Write Direct to Advertiser	
Music Society		Shure	95
Enter No. 20 on Reader Service Card		Hi-Fi Components	
Nakamichi	21, 92, 93	Enter No. 34 on Reader Service Card	
Hi-Fi Components		SME	16
Enter No. 21 on Reader Service Card		Damping Device	
Hi-Fi Components		Enter No. 35 on Reader Service Card	
Enter No. 22 on Reader Service Card		Sonic Research	79
Ohm	69	Phono Cartridge	
Loudspeaker Systems		Write Direct to Advertiser	
Enter No. 23 on Reader Service Card		Sony Corp.	54, 55
Ovation Audio	112	Transistors	
Audio Store		Enter No. 36 on Reader Service Card	
Write Direct to Advertiser		Soundcraftsmen.....	7
PAIA	96	Hi-Fi Components	
Synthesizer		Enter No. 37 on Reader Service Card	
Enter No. 24 on Reader Service Card		Speakerlab	106
Phase Linear	61	Speaker Kit	
Hi-Fi Components		Write Direct to Advertiser	
Enter No. 25 on Reader Service Card		Stanton	3
Pioneer	Cov. II, Pg. 1	Hi-Fi Components	
Hi-Fi Components		Enter No. 38 on Reader Service Card	
Enter No. 26 on Reader Service Card		Sumiko	101
Playback	97	Tonearm	
Audio Mail Order		Enter No. 39 on Reader Service Card	
Enter No. 27 on Reader Service Card		Tannoy	31
Polk Audio	37	Hi-Fi Components	
Loudspeaker Systems		Enter No. 40 on Reader Service Card	
Write Direct to Advertiser		TDK	13
Precision Electronics	90	Cassette Tapes	
Hi-Fi Electronics		Enter No. 41 on Reader Service Card	
Enter No. 28 on Reader Service Card		Teac	33, Cov. IV
PS Audio	101	Hi-Fi Components	
Hi-Fi Components		Write Direct to Advertiser	
Enter No. 29 on Reader Service Card		Technics	58, 59
Ram	26	Hi-Fi Components	
Amplifier		Enter No. 42 on Reader Service Card	
Enter No. 30 on Reader Service Card		3M	67
Rhoades	117	Magnetic Audio Video	
Teledapter T.V. Sound Tuner		Enter No. 43 on Reader Service Card	
Write Direct to Advertiser		Yamaha	41
Rocelco	14	Hi-Fi Components	
Phono Cartridge		Write Direct to Advertiser	
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TUNERS	JBL AQUARIUS S109WX
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AUDIO RETROFLEX LT-76	AMPEX 456-273111 1/2" TAPE
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ADVENT 101 DOLBY	TANDBERG TR 1040 RECEIVER
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113



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