

Audio

40th
ANNIVERSARY ISSUE

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SPECIAL
CAR STEREO
ISSUE

13th ANNUAL
CAR STEREO
DIRECTORY

8 CAR AMPS IN
HEAD-TO-HEAD
TEST

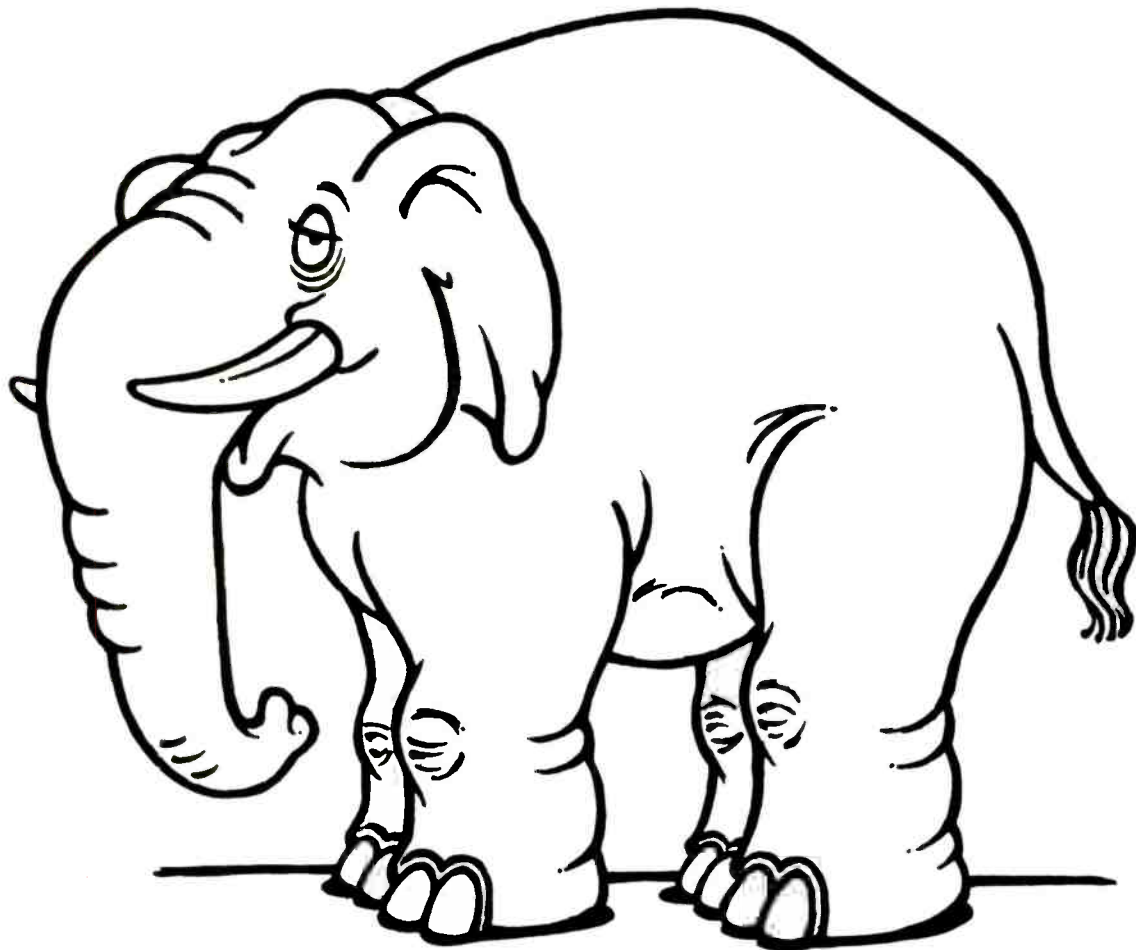
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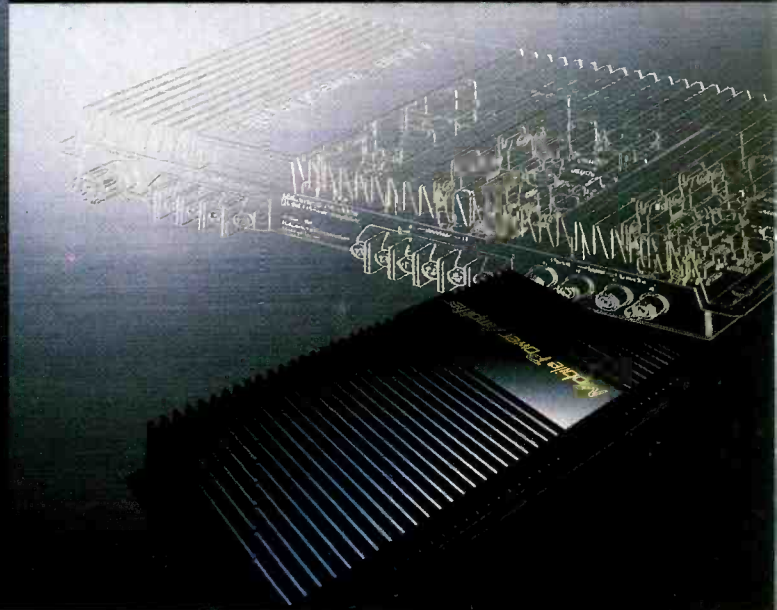
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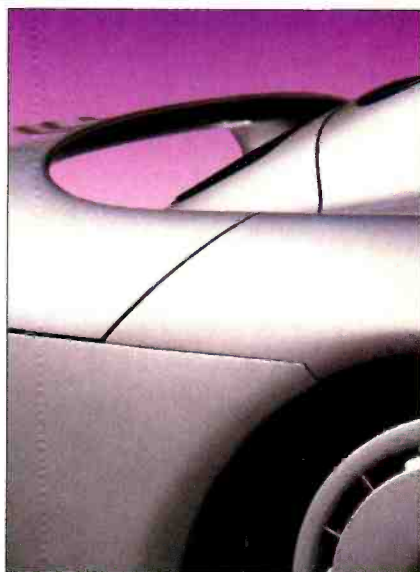
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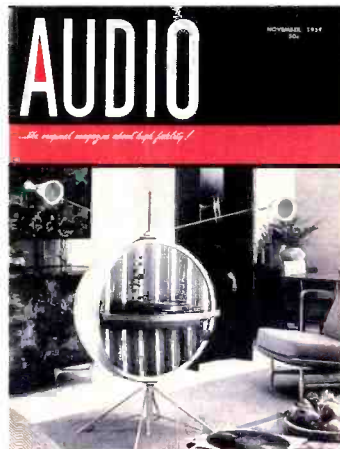
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Bass vs. Space

It's an old dilemma: To tolerate those large, room-dominating loudspeakers for the sake of true bass? Or sacrifice bass for the sake of more living space?

The classic solution to this problem—a solution that allows even efficiency-dwellers ample bass *and* space—is the satellite/subwoofer speaker system. Simply put, the mid-range and high frequencies are delegated to a pair of small satellite loudspeakers, placed for optimum stereo imaging. The bass is handled by a single large subwoofer unit, which can be hidden virtually anywhere in a room. (How? Frequencies under 100 hz are nondirectional;

the ears can't tell where they're coming from. So one subwoofer suffices.)

The most common kind of satellite/subwoofer system is "passive" (externally powered), such as the Canton Plus C.

Active Advantages

The Canton Plus Beta subwoofer looks much like the Plus C, but does the job quite differently. That's because it's "active" (internally powered).

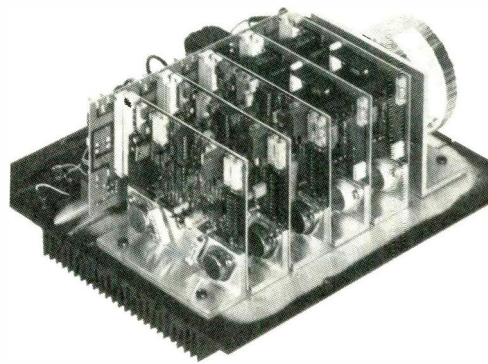


Canton's Plus Beta active subwoofer.

Don't have a preamp? No problem, your receiver can drive the Plus Beta too. The amplified power from your receiver is dropped down to preamp line level and the Plus Beta amplifies this signal through its own three amplifiers.

Canton has a variety of satellites to choose from: minis, indoor/outdoor, ultra-thin speakers or bookshelf units.

Featured at right are the Plus S mini speakers. Like most Canton products, they are available in black, white or walnut.



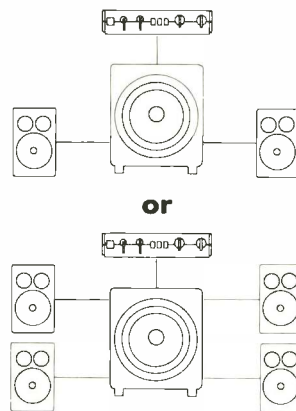
The Plus Beta contains three discrete power amps with digitally controlled active filters. They are frequency-driven and provide dynamic soft clipping for overload protection. The bass amplifier is rated at 100 watts RMS power; the satellite amps at 80 watts RMS per channel. THD is less than 0.01%.

Three advanced power amplifiers are built in, one custom-designed for the subwoofer and one each for the satellites. The active crossover network has three selectable crossover frequencies, allowing unparalleled flexibility in matching the Plus Beta with satellites. There is also an input sensitivity control and a bass level control.

Consequently, the Plus Beta can be used with a wide



The Plus Beta's control panel allows adjustment of: crossover point, for perfect matching with any satellite loudspeakers; input sensitivity, to optimize preamp compatibility; and bass level control to adapt for room characteristics.

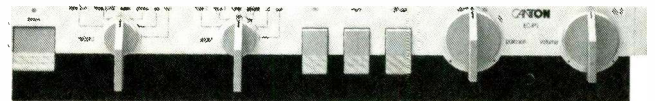


The Plus Beta can accommodate an extra pair of satellites, either

in the same room or as extension speakers in another room.

variety of satellites. For example, Canton's affordable and very compact Plus S or the high-performance Karat 100. If desired, the Plus Beta can accommodate two pairs of satellites. By way of driving the Plus Beta, virtually any preamp or receiver will do, whether a high-end unit such as the Canton EC-P1 or a more modest design.

Where space is at a premium, but the awesome dynamic range of digital program sources can't be missed, there's no better option than an active subwoofer such as the Canton Plus Beta.



A Plus Beta subwoofer/satellite system can be driven by any preamp, such as Canton's EC-P1.

Find out more about the entire Canton product line by visiting an Authorized Canton Dealer and picking up Canton's 1986/1987 40-page loudspeaker Journal.

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High Impedance and Power Output

Q. Test reports and company brochures describing the performance of amplifiers provide specifications for the equipment when it is connected to an 8-ohm loudspeaker system. There are instances where specs are provided when loads of 4 or 2 ohms are present. This information does not tell me what I need to know: What happens to power output, distortion, and frequency response when the loudspeakers are 16 ohms and 500 ohms?—J. R. Wakefield, Barberton, Ohio

A. The higher the load impedance, the less output power can be expected. This is true because solid-state equipment has a low output impedance; no reasonable load will likely

match that impedance (enabling maximum power to be transferred to the load). Thus, the higher the load impedance, the farther the load will be from a true impedance match. Frequency response and distortion will be substantially unaffected in most instances.

A 500-ohm load will represent a very serious impedance mismatch. Therefore, the power available to such a load will be so drastically below nominal ratings that you will likely not have sufficient acoustical volume from your loudspeakers.

Most loudspeaker systems do not, in themselves, have 500-ohm voice-coils. If you have speaker systems rated at 500 ohms, I believe there must be matching transformers within them which yield the 500-ohm impedance. If at all possible, I recommend that you remove the transformers and connect the loudspeakers directly to the amplifier. Use the terminals from which you have removed the secondary winding of the matching transformers.

If you don't wish to do that, use a matching transformer of 500:8 ohms (or a 62.5-to-1 ratio), capable of handling the power expected to appear at the speaker terminals. Such transformers should be available from dealers specializing in public-address (sound-reinforcement) equipment.

As for 16-ohm loads, the power provided by your equipment will likely be sufficient for your needs, though it will be somewhat reduced. The exact maximum power available will depend upon the design of the particular power amplifier. I believe it will be within 3 dB of the equipment's 8-ohm rating.

Guitar Versus Hi-Fi Speakers

Q. What are the physical differences among PM, bass guitar, and hi-fi loudspeakers? Can I use PM or bass guitar speakers in a high-fidelity system?—Name withheld

A. Regardless of any other classification, most loudspeakers are PM, which stands for "permanent magnet." Years ago, it was not possible to produce permanent magnets of sufficient strength to operate loudspeakers efficiently. Therefore, electromagnets were used, deriving their power from the devices to which they were connected. When the device was off, there was no magnet in the speaker.

Loudspeakers used for bass guitars are often designed with rather high resonant frequencies, such as 100 Hz. Thus, large amounts of acoustical power can be generated in that portion of the spectrum with relatively little amplifier power. Because of their non-uniform frequency response, they tend to sound "boomy" if used in high-fidelity systems. Also, all too often, bass guitar speakers are made to sell at low prices, so corners are cut in terms of suspension quality and magnet strength. This will result in a lack of good sound when such a speaker is installed into a high-fidelity system.

Bass guitar drivers are big (usually 12 or 15 inches). I have seen some which would doubtless work very well as subwoofers, units made with large-diameter voice-coils that are long enough to maintain a constant amount of wire in the gap during long cone excursions.

Loudspeakers for electric guitars are often small in diameter and have stiff suspensions. These cannot reproduce low frequencies below perhaps 60 Hz, and often possess serious peaks and dips in response. This is fine where these speakers are intended to color the music, but it is obviously not useful when accurate musical reproduction is desired.

Unauthorized Dealers

Q. I have had great difficulty in obtaining warranty service for a CD player which I recently purchased from a local audio dealer. As I understand it, the reason is that the store from which I purchased the player is not an authorized dealer for it (i.e., the store doesn't have a franchise agreement with the player's manufacturer). The retailer obtained the player from a shop which is an authorized dealer. Thus, my dealer was able neither to do the service needed nor to return the player to its maker. How important is it to purchase a piece of equipment from an authorized dealer? Is it unusual to have difficulty in obtaining warranty service when a piece of gear has been pur-

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

CODA



Richard C. Heyser

Richard C. Heyser, long-time Senior Editor of *Audio*, mentor to everyone who had the temerity to measure a loudspeaker, and perhaps the most brilliant man in this field, died on Saturday, March 14. Since our copy deadline is more than two weeks past, and the details of the accomplishments of this hugely modest man difficult to assemble in a single morning, we will publish a more fitting tribute next month.—E.P.

SIAMESE TWINS BORN IN JAPAN.

Introducing the Teac AD-7. Our latest cassette deck that comes with a rather unique attachment—our latest CD player. Together they offer a compilation of technical advancements equal to the most sophisticated of components.

On the left side, we've installed our exceedingly accurate 3-beam laser compact disc player. It includes enough features and programmability to merit a box of its own.

On the right side, there's an auto-reverse cassette deck with real-time reverse record and playback cobalt amorphous heads. Dolby B, C,* and dbx* noise reduction, 15-selection memory program and bias fine tuning. Plus Time Edit, an exceptionally intelligent device capable of discerning which selections on the disc will fit on each side of the tape. So there's no long blank space at the end of the first side and nothing is recorded over the tape's reversal period. You can even listen to a disc while you're taping an outside source. And all of this can happen via a wireless remote.

Now there's only one question. Is this the most advanced CD player, or is this the most advanced cassette deck?



TEAC

Made In Japan By Fanatics.

An unauthorized dealer will have trouble honoring a warranty if he can't obtain the parts he needs to do his own service work.

chased from an unauthorized dealer?—Yoji Shimizu, Madison, Wisc.

A. You did not make it clear whether your problem is simply that the retailer refused to provide service directly, that the manufacturer refused to honor his own warranty, or that no U.S. warranty was provided.

An unauthorized dealer will have trouble honoring warranties because he will usually be unable to obtain the replacement parts necessary to do his own service work. Further, as you've said, he cannot even return a defective product to its maker.

Many dealers sell equipment at

great discounts, which means their profit margin on each sale is low. Such dealers often provide very little service, since all customer service costs time and money. Thus, discounters may not want to handle warranty problems even if they are authorized dealers—and many discounters are not. In my experience, such dealers may tell customers that warranty problems are handled directly by the makers of the goods.

To obtain service from the manufacturer, you will usually have to write or call to find out how the company will handle the problem. Then you will have to either take or ship your equipment to the manufacturer's service department or nearest factory-authorized shop.

When you purchase equipment made overseas, however, you may get "gray market" goods whose warranty is not valid in the U.S. These goods have been imported directly by the retailer from foreign dealers or foreign distributors, and sometimes even direct from the manufacturers, for less than they would have cost if purchased through the manufacturer's authorized U.S. distributor. The authorized U.S. distributor is responsible for such expenses as stocking spare parts, selecting and training service people, handling warranty repairs, and advertising the product. Having spent this money helping to make the product more worth selling, he then passes on these costs, plus a profit, to his authorized dealers. He cannot be expected to stand behind products which he didn't sell, and so he usually won't honor warranties on gray-market goods. For this reason, some localities require that dealers who sell gray-market products say so, and tell whether those products carry a U.S. warranty or not.

If you know beforehand that you are buying products without a U.S. warranty, make sure you know a service technician competent to repair it. Otherwise, you'd better hope it doesn't break down.

(Editor's Note: While it is usually not possible to get warranty service on gray-market goods, manufacturers may help those who buy, through unauthorized dealers, goods imported by the authorized agent or goods made in the U.S. When in doubt, ask the manufacturer or official importer.—I.B.)



The Next Logical Step . . .

Meridian, the company which led the way in demonstrating the true sonic possibilities of the CD medium, continues to lead the industry with the introduction of their new model 207 Professional compact disc player.

The 207 is built on two chassis. The transport and all mechanical components are housed in a chassis which offers front loading convenience while carefully isolating both the disc drive and laser mechanism from external vibrations. A separate chassis containing the audio and control electronics is entirely free of the electromagnetic radiation of the transport motors and any microphonics that might be introduced by their operation. These factors contribute to the 207's ability to reproduce the more subtle nuances of a musical event.

The full function remote control capability of the 207 includes a recently designed circuit for controlling the output level. This revolutionary electronic gain control provides the highest audible quality ever available with a remote control, allowing the 207 to be conveniently used to directly drive active loudspeakers or a power amplifier without requiring a preamplifier.

In addition, the 207 provides an auxiliary high level input and a full tape loop, making this product essentially a CD player plus preamplifier. The 207's innovative design can simultaneously improve your sound quality and simplify your home entertainment by performing as the control center for your system.

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TAPE GUIDE

HERMAN BURSTEIN

Locating an 8-Track Player

Q. I have a collection of 8-track cartridge tapes and an excellent hi-fi system. My problem is that I cannot locate an 8-track playback unit with high-fidelity characteristics. The only unit I've found has a relatively poor frequency response of 50 Hz to 10 kHz. Can you tell me where I might purchase an 8-track playback unit with true hi-fi specs?—José Valencia, Barstow, Cal.

A. I do not know of any 8-track cartridge system ever made that was truly of high-fidelity caliber. Though they were capable of providing substantial listening pleasure, 8-track cartridges were never a high-fidelity medium, given their relatively limited performance with respect to frequency response, noise, distortion, and tape motion.

A playback unit that delivers substantially flat response between 50 Hz and 10 kHz can give very satisfactory results. Compare this range with the frequency response typically found in the AM sections of high-fidelity AM/FM tuners—substantially rolled off below 100 Hz and above 3 to 5 kHz. I doubt that your cartridges have appreciable response below 50 Hz or above 10 kHz. Therefore, I suggest that you try the cartridge player you did locate, provided you receive assurance that you can return it if not satisfied.

Clicks in Recording

Q. I own three good-quality cassette decks and do a lot of creative recording which subsequently requires editing. Whenever I use the "Stop" or "Recording" button to edit the tapes, there is an audible and annoying click which gets recorded and reproduced in playback. I have tried various means to eliminate this, such as depressing the "Pause" button and turning down the recording volume before operating the "Recording" or "Stop" button, but without positive results. On the other hand, I dare not edit my tapes by cutting and splicing because in my tropical climate the joints may come apart. I will appreciate your advice.—S. Roy Chowdhury, Calcutta, India

A. The button clicks you describe are a common phenomenon but tend to be absent in most top-quality decks. Often a small capacitor, or a resistor and capacitor in series, across the contacts of the offending button will

reduce or eliminate the problem. You might try a capacitor of about 0.1 μ F, or such a capacitor in series with a resistor of about 100 ohms. Of course, success cannot be guaranteed.

For specifics as to what might be done, you really should get in touch with the deck manufacturer or an authorized service agency.

Decks in Close Proximity

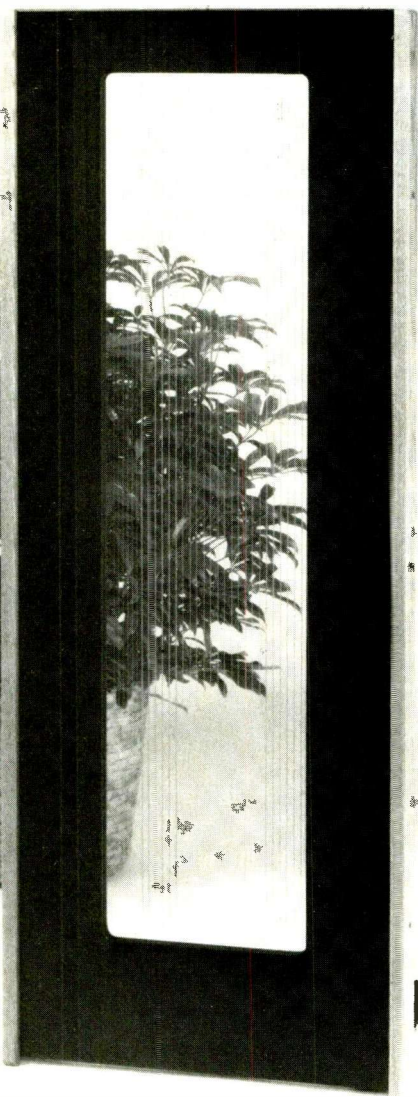
Q. I use an 8-track open-reel deck with Dolby C NR to record music in my home studio. I dub down to a two-track machine with an external noise-reduction unit, which then feeds two cassette decks. With all of these decks mounted in close proximity, what is the best way to go about demagnetizing their heads? I would prefer not to have to remove them one at a time and disconnect all the cables. If I demagnetize them one at a time, do I run the risk of magnetizing the others if they are nearby? If I do them all at once, I'll risk burning out my demagnetizer. And how far away should my recorded tapes be during this process?

It has been recommended that I measure the residual magnetism in the heads and only demagnetize when required, instead of following a regular demagnetizing schedule. If this is worth pursuing, do you know where I can obtain a device that measures residual magnetism?—Bob Andres, Redwood City, Cal.

A. Simply use a probe-type degausser on one deck at a time in their present locations. There is no risk of magnetizing one set of heads while demagnetizing the heads of another deck. Once you get about 3 inches away—and possibly much less—from the demagnetizer, it has no appreciable effect. Even powerful magnetic forces, such as those emanating from transformers, speakers, etc., have no appreciable effect beyond about 3 inches.

Effective demagnetization of the heads and other metal elements contacted by the tape should take no more than 30 S. If you allow a minute of

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.



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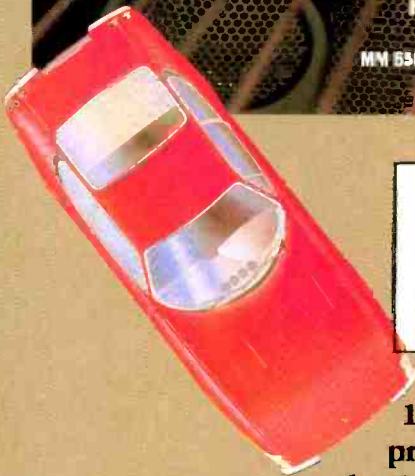
—Unique technology
—Ordinary price

* Speaker photographed with magnetic structure removed.

III MAGNEPAN

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Matthew Polk's New Generation of Revolutionary TRUE STEREO SDAs



SDA SRS
\$1495.00 ea.

SDA SRS 2
\$995.00 ea.

SDA CRS +
\$395.00 ea.

SDA 1B
\$695.00 ea.

SDA 2A
\$499.00 ea.

Digital Disc Ready

Matthew Polk's revolutionary SDAs have been acclaimed around the world. Australian HiFi called them "A stunning achievement."

Prices are MacArthur's. See History.com. Prices may vary.

Matthew Polk's Superior Sounding SDA's Win Audio Video Grand Prix Speaker of the Year Five Years in a Row!

1982 — **SDA 1** Speaker of the Year
 1983 — **SDA 2** Speaker of the Year
 1984 — **SDA CRS** Speaker of the Year
 1985 — **SDA SRS** Speaker of the Year
 1986 — **SDA SRS 2** Speaker of the Year

"They truly represent a breakthrough." *Rolling Stone Magazine*

Polk's critically acclaimed, 5 time AudioVideo Grand Prix Award winning SDA technology is the most important fundamental advance in loud-speaker technology since stereo itself. Listeners are amazed when they hear the huge, lifelike, three-dimensional sonic image produced by Polk's SDA speakers. The nation's top audio experts agree that Polk SDA loudspeakers always sound better than conventional loudspeakers. Stereo Review said, "Spectacular... the result is always better than would be achieved by conventional speakers." High Fidelity said, "Astounding... We have yet to hear any stereo program that doesn't benefit." Now all 5 SDAs incorporate many of the 3rd generation advances in SDA technology pioneered in the Signature Edition SRS and SRS2 including full complement sub-bass drive, time-compensated phase-coherent driver alignment and bandwidth-optimized dimensional signal.

Why SDAs Always Sound Better

Stereo Review confirmed the unqualified sonic superiority of Matthew Polk's revolutionary SDA Technology when they wrote, "These speakers *always* sounded different from conventional speakers — and in our view better — as a result of their SDA design.

Without exaggeration, the design principals embodied in the SDAs make them the world's first true stereo speakers. The basic concept of speaker design was never modified to take into account the fundamental difference between a mono and stereo signal. The fundamental and basic concept of mono is that you have one signal (and speaker) meant to be heard by both ears at once. However, the fundamental and

basic concept of stereo is that a much more lifelike three-dimensional sound is achieved by having 2 different signals, each played back through a separate speaker and each meant to be heard by only one ear apiece (L or R). So quite simply, a mono loudspeaker is designed to be heard by two ears at once while true stereo loudspeakers should each be heard by only one ear apiece (like headphones). The revolutionary Polk SDAs are the first TRUE STEREO speakers engineered to accomplish this and fully realize the astonishingly lifelike three-dimensional imaging capabilities of the stereophonic sound medium.

"A stunning achievement" *Australian HiFi*

Polk SDA Technology solves one of the greatest problems in stereo reproduction. When each ear hears both speakers and signals, as occurs when you use conventional (Mono) speakers to listen in stereo, full stereo separation is lost. The undesirable signal reaching each ear from the "wrong" speaker is a form of acoustic distortion called interaural crosstalk, which confuses your hearing.

"Literally a New Dimension in the Sound" *Stereo Review Magazine*

The Polk SDA systems eliminate interaural crosstalk distortion and maintain full, True Stereo separation, by incorporating two completely separate sets of drivers (stereo and dimensional) into each speaker cabinet. The stereo drivers radiate the normal stereo signal, while the dimensional drivers radiate a difference signal that acoustically and effectively cancels the interaural crosstalk distortion and thereby restores the stereo separation, imaging and detail lost when you listen to normal "mono"speakers. The dramatic sonic benefits are immediately audible and remarkable.

"Mindboggling, astounding, flabbergasting" *High Fidelity Magazine*

Words alone cannot fully describe how much more lifelike SDA TRUE STEREO reproduction is. Reviewers, critical listeners and novices alike are overwhelmed by the magnitude of the sonic improvement achieved by Polk's TRUE STEREO technology. You will hear a huge sound stage which extends not only beyond the speakers, but beyond the walls of your listening room itself. The lifelike ambience revealed by the SDAs makes it sound as though you have been transported to the acoustic environment of the original sonic event. Every instrument, vocalist and sound becomes tangible, distinct, alive and firmly placed in its own natural spatial position. You will hear instruments, ambience and subtle musical nuances (normally masked by conventional speakers), revealed for your enjoyment by the SDAs. This benefit is accurately described by Julian Hirsch in Stereo Review, "...the sense of discovery experienced when playing an old favorite stereo record and hearing, quite literally, a new dimension in the sound is a most attractive bonus..." Records, CDs, tapes, video and FM all benefit equally as dramatically.

"You owe it to yourself to audition them." *High Fidelity Magazine*

SDAs allow you to experience the spine tingling excitement, majesty and pleasure of live music in your home. You must hear the remarkable sonic benefits of SDA technology for yourself. You too will agree with Stereo Review's dramatic conclusion: "the result is always better than would be achieved by conventional speakers... it does indeed add a new dimension to reproduced sound."

polkaudio
 The Speaker Specialists®

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Polk Audio

The Speaker Specialists®

Where to buy Polk Speakers

AUTHORIZED DEALER LIST

CANADA Call Evolution Technology Toronto for nearest dealer 1-800-263-6395
AL Auburn: Audio Warehouse
Birmingham: Audition • **Dadsden:** Sound Performance • **Huntsville:** Campbell's Sound Distributors • **Mable:** Sound Advice • **Montgomery:** The Record Shop • **Nashville:** Kincaid Stereo & TV • **AK Anchorage:** Shmeke's • **Fairbanks:** Hottis • **AZ Flagstaff:** Sound Pro • **Mesa:** Hi Fi Sales • **Tucson:** Audio Emporium • **Yuma:** Warehouse Stereo
AR Little Rock: Leisure Electronics
CA Arcata: Arcalia Audio • **Bakersfield:** Sound Advice • **Berkeley:** Sounding Board • **Campbell:** Sound Goods • **Canoga Park:** Shelley's • **Concord:** C & M Stereo • **Davis:** World Electronics • **Fairfield:** C & M Stereo • **Los Angeles:** Beverly Stereo • **Mill Valley:** World of Sound • **Mountain View:** Sound Goods • **Napa:** Futuristic • **Orange:** Absolute Audio • **Pengrove:** California Stereo • **Sacramento:** World Electronics • **San Diego:** Sound Company • **San Francisco:** Stereo Store • **World of Sound • San Gabriel:** Audio Concept • **Santa Barbara:** Creative Stereo • **Santa Maria:** Creative Stereo • **Santa Monica:** Shelley's Stereo • **Stockton:** Gluskens Camera • **Thousand Oaks:** Creative Stereo • **Ukiah:** Music Hut • **Ventura:** Creative Stereo • **Victorville:** Laser Tech • **Walnut Creek:** High Fidelity Shoppe • **CO Boulder:** Soundtrack • **Wavelength Stereo • Colorado Springs:** Sunshine Audio • **Denver & Suburbs:** Soundtrack • **Pueblo:** Sunshine Audio • **CT Avon:** Hi Fi Stereo House • **Danbury:** Carlson's • **Fairfield:** Audio Design • **Greenwich:** Al Franklins • **Groton:** Roberts • **Hartford:** Al Franklins • **Newington:** Hi Fi Stereo House • **New London:** Roberts • **Norwalk:** Auditions • **DE Wilmington:** Bryn Mawr Stereo • **DC Myer Emco**
FL Daytona Beach: Stereotypes • **FT Myers:** Stereo Garage • **FT Pierce:** Sound Shack • **FT Walton Beach:** Audio International • **Jacksonville & Suburbs:** Audio Tech • **Lakeland:** Sound Factory • **Merritt Island:** Southern Audio • **Miami:** Electronic Equipment Co • **Naples:** Stereo Garage • **Orlando & Suburbs:** Audio Spectrum • **Pensacola:** Fidler Hi Fi • **St. Petersburg:** Cooper for Audio • **Tallahassee:** Stereo Systems • **Audio Vision • W. Palm Beach:** Electronic Connection
GA Atlanta & Suburbs: Hi Fi Buys • **Aust:** Stereo City • **Macon:** Georgia Music • **Savannah:** Audio Warehouse
HI Honolulu: Stereo Station
ID Boise: Stereo Shoppe • **Coeur D'Alene:** Electrarc • **Pacifica:** Spikes Brothers • **Sandpoint:** Electrarc • **Twin Falls:** Audio Warehouse
IL Aurora: Stereo Systems • **Bloomington:** Alan's Creative Stereo • **Buffalo Grove:** Columbia • **Carbondale:** Southern Stereo • **Champaign:** Good Vibes • **Decatur:** J R Loyds • **DeKalb:** Audio Plus • **Hoffman Estates:** Simply Stereo • **Highland Park:** Columbia • **Joliet:** Stereo Systems • **Lansing:** Audio Clinic • **Mt. Prospect:** Simply Stereo • **Naperville:** Stereo Systems • **Normal:** Glenn Piers • **Northbrook:** Alan's • **Peoria:** Team Electronics • **Riverdale:** Simply Stereo • **Rockford:** Columbia • **Shawnee:** Hi Fi Hutch • **Springfield:** Sundown One • **Stirling:** Midwest Hi Fi • **Vernon Hills:** Alan's • **Ill. Park:** Hi Fi Hutch • **Waukegan:** Alan's • **IN Bloomington:** Hoosier Electronics • **Evansville:** Riskey's • **FT Wayne:** Classic Stereo • **Indianapolis:** Ovalton • **Lafayette:** Good Vibes • **Marian:** Classic Stereo • **Muncie:** Classic Stereo • **South Bend:** Classic Stereo • **Terre Haute:** Hoosier • **IA Des Moines:** Audio Labs • **Dodge City:** Sound World • **Fairfield:** Golden Ear • **Masson City:** Sound World • **Sioux City:** Audio Emporium
KS Junction City: Audio Junction • **Overland Park:** Audio Electronics • **Wichita:** Audio Visions • **Topeka:** Nelsons
KY Bowling Green: Audio Center • **Lexington:** Stereo Shoppe • **Ovallon Audio • Louisville:** Audio Video Buy Design • **Owensboro:** Paduch • **Risley's LA Lafayette:** Sound Electronics • **Lake Charles:** Classic Audio Systems • **Opelousas:** Sound Electronics • **West Monroe:** Audio West • **ME Bangor:** Sound Source • **Camden:** Harbor Audio • **MD Annapolis:** Spaceways • **Baltimore:** Soundscope • **Frederick:** Evergreen • **Rockville:** Myer Emco
MA Boston: Waltham Camera & Stereo • **Fitchburg:** Fitchburg Music • **N. Dartmouth:** Creative Sound Systems • **MI Ann Arbor:** Absolute Sound • **Birmingham:** Almas Hi Fi • **Dearborn:** Almas Hi Fi • **East Lansing:** Stereo Shoppe • **Farmington Hills:** Almas Hi Fi • **Grand Rapids:** Classic Stereo • **Iron Mountain:** Sound North • **Kalamazoo:** Classic Stereo • **Lansing:** Stereo Shoppe • **Royal Oak:** Absolute Sound • **Saginaw:** Audio Shoppe • **Court St. Listening Room • Traverse City:** Stereo Shoppe • **W. Duluth:** Mel's TV & Audio • **Mankato:** Audio King • **Minneapolis & Suburbs:** Audio King • **Minnetonka:** Audio King • **Rochester:** Audio King • **St. Paul:** Audio King

MS Columbus: Audio Advantage • **Gulfport:** Empress • **Jackson:** Walters • **Jefferson City:** The Stereo Bull • **Joplin:** The Stereo Bull • **Pascagoula:** Empress • **Spartanburg:** The Stereo Bull • **Tupelo:** Audio Advantage • **MO Cape Girardeau:** Stereo One • **St. Louis:** Sound Central • **MT Bozeman:** Thrifty Ear • **Great Falls:** Rocky Mountain Hi Fi • **Missoula:** Aspen Sound
NC Asheville: Mr. Toad's Stereo Video • **Chapel Hill:** Stereo Source • **Greensboro:** Stereo Sound • **Moorehead City:** Anderson Audio • **New Bern:** Anderson Audio • **Pineville:** Stereo Video • **Raleigh:** Audio Buys • **Stereo Sound • Rocky Mount:** Micro-nova Audio • **Wilmington:** Atlantic Audio • **Winston-Salem:** Stereo Sound
NE Bismarck: Pacific Sound • **NE Lincoln:** Stereo West • **Norfolk:** Mid City Stereo • **Omaha:** Stereo West • **NH Concord:** Audio of New England • **Exeter:** AutoSound & Soundations • **Laconia:** Audio of New England • **Salem:** Cuzco's • **East Brunswick:** Stereo Sound • **Franklin Lakes:** Franklin Lakes Stereo • **Maple Shade:** Bryn Mawr Stereo • **Montclair:** Perdue Radio • **Hartland:** AC Audio • **Ridgewood:** Soundings • **Shrewsbury:** Audio Advantage • **Toms River:** Rand's Camera • **West Caldwell:** Perdue Radio • **NM Albuquerque:** Real Time Audio • **Alamogordo:** D&K Electronics • **Carlsbad:** Beason • **NV Las Vegas:** Upper Ear • **Reno:** The Audio Authority
NY Albany: Clark Music • **Batavia:** Unicorn Audio • **Buffalo:** Speaker Shop • **Corning:** Chemung • **Elmira:** Chemung • **Fredonia:** Stereo One • **Glens Falls:** Audio Genesis • **Huntington:** Audio Breakthroughs • **Ithaca:** Chemung • **Jamestown:** Studio One • **Manhasset:** Audio Breakthroughs • **New York City:** Audio Breakthroughs • **Electronic Workshop • Rochester:** JB Sound • **Scarsdale:** Lorraine • **Syracuse:** Clark Music • **Vestal:** Hart Electronics
OH Akron: Audio Craft • **Cleveland & Suburbs:** Audio Craft • **Cincinnati:** Stereo Lab • **Columbus:** Stereo Lab • **Dayton:** Stereo Showcase • **Findlay:** Audio Craft • **Lima:** Classic Stereo • **Toledo:** Audio Craft • **OK Lawton:** Hi Fi Shop • **Oklahoma City:** Audio Dimensions • **Tulsa:** Audio Advantage • **OR Beaverton:** Stereo Superstore • **Bend:** Audio Video Lab • **Eugene:** Bradford's High Fidelity • **Grants Pass:** Sheppells • **Medford:** Stereo Dimensions • **Portland:** Stereo Superstore • **PA Allentown:** Bryn Mawr Stereo • **Altoona:** Sound Concepts • **Blakely:** Mart Electronics • **Bryn Mawr:** Bryn Mawr Stereo • **Camp Hill:** Bryn Mawr Stereo • **East Stroudsburg:** Johnstown • **Gary's Entertainment • Kingston:** Hart Electronics • **Lancaster:** G R T Stereo • **Montgomeryville:** Bryn Mawr Stereo • **Norona Heights:** Stereo Lab • **Philadelphia & Suburbs:** Bryn Mawr Stereo • **Pittsburgh:** Audio Junction • **Quakertown:** Bryn Mawr Stereo • **Reading:** G R T Stereo • **Salisbury:** Stereo Shop • **Williamsport:** Robert M. Sides • **PUERTO RICO Rio Piedras:** Precision Audio • **RI N. Providence:** Eastern Audio • **SC Anderson:** John Beard • **Durham:** Charles's Audio Warehouse • **Greenville:** Mitchell's Stereo • **Greenswood:** Stereo Shop • **Rock Hill:** Tavis • **Spartanburg:** Stereo Shop • **SD Rapid City:** Team Electronics • **Sioux Falls:** Audio King • **TN Chattanooga:** College Hi Fi • **Cookeville:** Lindsey Ward • **Jackson:** New Wave Electronics • **Johnson City:** Mr. Toad's Stereo Video • **Kingsport:** Mr. Toad's Stereo Video • **Knoxville:** Lindsey Ward • **McMinnville:** Lindsey Ward • **Memphis:** Opus II • **Nashville:** Hi Fi Buys • **TX Abilene:** Sound Effects • **Arlington:** Sound Idea • **Austin:** Audio Video • **College Station:** Audio Video • **Corpus Christi:** Tape Town • **El Paso:** Soundways • **FT. Worth:** Sound Idea • **Galveston:** Island Audio • **Houston:** Sheffield Audio • **Lubbock:** Ultra Electronics • **Midland:** Harold's Electronics • **McCombs:** Synair Music • **Gilchrist:** Harold's Electronics • **San Antonio:** Bill Case Sound • **Sherman:** Worldwide Stereo • **Temple:** Audio Tech • **Tarrant:** Sound Concepts • **Waco:** Audio Tech • **UT Logan store only:** Spikes Brothers • **Salt Lake City:** Broadway Music • **VT Burlington:** Audio Den • **VT Burlington:** Mr. Toad's Stereo Video • **Charlottesville:** Sound Machine • **Falls Church:** Myer Emco • **Leesburg:** Evergreen Audio • **Richmond:** Gary's Stereo • **Roanoke:** Audio Dimensions • **Smyth:** Digital Sound • **WA Bellingham:** CC Stereo • **Cheilan:** Music Store • **Dak Harbor:** CC Stereo Center • **Richland:** In Ear Stereo • **Seattle & Suburbs:** Northwest Audio Video • **Spokane:** Electrarc (Italy) • **WV Barboursville:** Beckley • **Charleston:** Huntington • **Pied Piper • Piedmont:** Sound Gallery • **WI Appleton:** Sound World • **Eau Claire:** EME Audio Systems • **Green Bay:** Sound World • **Lacrosse:** Sound World • **Madison:** Happy Medium • **Marquette:** Sound Seller • **Milwaukee:** Audio Emporium • **Wausau:** Sound World • **WY Cheyenne:** Electronics Unlimited

There can be a problem with accurate azimuth alignment in some of the more accurate azimuth reverse decks, but you may be able to make corrective adjustments.

cooling time between decks, demagnetizing all four of them is a matter of well under 10 minutes.

Magnetometers, which measure residual magnetism, are sold by R. B. Annis Manufacturing Co., 1101 North Delaware St., Indianapolis, Ind. 46202.

Time to Realign?
Q. The manual for my Sony cassette deck states that I should use Sony tapes for best results. Sony has a new line of improved cassettes. Will my deck have to be realigned with respect to bias and equalization because of this improvement?—Kevin McGarvey, West Chester, Pa.

A. For a given tape type (I, II, or IV), tapes from reputable manufacturers tend to be substantially similar in their characteristics with respect to bias and record equalization. (An exception occurs with a few Type IV metal-particle tapes, which call for Type II bias and record equalization.) The playback equalization requirement always remains the same, in accordance with industry standards: 120 µS for Type I and 70 µS for the others. Hence, you can expect that the requirements of the improved tape will not differ substantially from those of the old tape.

However, if you want the utmost in performance (a close approach to flat frequency response along with minimal distortion), it may be wise to have your tape deck aligned for the particular tape you are using. The alternate (and less expensive) course is to leave your deck alone and try several good brands of tape to ascertain which gives the most satisfactory performance. It may well turn out that your ears will detect no difference between the improved tape and your old tape, nor among leading brands, although measuring instruments might.

Auto-Reverse Trade-Off

Q. I am trying to choose between two cassette decks, priced much the same and having similar features (such as three heads, dbx noise reduction, and bias adjustment). One of the decks also has auto reverse. I have heard that head azimuth can be affected by auto reverse. Is there a possibility that the deck with this feature would give inferior reproduction?—Alex Farwick, FPO San Francisco, Cal.

A. Yes, in auto-reverse decks there can be a problem with accurate azimuth alignment, which is essential in order to maintain high frequency response. If response is inferior in one direction, it is usually in the reverse direction, though the opposite may be true in some cases.

If you are interested in the auto-reverse feature, listen to the deck in question to ascertain whether you hear a difference in performance between the two directions of tape travel. Also, ask a salesperson or consult the instruction manual to find out whether this deck provides for azimuth adjustment (by the manufacturer or a service shop) in each direction of tape travel, as some—but not all—do. Finally, check equipment reviews in *Audio* and other magazines to see if you can find information about the deck's auto-reverse performance.

Counter Revolutions

An increasing number of tape counters show elapsed or remaining time, but most just count turns of one tape hub. In the October 1986 issue, I suggested that it might be possible to plot the relationship between counts and time; reader Jeff Bonwick, a math major at the University of Delaware, has managed to come up with the necessary formulas.

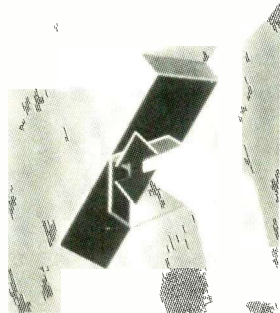
Using his formulas and a simple procedure for ascertaining how one's tape counter is calibrated, it is possible to determine elapsed time from a counter reading, to determine what counter reading will correspond to a specific elapsed time, and to construct a graph from which this data can be estimated at a glance.

The math involved is algebra, though square roots are used in the formula to determine what counter readings correspond to given times. Even so, explaining and demonstrating Mr. Bonwick's formulas would take too much space here. I am therefore making this explanation available by mail to anyone who sends a stamped, self-addressed envelope to: Tape Formula, c/o Ivan Berger, *Audio Magazine*, 1515 Broadway, New York, N.Y. 10036. Please do not address requests for the formulas to me, since only Mr. Berger has copies ready for mailing to interested readers.—H.B.

Canton announces significant engineering advances in the science of music reproduction.



Enlarged detail from center of photo: the rigid aluminum ring with obliquely positioned permanent magnets. In front of it, the semiconductor sensor which is linked via a supporting plate with the diaphragm and moves to and from with it.



Motion Feedback:

All loudspeaker systems have an inherent problem. A driver's diaphragm is burdened by mass and reacts to sound impulses with a certain amount of inertia. A time delay exists between the instantaneous sonic impulse and the acceleration and deceleration of the diaphragm. This delay translates into coloration of the source material.

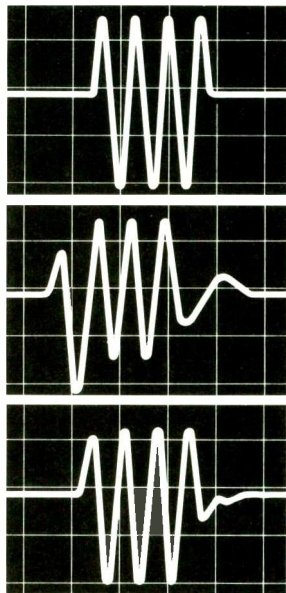
Canton's new CA series, in addition to their advanced power amplifiers, are equipped with a built-in electronic signal correction system which monitors each speaker diaphragm, checking whether its motion corresponds exactly with the impulses of the musical signal at all times. Instantly—within a fraction of a

A "sound burst" (upper curve) as seen on the oscilloscope: fast attack and equally rapid decay of sonic impulses. Here's

what an uncorrected speaker makes of the signal (center curve): there are distinct discrepancies on both incursion and excursion. And here's how the Canton system corrects diaphragm motion (lower curve): to the exact image of the original sound burst, in all but infinitesimal "alterflash."

millisecond—any discrepancies are registered, fed back and corrected via counteraction of the built-in power amplifiers.

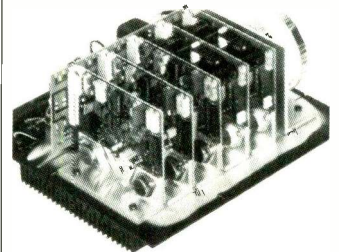
Canton employs a number of new patented processes for driver correction. In the woofer illustrated here, the "Hall Effect" is used. A semiconductor element serving as a sensor cuts across the field of a fixed magnet. This creates an electrical voltage related to depth of insertion. Inversely, this "Hall Voltage" is an indicator for the position of the sensor, e.g. the diaphragm. By comparing this actual value with the target value of the musical signal, the control circuitry acquires the impulse needed for any amplifier counteraction. The diaphragm is accelerated or braked accordingly.



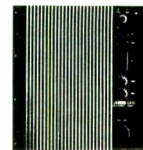
The top-of-the line CA 30 active speaker is a 4-way system powered by 7 internal amplifiers (one for each driver). The woofers are powered by 4x120 Watt amplifiers, the midranges by 2x100 Watt amplifiers and the titanium tweeter by 1x100 Watt amplifier. A total of 780 Watts per CA 30 speaker.

In addition, problems normally associated with passive crossover networks are non-existent due to Canton's advanced MOS-FET electronic crossovers.

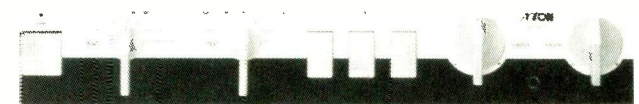
Each amplifier is meticulously fine tuned to achieve optimal performance with its associated, companion driver.



With these high standards, all components—not just the signal correction circuitry—incorporate the most sophisticated technical advances. The entire system reflects the design approach customary in industrial electronics like using thick film modules with SMD's (Surface Mounted Devices), bus interface connections, and plug-in card technology for high reliability and performance capability.



Connecting and control elements on rear panel of a CA series active speaker. Each frequency range can be independently boosted or attenuated to compensate for listening room idiosyncrasies.



Since active speakers incorporate their own built-in power amplifiers, all that's needed to drive them is a pre-amp like the new EC-P1 from Canton (pictured above).

Find out more about the entire Canton product line by visiting an Authorized Canton Dealer and picking up Canton's 1986/1987 40-page Loudspeaker Journal.

Advanced Technology

from

CANTON

High Fidelity Made in W. Germany

Canton North America, Inc. 254 First Avenue North Minneapolis, MN 55401 Telephone (612) 333-1150

Enter 14 in Reader Service Card

A car stereo designed for people with ears. And something between them.

Odd as it may seem, most people judge how a car stereo sounds by judging how it looks.

Is it loaded with flashing lights? Littered with impressive buttons?

Then it must be a sterling example of modern technology.

This reaction, while somewhat understandable, never ceases to amaze the 326 car stereo engineers who work for Blaupunkt in Hildesheim, West Germany.

fiddle with a confusing array of buttons and knobs.

Keep this in mind, and it's easy to appreciate the difference between Blaupunkt and other leading brands.

If we don't engineer it, we don't sell it.

While other car stereo makers are content to purchase tape mechanisms, amplifiers, tuners, speaker components, and other vital equipment from outside sources, Blaupunkt

and hybrid chips.

To eliminate wow and flutter in cassette mechanisms, dynamically-balanced heavy brass flywheels are honed to within tolerances of .005 inch.

To make systems easier to operate, controls are arranged in logical fashion. So drivers can operate them by touch, without taking their eyes off the road.

It's a painstaking process. And it's repeated for every

product we offer: Cassette receivers. CD players. Amplifiers. Equalizers. Speakers. Antennas. Even the connecting cables.

Few manufacturers go to all this trouble. With every feature. On every product.

Which makes it all the more remarkable that the design stage is only the first step in making a Blaupunkt.

Now comes the hard part.

Tuners are taken from mountain ranges to bustling urban areas to measure radio reception.

Antennas spend weeks in salt baths in order to measure rust resistance.

Literally hundreds of tests are conducted.

To ensure performance at 160°F above zero.

To ensure performance at 5°F below zero. To ensure performance after 24 hours



The Blaupunkt Lexington SQR 46. Complex audio technology engineered to be simple.

They prefer to take a more intelligent approach.

When designing car stereos, don't forget the car.

Blaupunkt might be the only car stereo company that thoroughly understands this simple fact:

A car is a horrible place in which to reproduce true high-fidelity sound.

It requires an incredible effort to overcome challenges like road noise and vibration. Shrill glass surfaces. Cushiony seats. Bad reception. Temperature variations. And the obvious principle that a driver has better things to do than to

engineers do almost everything from scratch.

To pack more technology into a smaller space, Blaupunkt engineers design their very own circuitry. Controls are designed to ensure ease of operation even while wearing racing gloves.





The mountains of Europe are just one of the obstacles Blaupunkt engineers have had to overcome to improve radio reception.

of punishing vibrations.

Last year alone, Blaupunkt engineers spent hundreds of thousands of hours testing.

And once a new model is approved for production, you might imagine that Blaupunkt

to up to 400 additional tests.

Why do we do it?

If you're a rational person, you almost begin to wonder why on earth Blaupunkt goes to such incredible lengths.

Perhaps because customers

brings you up-to-the-minute traffic reports in many major U.S. cities. And it's a standard feature in most new Blaupunkt receivers.

A thank you. And an invitation.

While we appreciate this opportunity to explain how well Blaupunkts are built, we are regretfully unable to demonstrate how good they sound.

For that, we invite you to visit the independent car stereo specialist near you who sells, services, and installs our products.

Check your Yellow Pages under "Automobile Radios & Stereo Systems."

Or call 1-800-237-7999, and we'll be happy to direct you.

Because frankly, while you may be surprised by how much goes into a Blaupunkt, you'll be even more amazed by what comes out.



Standard in VW and BMW (Europe), and worldwide in Ferrari, Porsche, and Audi.

engineers might relax a bit.

Wrong.

Every individual component is tested before assembly.

Then tested again during assembly.

Then the finished product is placed on a computer stand and tested before shipping.

But even that isn't enough.

Spot checks at random during assembly subject units

have come to expect it.

Customers like you.

And customers like Lotus. Porsche. Audi. Rolls-Royce. Aston-Martin. Ferrari. Just to name a few.

But a more important reason is simply because that's the way they do things over in Hildesheim, West Germany.

Since 1932, when Blaupunkt introduced the first car radio to Europe, Blaupunkt has been obsessed with automotive sound.

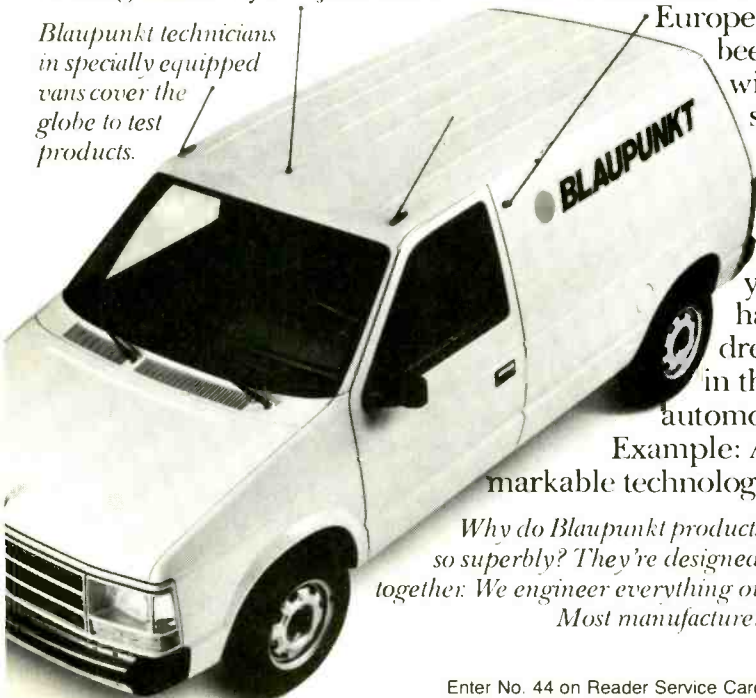
It's hard to argue with the results.

Over the years, Blaupunkt has earned hundreds of patents in the field of automotive sound.

Example: ARI, a remarkable technology that

Why do Blaupunkt products perform so superbly? They're designed to work together. We engineer everything ourselves. Most manufacturers don't.

Blaupunkt technicians in specially equipped vans cover the globe to test products.



BLAUPUNKT

BOSCH Group



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A QUADMIRE OF SOUND

The problems with quadrasonic sound a dozen years ago—now it is known as surround sound—were at least twofold, if not fourfold. Last month I gave you, I hope, a sense of the engineering confusion that surrounded the whole four-channel episode and doomed it from the start. Perhaps even more harmful, however, was the hopelessly muddled esthetic applied to the use of four channels of musical information. What were we to do with them? What *did* we do? Everything, anything, from the sublime to the ridiculous. We never had time to think much about that side of it. Anyhow, we seldom did think.

There were indeed good ideas. There usually are. But on the whole we simply improvised, or tried to do the spectacular in every zany way that might sell the extra channels. The collective results of all this, from the consumer point of view, were simply scatterbrained. We were charging off in 50 directions at once.

With no clear guiding convictions on the part of the producers, our publicity people were stranded, and proceeded to fly off in even more unlikely directions. They do need primary guidance, after all. I can still conjure up one of those quadrasonic ads, featuring a mass of orchestral players hanging languorously in space above a living-room couch, with Toscanini or somebody at the (floating) helm and the listener looking up, in fascination. Or was it dismay? More likely that.

We certainly did not often get to hear the quadrasonic miracles we were expecting. Most consumers, disgusted with the technical complexities and the commercial bickering alike, just gave up the whole business and returned to solid stereo. Only a mini-minority of listeners, with alert ears and inquiring minds, kept going with four channels and hung on to the death—and far beyond. That was because they had managed to discover entirely on their own some of the things that multi-channel sound could indeed do for their own type of listening. I count myself among these people; I hung on, too. My music is largely classical, but there were others in that persistent minority with quite different interests, and different personal discoveries.

Do not forget that multi-channel



Illustration: Rosalind Ivens

sound is an extension of the stereo principle. What we call stereo is simply the *minimal plurality* of channels. Nature's receptors, ears and eyes, have done astonishing things with that minimal plurality of differentiation. We in audio are not quite as clever, and *our* minimum difference, between just two channels and generally "frontal" loudspeaker sources, can in fact be refined and made more subtle with extra channels of information to round out the whole. Stokowski's "Fantasia" in 1949 had more than two, as did his even earlier live stereo transmission of the sound of an orchestra from a hall in Philadelphia to a hall in New York.

Why did stereo work out so well on discs and tapes, beginning in the '50s, whereas its refinement into four channels, variably discrete, was a bust? The answer is actually positive. In spite of the usual loud publicity and a great deal of silly hoopla about stereo (which misled many people into thinking it was just another gimmick, for double sales), we knew what we were doing with it. We had enough to go on long before two channels became technically possible on a mass commercial basis.

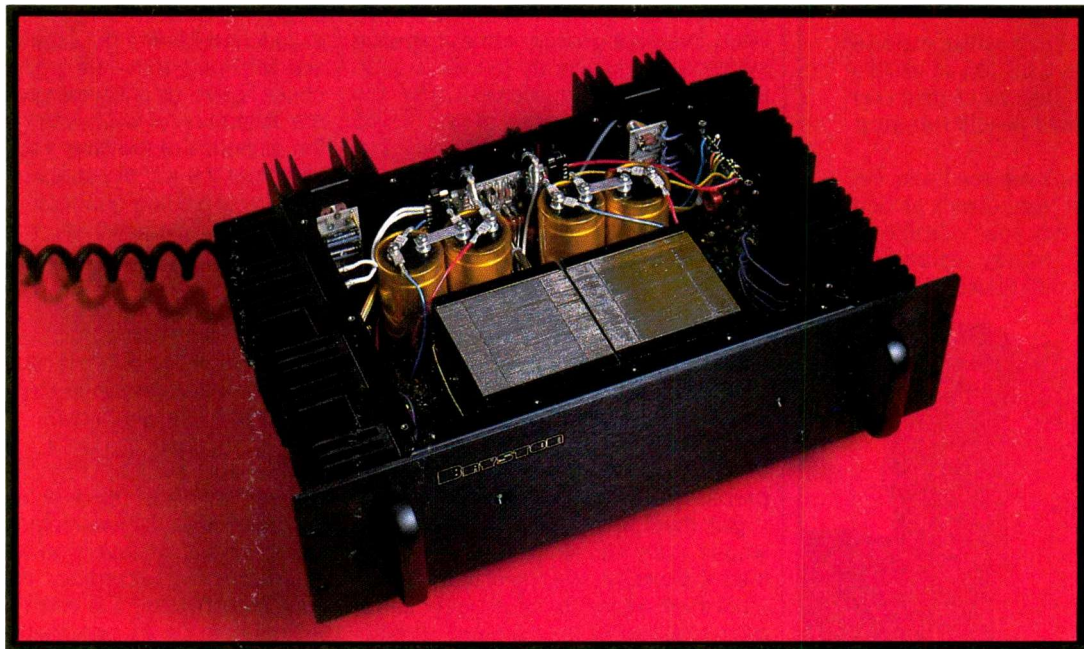
The stereo principle, a plurality of sound channels and a resulting direc-

tional potential, goes back to the 1930s and was actively explored in both England and America—note the experimental 45/45 stereo discs cut back in 1931 for Bell Labs. I heard the original "Fantasia" in its first run, and I was also subjected to numerous (taped) stereo demonstrations in the very early '50s by those who were then actively experimenting. True, stereo didn't work very well at the press demos (I wasn't sold on it for a long time), but this, I suspect, was mostly because of grossly unmatched response between the two channels, especially in the somewhat colorful-sounding loudspeakers of the day, which were not made to match *anything*. There was also the problem of phasing throughout the double audio chain—it was reversed just about 50% of the time, in spite of endless segment-by-segment phase checks. But all that was merely incidental. Information was being piled up, gathered, assimilated; soon the "biggies" began to take notice and do their own developing. My earliest commercial stereo was a shelf of two-track RCA stereo tapes, most of them issued, I think, in 1955. The stereo LP came in 1958.

Moreover, for the stereo disc there was a comprehensive agreement on

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Bryston design philosophy incorporates three general concepts.

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3. Product integrity

MUSICAL ACCURACY

Musical accuracy is reflected throughout all Bryston power amplifiers and includes the necessity for wide-band transient accuracy, open loop linearity ahead of closed loop specifications, and power supply design as an integral part of the overall sonic and electrical performance of a power amplifier.

We have found that a simple carbon film resistor can contribute more static distortion to a signal than the entire remainder of the amplifiers circuitry combined.

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We discovered that under certain actual conditions of speaker loading amplifiers were incapable of yielding high-power transients without distortion.

Each of the various steps or stages in every Bryston amplifier, from the input section to the output section, without exception, are designed to optimize the musical experience.

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We consider this criterion to be exceedingly important. We have applied techniques and materials in our everyday construction of electronic equipment more typically utilized in the military and aerospace industries.

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As may be seen, Bryston takes very seriously the correct functioning and long term reliability of its products.

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Bryston contends that the term 'best' should apply to the honesty pride and courage with which we conduct our business, as well as to the performance of our products.

For this reason, you will not find Bryston's products being cosmetically "updated" on a regular basis merely in order to keep the customer's interest in something 'new'. If we make a change in the circuitry, it will be because, and only because, it yields a worthwhile performance or reliability improvement.

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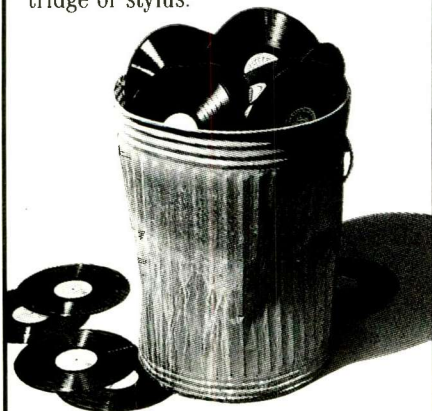
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SHURE®

Multi-channel sound has now had a dozen years of "preparation" after the quad fact—a dizzy way to prepare for anything.

one disc system right at the beginning, so that all stereo discs since then have been interchangeable. Other tentative systems fell quickly by the wayside in the face of this agreement and the clearly superior results of the 45/45 system, both the sonic equality between its channels and the economy of a single groove. Thus, stereo was extremely well prepared and understood ahead of time, even if we had not heard much about it earlier on.

In contrast, stereo's extension into quadraphonic in the '70s was a mess. I do not know where the sudden impulse originated—that is, which large outfit first thought it saw Bigness and Sales ahead—but my guess is that the whole thing caught 95% of the industry unprepared. They never did catch up.

But then again, like the refrigerator whose hum you're conscious of only after it shuts off, the four-channel principle itself began to make better sense after quadraphonic was dead. In addition to that mini-minority of continuing listeners, there was a similar tiny but brilliant group of engineers who also did not quit, as things from their point of view were beginning to look a lot better. And then came digital—but let that rest. In any case, things have gone a long way in these dozen-odd years. Oppositely from two-channel stereo, multi-channel sound has now had a dozen years of "preparation," after the quadraphonic fact—a dizzy way to prepare for anything, but useful nevertheless! Now we are at last set to go, after a fashion, as we certainly were not in the quadraphonic days.

You cannot, if you are young, imagine what it was like. There you were, an experienced and busy record producer or recordist. You had worked in the stereo medium for years and had mastered its esthetics from solo guitar to super-orchestra, for remarkably acceptable results when the home listener got around to your product in his living room or his car. And then suddenly, one day, a Big Boss phones down a message. Hey, start recording in double stereo. No, not next year, 10 minutes from now.

A slight exaggeration, but that was really how it was, if a bit slower by a few hairs. Recently I was on an AES panel chaired by Thomas Frost, long-time and notable producer of classical

recordings (mainly), who was in precisely this position in real life. Our panel touched briefly on quadraphonics, and Mr. Frost, with a bit of tongue in his cheek, gave us a stunningly appropriate illustration of what was going on in the esthetics of the time. He had been assigned the job of supervising the recording of a string quartet in four-channel sound, evidently at a somewhat early stage in the quadraphonic era. Yes, there was a multi-track recorder. There were lots of mikes (I am elaborating on Mr. Frost's quick account, at my own risk) and a place to record. Also the members of the string quartet. But what to do, and how?

Well, in case of doubt, do what is simple and trust to logic. It so happened, Mr. Frost said, that the tape recorder was a four-track machine. There were four players, and this was a quadraphonic recording. What could be more obvious? Put each of the four instruments on its own track, presumably with enough common ambience for a blend and an ensemble feeling. So that is what he did. And that, of course, was the end of his job. Clever idea—you could "mix down" those four instruments by technical means in any configuration you wanted. But the obvious mix was to put one in each channel, as already recorded. In the home, that would mean an instrument more or less in each of the four speaker systems, perhaps one in each corner of the room. Wonderfully logical—four on four on four, all the way. I could almost see the Frost tongue inside the Frost cheek.

I imagine (and here I go on from Mr. Frost to my own speculations) that this recording pleased those in his company who were avid for a good, solid, well-separated (perhaps even discrete?) four-channel demo, and also a recording that would be dramatically different in home listening. This one would be, all right! The number four would extend right through into four amp channels and on into four speaker systems, with the most consummate logic. Could anything be simpler?

So there you'd be, the listener, sitting in the center of your own listening area with four widely spaced stringed instruments surrounding you, probably one in each corner of the room, and the entire music turned precisely in-

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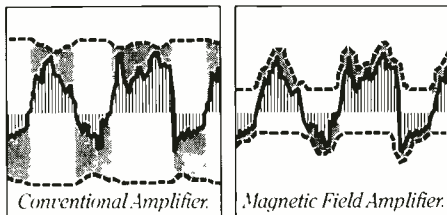
Why the Carver M-500t Magnetic Field Power Amplifier has helped begin an industry trend and how it has stayed ahead of its inspired imitators.



Twice in the last decade, Bob Carver has taught the high fidelity industry how to make amplifiers that give you better performance and value. Both times his bold lead has attracted followers. Still, as evidenced by the current release of the M-500t, Carver sets standards yet unequalled in the audio community.

With its astonishingly high voltage/high output current and exclusive operation features, it is a prime example of why Carver remains the designer to emulate:

- Continuous FTC sine-wave output conservatively rated at 250 watts per channel.
- Produces 600 to 1000 watts per channel of dynamic power for music (depending on impedance).
- Bridging mode delivers 700 watts continuous sine-wave output at 8 ohms.
- High current Magnetic Field power supply provides peak currents up to ± 100 amps for precise control of voice-coil motion.
- Designed to handle unintended 1 ohm speaker loads without shutting down.
- Equipped with infinite resolution VU meters.



Solid line: audio output signal.
Broken line: power supply voltage.
Shaded area: wasted power.
Vertical lines: power to speakers.

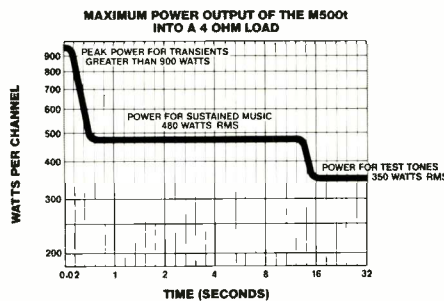
POWER EXPRESSED BY THE DEMANDS OF MUSIC.

The Carver M-500t Power Amplifier responds to musical transients with better than 600 watts per channel of instantaneous peak power through 8 ohm speakers. Well over 900 watts per channel into 4 ohm speakers.

And yet its Federal Trade Commission Continuous Average Power Rating is 250 watts per channel into 8 ohms.

The gulf between the two power ratings represents Bob Carver's insistence that amplifier design should fit the problem at hand. That problem is reproducing music with stunning impact, not simply satisfying a sine-wave test which doesn't even include speakers or sound sources. Hence the seeming gulf between the two ratings.

Bob reasoned that since music is composed of three basic types of power waveforms, those types of waveforms are what an amplifier should be designed to satisfy.



The Carver M-500t delivers massive power at three important output levels.

First there are instantaneous peak transients – the sudden smash of cymbals, drums, or the individual leading edge attack of each musical note. While these waveforms last less than 1/100 of a second, they form the keen edge of musical reality which must be present if you are to realize high fidelity. Though momentary, they also demand a tremendous amount of amplifier power.

Directly following instantaneous transients are combinant musical crests of demand that come from multiple instruments and their harmonics. These long term power demands may last up to several seconds but usually come and go in less than a second. And yet they can tax anything but an exceptionally powerful amplifier.

The third type of power demand is represented by the average power contained in the music, and is approximately one third to one half of the FTC continuous power rating.

At extremely high output current levels, the Carver M-500t not only delivers over 700 watts of instantaneous peak power for instantaneous transients, but can deliver over 600 watts

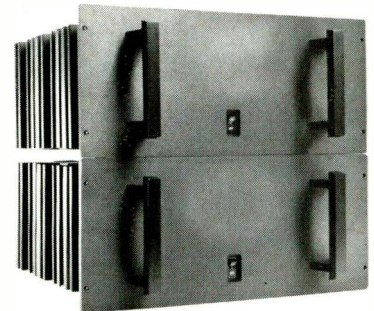
RMS of long term power for demands lasting up to several seconds. **The M-500t provides more power, more current and more voltage than any comparably priced amplifier ever offered.**

THE MAGNETIC FIELD AMPLIFIER VS. CONVENTION.

Audiophiles, critics and ultimately other manufacturers have each accepted the wisdom of Bob Carver's fresh approach to delivering power in musical terms. Yet only Carver has so elegantly translated theory into practice.

Rather than increase cost, size and heat output with huge storage circuits, Magnetic Field Amplification delivers instantaneous high peak and longterm power from a small but powerful Magnetic Field Coil. The result is an amplifier capable of *simultaneous* high current and high voltage that can do sonic justice to the dynamics of Compact Discs and audiophile records in a compact, cool-running design. An amplifier costing considerably less than the ultra-esoteric models which figured significantly into the genesis of its circuitry. For a reprint of the full story of its development as well as a catalog of Carver high fidelity audio components please call or write to us.

Figure 1



This \$7,000 pair of esoteric amplifiers figure significantly into the heritage of the M-500 "t" version circuitry.

Figure 1 above shows a \$7,000 pair of ultra-esoteric mono amplifiers. No expense was spared on their admittedly magnificent but still conventional design and construction.

Figure 2 shows the massive toroid output transformers contained in these prestigious audiophile designs. At 10% regulation, their output current is ± 50 amperes.

All conventional amplifiers are condemned to using this type of design.

DEFINITION.

Figure 2 also shows the patented Magnetic Field Coil employed in the Carver M-500t. Its output current is ± 100 amps at 10% regulation!!!!

Figure 2



Over 40 pounds of toroid coils put out half the current of a single six pound, four ounce Magnetic Field Coil.

DISTINGUISHING FEATURES OF THE CARVER M-500t.

Power is mandatory for dynamic impact and musical realism. And yet power requires control and finesse. While the Carver M-500t isn't the only amplifier to deliver adequate output, it is one of the few that tempers force with protection circuits beneficial to both the amplifier and your loudspeaker system.

◆ These include DC offset, short circuit power interrupt as well as two special computer-controlled speaker monitor circuits which protect against excessive high frequency tweeter input and an overall thermal overload.

◆ The Carver M-500t continuously displays power output through dual, lighted infinite resolution VU-ballistic meters. Meters which can react to musical transients as brief as 1 millisecond.

◆ The M-500t is quiet. Inside and out. Its circuitry has the best signal-to-noise ratio of any production amplifier. Better than -120 dB. And, in spite of its massive output capability, the M-500t does not require a noisy fan to dissipate heat. Thanks to the cool running Magnetic Field Amplifier circuitry.

◆ No other amplifier in the M-500t's price or power ranges is capable of handling problematic speaker loads as low as 1 ohm. Whether required by certain brands of speakers, or inadvertently derived by pairing too many low impedance speakers at one set of output terminals, all conventional amplifiers simply shut down or blow their fuses when faced with this condition.

◆ In stereo use, both channels of the M-500t can actually borrow from each other during unequal output demands. In addition, Carver amplifiers have pioneered phase inversion circuitry which takes advantage of the in-phase (mono) characteristics of bass to essentially double available power supply current at low frequencies.

◆ Finally, the Carver M-500t can be used in a bridged mode as a 700 watt RMS per channel mono amplifier without any switching or modification.

MUSIC IS THE FINAL PROOF.

Were you to buy a power amplifier solely on features and performance specifications, painstaking comparison would inevitably lead you to the Carver M-500t.

But we are sure that your final judgment will be based on musicality. It is here that the M-500t again distinguishes itself.

Bob Carver has carefully designed the M-500t to have a completely neutral signal path that is utterly transparent in sonic character. The result is more than just musical accuracy. It means a total lack of listener fatigue caused by subtle colorations sometimes exhibited by conventional amplifier designs, regardless of their power rating.

It means a veil is lifted between you and your musical source as the most detailed nuances are revealed with realism, believability and delivered with stunning impact.

VISIT YOUR CARVER DEALER FOR A SURPRISING AUDITION.

We invite you to audition the Carver M-500t soon. Against any and all competition. Including those who are only now embracing the principles which Bob Carver has refined over the last several years.

We doubt that you will be surprised when the M-500t lives up to the claims made in this advertisement. What will surprise you is just how affordable this much power, musicality and accuracy can be.

SPECIFICATIONS: Power, 251 watts per channel into 8 ohms 20Hz to 20kHz, both channels driven with no more than 0.15% THD. Instantaneous Peak Power, 1000 watts into 2 ohms, 950 watts into 4 ohms, 600 watts into 8 ohms. Longterm RMS Power for Music, 500 into 2 ohms, 450 into 4 ohms, 300 into 8 ohms, 1000 watts bridged mono into 4 ohms, 900 watts bridged mono into 8 ohms. Bridged Mono RMS Continuous Power, 700 watts continuous into 8 ohms. Noise -120 dB IHF Weighted. Frequency Response, $\pm 0-3$ dB 1Hz- 100kHz. Slew Factor, 200. Weight, 25 lb. Finish, light brushed anthracite, baked enamel, black anodized.



CARVER

POWERFUL

MUSICAL

ACCURATE

We never got beyond the sensational demo disc into a more mature and more reasonable application of multi-channel sound.


side out! The Inverse Concert Hall, with The Obverse String Quartet playing inward, toward the center, instead of outward, toward the audience.

How many can you get, I ask you, if you are considering the music itself, and the performance of the music for sound reproduction? It was a quadra-

phonic stunt; as far as the music-minded listener is concerned, the players could have been standing on their heads or maybe performing upside down on the ceiling. These tricks would be worthy of Paganini himself (who did worse), but do they really belong in serious music?

If you think I'm taking a special case, remember the much bigger quadrasonic recording under Boulez of Bartók's "Concerto for Orchestra," done quite literally "in the round" at the actual recording session, with Boulez in the center, nearly breaking his neck trying to conduct all the musicians who surrounded him in the flesh. It was done that way precisely so that (it was hoped) you would be able to hear the music *exactly the same way*, inside out, in your own Inverse Concert Hall. There must have been plenty more examples, others equally odd in different ways and, perhaps, equally unsuited to the actual sound we were to hear. Everybody improvised and in a dreadful hurry, all too often without a sensible thought as to the most appropriate use of the new medium. We never got beyond the sensational, the demo disc, into a more mature and reasonable—and hence a widely satisfying—application of multi-channel sound. This was true not only for classical music but also for pop and jazz, which could have had *more* tricks than most quadrasonic releases brought forth. They were curiously conservative, as I recollect it.

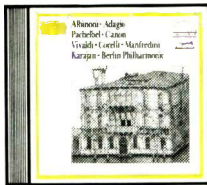
I am not, I hope, being stuffy. It isn't easy to apply optimum good taste to a brand-new medium, especially where, as in classical works, hundreds of years of live-performance tradition must be somehow accommodated. Of course we must adapt in any type of recording, including plain stereo. A recorded reproduction is *never* the same as a live performance, even if miked "live." But we do this, necessarily, within a historical context and within the traditions, whenever these apply. Sonic experiments can be heady and exciting but they are ephemeral if merely stunts.

So quadrasonic flopped for good reasons: Too many competing systems, unpleasant fights over them, failure to deliver the advertised engineering, both in terms of sonic fidelity and the supposed directionality. Worst of all, there was a hopelessly confused and jumbled esthetic, for every sort of music. But the idea of an extended surround stereo, or a differentiation of all-around point sources, will not die, because it is, very simply, a good idea. Potentially. We shall see. 

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BEHIND THE SCENES

BERT WHYTE

THE GOOD AUD DAYS



Illustration: Steve Dirrimo

With justifiable pride and appropriate ruffles and flourishes, this issue celebrates the 40th anniversary of *Audio* magazine. When this publication was launched in 1947 as *Audio Engineering*, it was coincident with what is generally regarded as the beginning of the high-fidelity era. Ever since, this journal has faithfully chronicled the spectacular growth and remarkable technical advances in the field of audio.

Forty years ago, people in this country were listening to music on 78-rpm records. These fragile discs provided just four minutes of music per side, so the only way to hear long works without leaping to the turntable 15 times an hour was to use cumbersome record changers. These players relentlessly attacked the record grooves with several ounces of stylus tracking force to the accompaniment of great amounts of hissy, scratchy, crackling surface noise. Even the most wide-eyed visionary could not have foreseen that 40 years hence, we would be listening to music from little silvery discs that provide nearly 75 minutes of playing time with no surface noise whatever, discs that are tracked by a beam of light!

For the first several years of its existence, this journal was read mostly by audio professionals in the broadcast and motion picture fields. (I myself discovered *Audio Engineering* in the Georgia Tech library in 1949; soon I was avidly reading the back issues and enjoying the interesting observations of Edward Tatnall Canby!) A few years later, strictly by happenstance, some very zealous audio hobbyists discovered the superior quality of loudspeakers, amplifiers, and other equipment used in broadcasting and motion pictures. Thus the "hi-fi nut" was born, later to be dignified by the appellation "audiophile."

Many old-timers rather wistfully recall the early hobbyist days of audio. There was indeed an aura of excitement, as new advances and developments provided an ever-higher degree of fidelity in the reproduction of music. There was also an element of camaraderie—somewhat akin to the early days of sports cars, when aficionados would wave to each other on the road.

In the early '50s we had "audio fairs," where manufacturers could demonstrate exciting new products to hordes of eager audiophiles. One

fondly remembers that if you owned a Fisher tuner, you could talk about your unit with Avery Fisher himself. Similarly, if you used Bozak loudspeakers, Rudy Bozak was on hand to answer your questions. If you were lucky enough to own McIntosh or Marantz amplifiers, Frank McIntosh and Saul Marantz were always willing to discuss their circuitry. It is this kind of up-close and personal contact that makes people talk about the "good old days." But it has long since faded from the scene, as have the audio fairs and most consumer shows. With the demise of the Terry Rogers audio shows some years ago, an era ended. It is a shame, really, that today's audiophiles have little opportunity to savor the fun and excitement and new product introductions once provided by these shows. They still exist in foreign climes, most notably in England, where the annual Heathrow/Penta show is held.

What kind of equipment did we use in the old days? It must be noted that in the early years of *Audio*, there were no hi-fi salons or dealer stores such as we have today. There was no place you could buy commercially manufactured home loudspeaker systems; there was no AR, no B & W, no Polk, or any other. It was, of necessity, the do-it-yourself era, so we all built big bass-reflex enclosures, lined them with Tuflex or carpet underlay, and used such things as Altec or James B. Lansing 15-inch theater woofers, crossed over at 800 cycles to multi-cellular-horn compression tweeters! If you were really lucky, you were able to get the great Western Electric 713C driver coupled to a 12027 cast-aluminum sectoral horn, which could respond to 15 kHz. Eventually, some new speaker drivers appeared on the market and began to supplant all the old theater equipment. Not long after that, complete speaker systems started to become available.

A vogue for all sorts of horn-loaded enclosures began. *Audio* editor C. G. McProud designed an efficient horn system which was constructed by quite a number of audiophiles. A huge, bathtub-like, back-loaded horn was made for the Jensen triaxial loudspeaker. For electrical-engineering students, it was practically a rite of passage to arduously construct their own Klipschorns!

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—REVUE DU SON, foremost French stereo magazine.

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The next time you gripe about the list price of a Compact Disc, remember that in 1955 an open-reel tape cost nearly \$19!

Some of us favored infinite baffles, and in 1954 I decided to build a real blockbuster speaker. Even in those early days I was a firm believer in the value of anti-resonant enclosure construction. I made a huge enclosure with 16 cubic feet of internal volume. Each enclosure wall was made of two ¾-inch-thick pieces of plywood with an inch of space between them. In the manner proposed by Gilbert Briggs of Wharfedale, this space was filled with fine, dry sand. The driver complement was two 15-inch Wharfedale woofers, two 8-inch Bozak midrange cones, and an array of eight 2-inch Bozak cone tweeters. Crossovers were at 350 and 3,500 Hz. This behemoth weighed more than 600 pounds; driven by 75 watts of McIntosh power, it put out one helluva sound, with especially clean, non-boomy bass. Brute force indeed, but sand-filled panels were (and still are) a fairly effective anti-resonant construction.

Back in the old days, amplifiers were as controversial a subject as they are today. The 30-watt Brook amplifier using 2A3 tubes was the top choice among devotees of triode design, while the 50-watt McIntosh 50W2 amplifier was the darling of those who fancied the 6L6 beam pentode tube. A little later, Marantz was setting the standards for triode design, while McIntosh still reigned supreme in the higher powered beam pentode camp.

A few years later, there was a lot of interest in building amplifiers from kits. Heathkit sold a lot of them, but the most prominent name in amplifier kits was David Hafler, whose Acrosound design was very highly regarded for its Ultralinear transformer. Audiophiles were also building Williamson amplifiers, a British design, and for years the Partridge Transformer Co. of England ran an ad in *Audio* extolling the virtues of using their product in this type of amplifier. When the first transistor amps came onto the market, they were scorned and castigated for the harsh, strident sound they produced. Of course, things are different now, but many vacuum-tube amplifier aficionados still think transistors are the invention of the devil!

Oddly enough, until well into the hi-fi era, turntable and tonearm design lagged well behind amplifiers and


loudspeakers in terms of technology. About the best we could do was use a Rek-O-Kut turntable with a hysteresis synchronous motor and a Pickering arm and cartridge. To cut down on the omnipresent turntable rumble, we would employ the "high mass" approach. We would use a ¾-inch-thick piece of steel boilerplate, cut out mounting holes for the turntable and arm with an acetylene torch, and then mount this massive plate on a very heavy wooden plinth! Later on, we modified the plinth by mounting it on hydraulic dampers. Still later, we abandoned the massive turntables for one of the first suspended turntable designs, pioneered by H. H. Scott. Also, despite the fussiness of tuning its demodulator, we used the Weathers FM arm and cartridge because it permitted tracking vinyl records at 1 gram!

There have been many milestones, many innovations and breakthroughs, along with many fads and foibles in the 40 years that *Audio* has been reporting on the hi-fi scene. The ubiquitous receiver exists because of the initially maligned transistor; in its tube embodiment, the receiver was a failure, due, of course, to overheating. Quadraphonic sound was a flop, partially because there were too many competing formats thrust upon the market before their technologies had been properly engineered, but also because placing discrete orchestral sounds behind the listener violated 300 years of traditional concert performances. Today, there is obviously a minor revival of surround sound, with the popularity of Dolby Surround-encoded videotapes. However, this is in a somewhat different context. Make no mistake: I think it is inevitable that we will eventually employ some sort of multi-dimensional sonic augmentation to simulate the experience of listening to music in a concert hall.

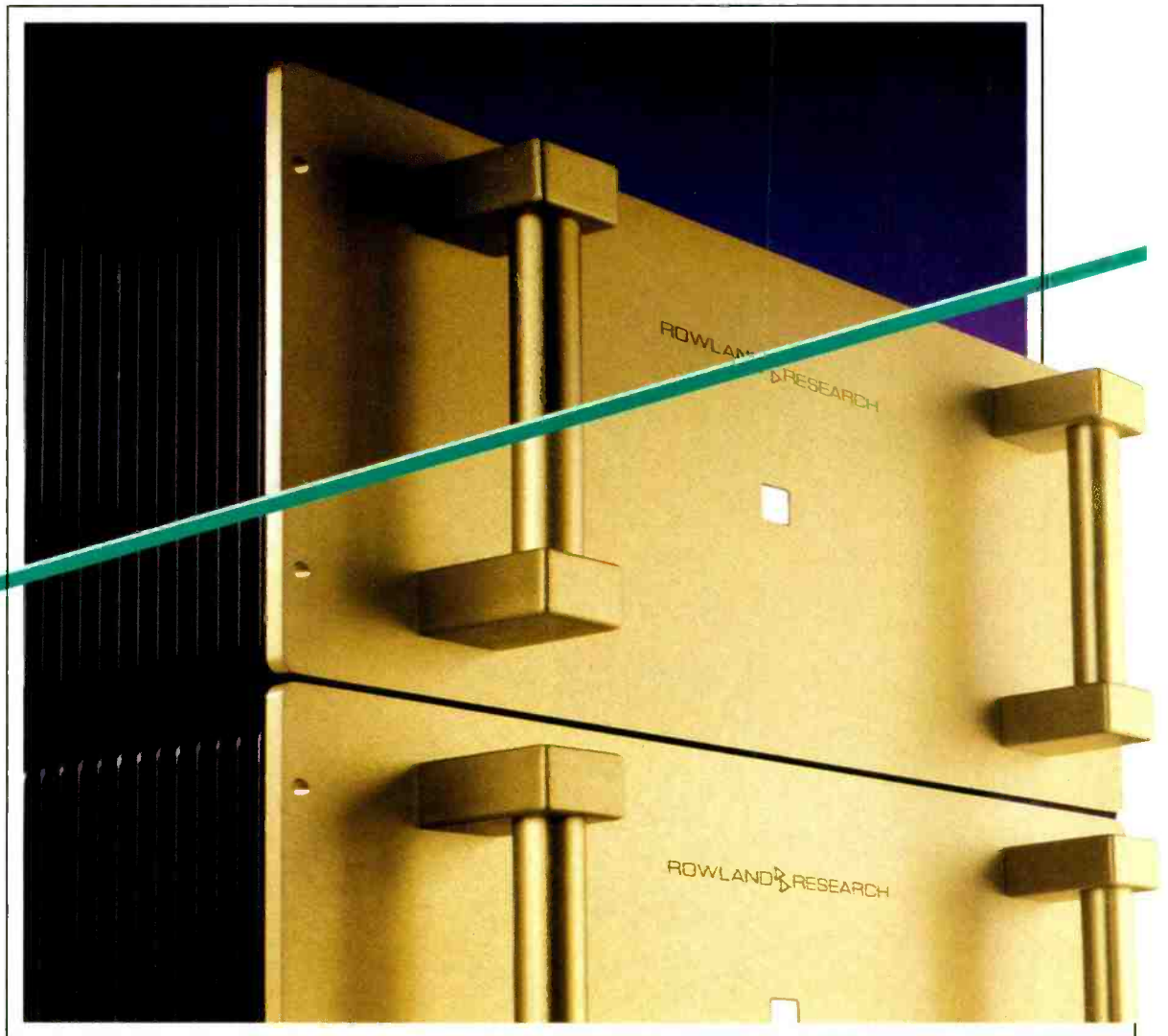
It is sad to note that in the 40-year history of hi-fi, many respected companies that helped to found the industry have vanished from the audio scene. However, surely the saddest and most dramatic tale of all is the birth and death of the prerecorded open-reel tape, all within a span of 32 years. I am particularly distressed by this, since I was directly involved with its genesis. For perhaps a year or two before 1954,

there had been several small companies issuing prerecorded open-reel tapes. In 1954, 16 executives of RCA, including some from the broadcast and record divisions, were at Murray Crosby's laboratory in Syosset, Long Island, to hear a closed-circuit demonstration of the Crosby FM stereo multiplex system. I had arranged the session for Murray, initiated by the request of my friend Leopold Stokowski to David Sarnoff, head of RCA. The material for the closed-circuit broadcast was stereo tapes I had recorded with the Chicago, Detroit, and Minneapolis symphony orchestras. Now, these RCA officials had never heard stereophonic sound, let alone stereo FM multiplex! They were simply bowled over by it, and while they never did anything about the Crosby multiplex, the stereo sound inspired the record people to issue the first major-company, prerecorded open-reel tapes. Number one was the famous Fritz Reiner/Chicago Symphony recording of Richard Strauss' "Also Sprach Zarathustra." The format was half-track stereo—two tracks running in one direction. As I write this, I have RCA tape GCS-6 next to the typewriter. This was the sixth prerecorded open-reel tape RCA issued, a recording of Charles Munch and the Boston Symphony playing "Symphonie Fantastique" by Berlioz. Clearly printed on the tape box is the price, \$18.95. Now, the next time you gripe about the \$15.99 list price of a CD, translate that 1955 tape price into today's dollars!

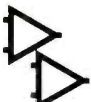
Back then, tape was the only way you could hear stereophonic sound, and for 32 years—well into the stereo LP era—thousands of great open-reel tapes poured forth from the duplicators. Alas, the encroachments of prerecorded cassettes and, more especially, the technical superiority of the Compact Disc put the nails in open reel's coffin. The Barclay-Crocker tape-duplicating people made a most valiant effort to keep open-reel tape alive, but in 1986 they too ceased operation. This signaled the final demise of a fine music format that was clearly the victim of advancing technology.

So congratulations to *Audio* on its 40th anniversary. This writer is glad to have participated in a lot of audio developments in that span of time. 

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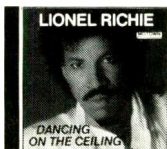
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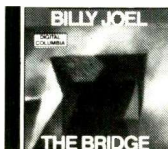
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343624. Wynton Marsalis Plays Trumpet Concertos—Haydn, etc. (Digital—CBS Masterworks)
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345553. Branford Marsalis—Romances For Saxophone. (Digital—CBS Masterworks)
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348649. The Pachelbel Canon And Other Digital Delights. The Toronto Chamber Orchestra (Digital—Fantone)
349373. Beethoven: Symphony No. 9 (Choral)—Bernstein, NY Phil. (CBS Masterworks)
- 314997-394999. Stevie Wonder's Original Musiquarium I. (Tamla)
348110. Buddy Holly—From The Original Master Tapes. (Digitally Remastered—MCA)



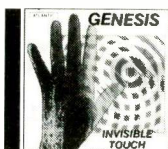
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ENDING THE REIGN OF ERROR



Error protection is one of the great opportunities of digital audio storage media such as the Compact Disc. It offers something that was never possible with analog media—the chance to correct errors and repair damage.

When you scratch an LP record, the grooves are irrevocably damaged, along with the information contained in them. Forever after, there will be a click or pop as the damaged part of the groove passes underneath the phonograph stylus. But when you scratch a CD, the nature of the data on the disc and the player's design offer you a second chance. The data on the disc includes a special error-correction code, and your player uses this to correct for damaged data. Thus, it strives to deliver the original information intact, and it performs this error correction each time the disc is played.

Let's examine some fundamentals of error protection. To start off, consider these two messages:

1. Turn to page 345 in your hymnals.
2. Let's party! Let's party!

The first message is like the information in an LP groove, and the second is like the data in a CD pit track. Now, lay a finger vertically across the two mes-

sages, to represent a scratch. You'll observe that part of the first message is irrevocably gone, whereas the second message can be reconstructed because we have used redundant data to repeat it. In fact, redundancy is the essence of error protection. This is extra information, derived from the original data, which is not essential (in the absence of errors) to the message itself. In general, the greater the redundancy, the greater the error protection. By comparing redundant messages, you can overcome the effect of the error. Note that we haven't *prevented* the error; we have simply ensured against its effect. Clever, eh?

Of course, even the most clever of ideas has its limitations. As you lay more and more fingers over the message, reconstructing it becomes more and more difficult. Thus, the severity of the error is an important factor in our ability to make corrections. Also, if you lay your finger horizontally across the page, you might completely obscure the entire line, destroying both the message and its redundancy. Therefore, the nature of the error plays a role too. In addition, we should note that error correction demands a price; in this case, including an error-correction

code doubles the amount of storage space required.

On the negative side, error protection is not only an opportunity but an obligation. Digital audio on a Compact Disc might require storage of 15 billion bits, which amounts to about 100 million bits per square centimeter. With such great data density, even the smallest speck of dust would wipe out a considerable number of bits. This points out the fact that, in reality, the type of error correction utilized has to be a great deal more sophisticated than our simple redundancy scheme.

We should also consider the vulnerability of digital data. Even one bad bit could wreak havoc. For example, if the digital word 0000000000000000 (representing silence) was misread as 1000000000000000 (representing a pretty loud level), a loud click would result. Highly unacceptable! Thus we have no choice; for satisfactory digital audio storage, error protection is essential. Data on a CD must be error-protected before the disc is made, and a CD player must be able to correct errors during playback.

But before a CD player can correct errors, it must detect them. While this might sound obvious, the problem can be considerable. If presented with a data word, could you tell whether or not it contained an error? For example, does 1100101000011110 contain an error? Unless you are psychic, there's no way to tell. I could transmit the message twice:

1100101000011110 110010100011110
and close examination would reveal a difference between them. Obviously, both cannot be correct, but which message is right? I could transmit the message three times, with two identical data words and one slightly different, and you might have a good suspicion of which was correct. But would you be sure? What if I repeated the message three times and all three versions were different?

Obviously, simple repetition is an inefficient way of going about error detection and correction; we need to devise a better method. Redundancy is the best way, but we must optimize it to limit its inherent penalty of overhead. This leads to the development of elaborate error-correction codes which make very efficient use of redundancy

Illustration: Carol O'Malia

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by coding the information in certain ways. Error-correction codes use special algorithms to create redundant information, balancing the information between the twin tasks of detection and correction.

What is a code? A code is simply a way of representing information. Common examples include Morse code, ASCII (American Standard Code for Information Interchange), and the ISBN (International Standard Book Number) code. An ISBN number is more than just a series of digits. For example, consider the ISBN number 0-672-22388-0. The first digit designates the country of origin; for example, 0 is for the U.S. and some other English-speaking countries. The next three digits comprise a publisher code, and the next six make up the book number code. The last digit is particularly interesting; it is a check digit with a value derived from the values of the previous digits. This allows us to verify the correctness of any ISBN by adding together the first nine digits, in modulo 11 arithmetic, and comparing them to the last digit.

In practice, the redundancy contained in digital audio protection codes acts very much like this last digit of the ISBN. Specifically, the redundancy often takes the form of a parity bit, an extra bit chosen according to a predefined rule, using the message as the basis. For example, in an odd-parity scheme, the parity bit is chosen so that the number of ones in the message, including the parity bit, is odd. A word such as 11010100 would have a parity bit of 1 appended. When the word is read from a storage medium, we can use the parity bit to perform a simple check on the word's validity. In this case, if the number of ones in the received message were even, we would know an error had occurred, though not which bit was wrong.

To increase their detection reliability, parity codes can be made more complex. In some codes, data is divided into blocks and parity bits are added to each block. Consider the example in Fig. 1. In addition to the 16 data values, nine extra parity values are created and appended. They are placed at the end of each row and column, and each represents the sum of that row or column. Note that a parity value is also

10	04	04	02	
05	04	11	02	
01	12	06	03	
00	07	12	06	
16	27	33	13	89

Fig. 1—Original data block (A) and same data block with parity values added (B).

10	04	04	02	20
05	04	11	02	22
01	[18]	06	03	22
00	07	12	06	25
16	27	33	13	89

Fig. 2—Error detection and correction, using parity values.

given for the parity row and the parity column.

If an error occurs in any data (or parity) value, the error can be easily located and the correct value can be easily calculated, using the other data present. For example, suppose that the data block shown in Fig. 2 is received. As we calculate each parity value at the receiving end, and check it against each transmitted parity value, we observe a disagreement. In fact, there is a disagreement in both a row and a column parity value. The intersection of the row and column points to the error. Furthermore, we can now substitute the correct value, thanks to the transmitted parity values. The data in the block is thus made substantially more reliable than it had been. Of course, instead of 16 values, 25 are now required in order to accommodate the error code.

Using parity, the system can detect and correct errors, and supply good-as-new information. However, as I've mentioned, the performance of the error-protection system depends on the nature of the error. What if a large error obliterated both the data and its parity? There would be nothing left from which to reconstruct the message. It is thus important to understand the nature of the errors and devise protection accordingly.

Errors can occur in large groups, called burst errors, or in isolated instances, called random errors. For example, a badly formed pit would cause a random error, whereas a greasy fingerprint would cause burst errors. The CD must guard against both kinds.

Interleaving is employed to protect against the all-too-likely occurrence of burst errors. Interleaving might be thought of as shuffling a deck of cards; data words are redistributed in the bit stream during recording so that consecutive words are never adjacent in the medium (such as a dust particle on the disc) might prevent the successful reading of a number of adjacent values. However, upon de-interleaving, the shuffled words are placed back in their original and rightful positions in the stream, and the errors are scattered in time. Thus isolated, they are much easier to correct. Figure 3 shows what happens to a data dropout with-

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Like shuffling a deck of cards, data interleaving scatters errors in time, making them more easily correctable in playback.

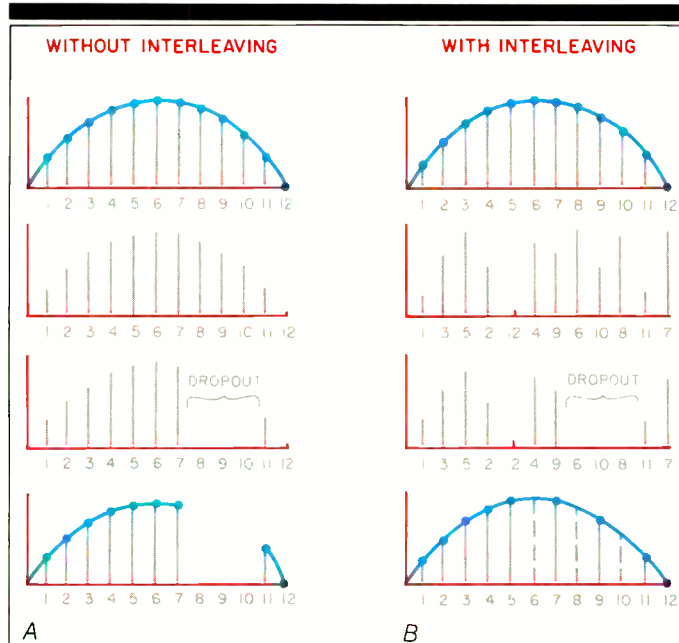


Fig. 3—Without interleaving (A), large dropouts (burst errors) cause irretrievable data losses. With interleaving (B), the effects of dropouts are distributed, allowing errors to be corrected or concealed.

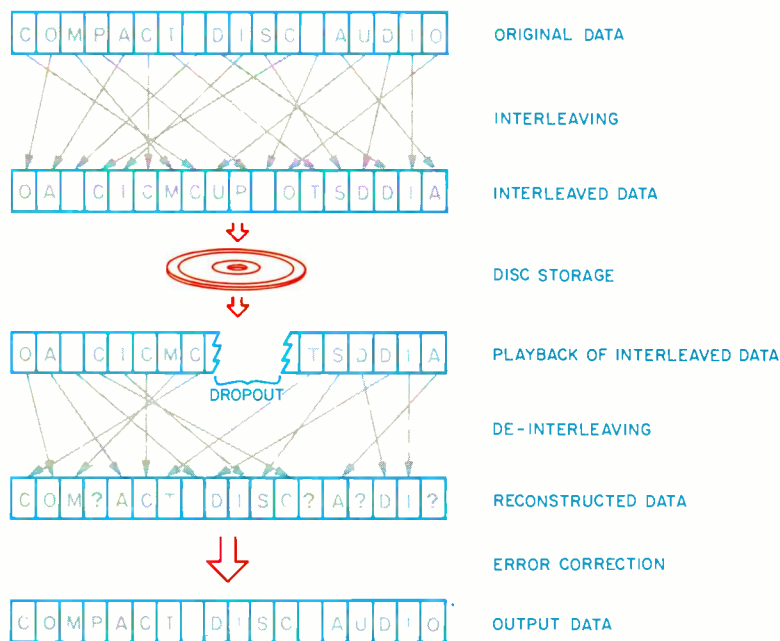


Fig. 4—A more detailed look at how interleaving works.

out and with interleaving. In the latter case, a large defect in the medium is distributed following de-interleaving. Because consecutive data bits are stored far apart, any errors will be scattered, becoming more like random errors—which are more easily corrected.

Figure 4 shows how interleaving and de-interleaving works. It appears complicated, but simply delaying the data with differing delay times during recording, and delaying it again (in a complementary manner) upon playback, accomplishes the job. Cross-interleaving carries the idea one step farther; data is interleaved, then interleaved again. This adds extra robustness, providing correctability for larger errors. The nice part about cross-interleaving is that while error protection is enhanced, the amount of redundancy is not increased.

While total error correction is theoretically possible (short of catastrophic failure of the system), it would be impractical to implement. With real-life digital audio systems, some errors are too massive for the error-correction scheme, and we must fall back on error concealment. Using error-detection results to pinpoint massive errors, interpolation methods utilize valid data surrounding the error to calculate a new value to substitute for the error. Unlike correction, in which the new value is identical to the original, interpolation is only a best guess. But with a good interpolation scheme, an uncorrected error can be made virtually inaudible.

In worst-case scenarios, where the error is so massive that even error concealment would fail, we choose to mute the audio signal. (After all, brief silence is preferable to a burst of distortion.) By swiftly attenuating the signal before and after the mute, even these catastrophic errors are often made inaudible to most listeners.

As we have seen, error protection consists of several kinds of processing tasks. Errors must be detected and then corrected (if possible), concealed, or muted. To accomplish those chores, the signal must be carefully encoded with detection and correction codes, and interleaved. It's a lot of work. Next time you're eating something greasy and listening to CDs, I hope you'll appreciate it. **A**

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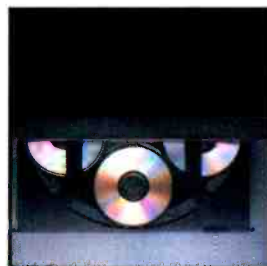
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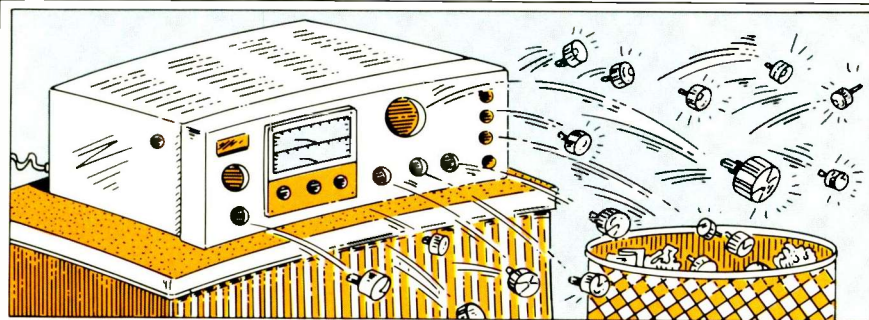
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NO KNOBS IS GOOD KNOBS



The Shape of Digital

Digital control of analog circuits is reshaping audio components. As the circuits being controlled become digital too, the process will accelerate.

Tuners have been digitally controlled for the longest time, so they show the most change. Knobs and dials have given way to up/down buttons and digital displays, better suited to digital's all-electronic, step-by-step nature. Because digital circuits can be programmed to perform complex tasks, we have new functions such as seek and scan; also, station memories, easier and cheaper to implement when they hold numbers rather than dial positions or capacitances, have become more common. However, fudge-factor functions (such as the ability to tune a bit off-frequency to avoid a strong adjacent-channel signal) involve a bit of extra circuitry and therefore are fairly rare. Because digital circuitry lets us leap from one point to another, there may be a keypad for entering a station frequency directly. And because digital circuitry also permits one button to perform different functions, the station-memory buttons often double as the direct-entry keypad.

These changes are gradually being echoed in other components. Note, for example, the gradual replacement of volume knobs by up/down volume buttons in car stereos and home audio components, and the complex functions that can be programmed into CD players. There are plenty more such changes still to come.

Today's displays, for example, show only the limited information preprogrammed for it: Station-frequency numbers change, but most other information is shown by illuminating words and symbols built into the display. Tomorrow's displays may be capable of showing any words or symbols transmitted to them. Those could include error messages ("Speaker load below 2 ohms," "Antenna disconnected," or "Signal overload"), diagnostics ("Left-channel output fuse blown"), or useful information ("104.3—WNCN—Classical" or "The sidemen on this session included . . .").

With digital technology, the controller need not be anywhere near the circuit controlled. One obvious result of this is remote control; we're even getting two-way systems, such as B & O's Beosystem 5500, whose controller can not only set system functions but also read and display

whatever functions have been set directly or from other remotes. A less obvious benefit is that the circuit layout inside a component need no longer dictate the layout of the controls. This leaves the designer free to group controls according to the best dictates of human engineering (or to ignore ergonomics and concentrate on style).

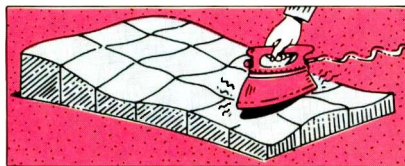
Eventually, most of the actual signal-handling circuits may be in featureless boxes that can be kept out of sight, and all control will be remote. Cases in point include a preamp from Meitner and car-stereo systems with control heads in the passenger compartment and the works hidden in the trunk (a CD changer in Sony's case, CD and cassette changers in Alpine's). When the parts of the system we see and touch contain only control circuitry, they can get smaller, and their shapes more fanciful. On the other hand, as the signal-handling circuitry itself goes digital, it might grow small enough to fit back into the controller.

More and more, digital control and display systems are becoming simpler, cheaper, and more versatile than analog. But they're not always the best way to go. Analog meters are more precise than the crude steps of digital bar-graph displays; they're better at showing trends and easier to read when monitoring fast changes than numerical displays can be. Analog controls still beat digital at providing a smooth range of response, as in record-level and volume controls. Some of the latest remotely controlled amplifiers and receivers, I note, have abandoned up/down volume buttons in favor of motor-driven analog volume knobs.

Flatter Visual Response

For a year or two, we've been running "three-dimensional" graphs of power versus frequency versus distortion with some of our amplifier and receiver tests. In the future, we'll be doing more. You may, however, have noticed that the 3-D graphs in our January '87 and subsequent issues have looked a bit flatter than our previous ones. This is because we have shifted from using a linear to

a logarithmic THD scale in plotting these graphs (we already used log scales in some two-dimensional graphs). Using linear scales exaggerates changes in distortion.



For Cryin' Out Loud

The makers of Hall's cough drops have a swell way to drum up business, at least in Japan. They hold an annual Shouting Contest, awarding 50,000 yen (nearly \$300) to each year's loudest man and woman. The loudest woman in last year's contest hit 109.3 dB SPL; the loudest man reached 117.7 dB SPL. (Years ago, a researcher got even louder readings—from children.)

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FEDCO (MEMBERS ONLY)
Santa Ana
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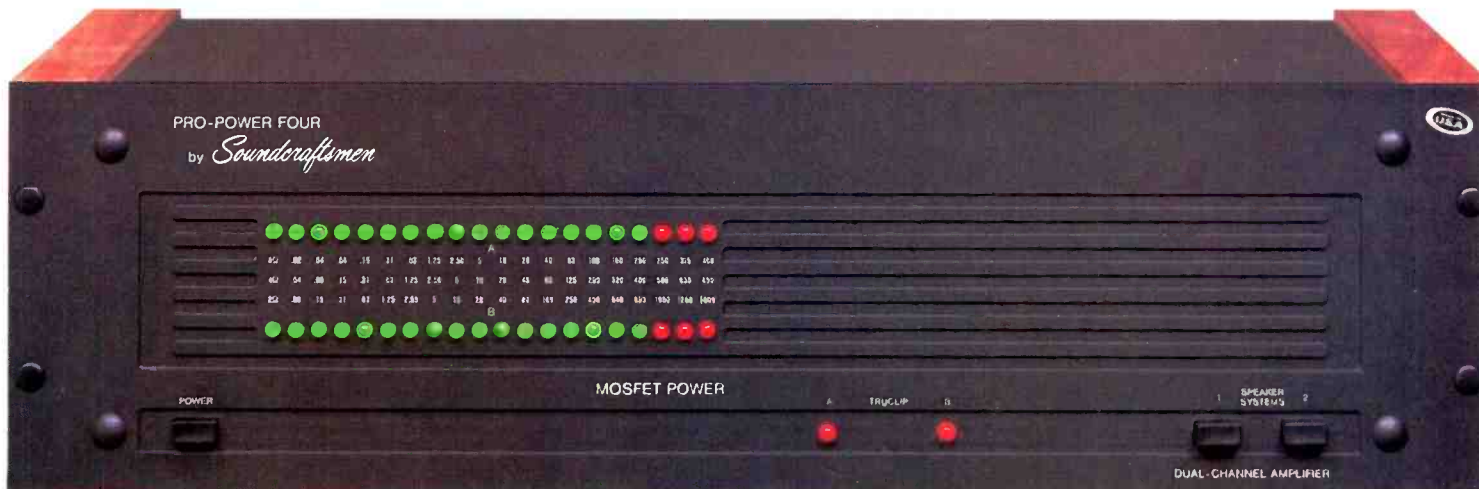
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8

CAR AMPS TESTED

Leonard Feldman and Ivan Berger

For *Audio's* first comparative test of car stereo amplifiers, I was asked to measure the laboratory performance of eight models, all from companies that also produce highly regarded home audio equipment. These amplifiers range in power from 35 to 120 watts per channel when driving 4-ohm loads.

As the technology of mobile amplifiers advances, music lovers have come to expect the same kind of sonic excellence from their car systems as from their home components. That being the case, the second phase of these tests (conducted by *Audio's* Technical Editor, Ivan Berger) involved evaluating the eight amplifiers when they were powering high-quality home speaker systems. It can be argued that such a test does not duplicate real-world conditions, but it enabled Ivan's listening panel to judge the subtle sonic differences that exist among the various amplifiers tested.

Before discussing these amplifiers individually, let's look at some of the features that most or all of them have in common.

The power an amplifier can develop across a given load impedance depends on the power-supply voltage available at the amplifier's output stage. Car amplifiers draw from a "12-V" electrical system which may actually deliver anywhere from 10 to 14.4 V. The standard voltage used for car stereo measurements, 13.8 V, is only sufficient to develop about 6 watts across a 4-ohm load. And since that voltage is d.c., it cannot be raised by a transformer.

The amplifiers built into most car stereo head units simply live with this limitation, which is why most are rated at 6 watts per channel, or less, at acceptable distortion levels. For high-powered car amplifiers such as those tested here, the battery supply is used to drive an oscillator, whose alternating voltage can then be raised by a transformer to the potentials needed. The oscillators used in car amplifiers typically run at 20 to 30 kHz because transformers for such high frequencies can be very small—a distinct advantage in mobile installations.

In addition to power, input, and output connections, car amplifiers usually have a "remote" terminal, not found on home amplifiers. This terminal is connected to a 12-V line that is switched on whenever the head unit (tuner/cassette, receiver, or CD player) is turned on. When 12 V is not present on this line, the amplifier turns off, ensuring that it won't drain your battery when you're not using your sound system. Some head units have connections for this purpose; those that do not will probably have a power-antenna switch which may also be used to turn the amplifier on. If neither of these is provided on your amp, you should connect the remote terminal to a 12-V source that becomes available

Photographs: David Hamsley



AS TECHNOLOGY ADVANCES, music lovers have come to expect the same sonic excellence in their cars as they enjoy in their homes.

only when your car's ignition switch is turned on. (Never connect the remote terminal of a car amplifier directly to the car's battery, or the amp will be on all the time and will drain the battery in short order.)

Many car stereo amplifiers, especially lower powered ones, have DIN input jacks wired to match the same manufacturers' head-unit connections (which usually means that they'll match no other head units). All of the models we tested, however, employ standard RCA-type phono jacks for input. With two exceptions, these amplifiers also have screw terminals for speaker-output and power connections. (The Linear Power uses special plugs, while the Proton has a harness of wires for these connections.)

Many manufacturers emphasize the importance of using adequately heavy wiring, suggesting #10 wire for power and ground connections, and at least #12 wire for speaker connections. The screw terminals on the amplifiers we tested will accept these wires, and sometimes even heavier ones (such as #10 wire for speakers).

Most of the models tested have three forms of circuit protection built in—thermal protection, over-voltage protection, and protection against short circuits. All but two (the Infinity MRA-150 and the Soundstream D200) have built-in power-line fuses, but even the two that include no fuses recommend that external fuses be wired in series with the line to your car battery. Speaker fuses were supplied only with the Hafler amplifier, but of course you are free to install fuses in series with wires leading to the speakers for any of the other amplifiers, if you so choose.

Measurements and Specifications

In Table I, my measurements for each amplifier are noted alongside each manufacturer's published claims. While there are well-established measurement standards for home amplifiers, the standards that most manufacturers of car amplifiers use are not nearly as well established or as consistently followed. For example, the FTC's power rule mandates that power output for home amplifiers be stated on a per-channel basis, with end frequency limits, maximum expected distortion levels, and load impedances all clearly spelled out. Through what may well have been an oversight on the part of the FTC, the rule does not apply to car audio equipment. As a result, many car amplifier makers continue to quote "total power output," the sum of power available from both stereo channels (or, in the case of a four-channel amplifier, the sum of all four). It is to the credit of all eight manufacturers whose products I tested that their technical specifications follow the FTC guidelines—even though some do list total power in their promotional material.

Operating characteristics other than power output are listed less uniformly, and I have placed an asterisk (*) next to the manufacturers' specifications if they are quoted on a different basis than my measurements are. For example, five manufacturers quote sensitivity as the input voltage required for full rated output, while my measurements show the input required to deliver 1 watt into the rated input impedance (in this case, 4 ohms).

A similar situation exists with regard to signal-to-noise measurements. The EIA Measurement Standard calls for measurements to be made with 0.5 V applied at the input

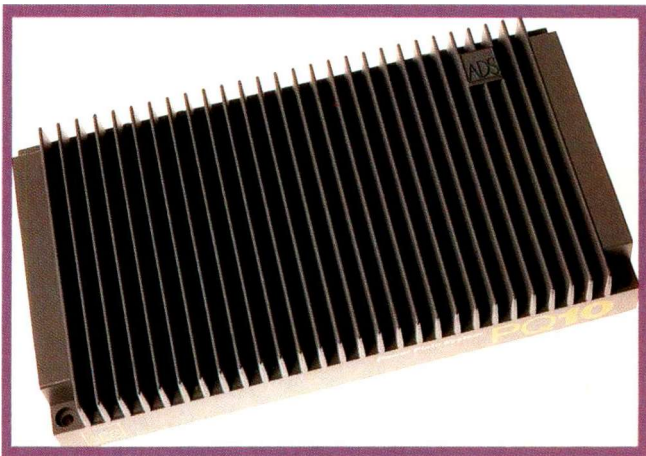
and with input level controls (if provided) adjusted to produce 1 watt into the rated load impedance. Many manufacturers ignore this method and instead quote S/N with respect to rated output. As you might guess, this usually yields a higher value. For those manufacturers who choose to specify S/N in that manner, I have placed an asterisk next to the figure which they have supplied.

In making harmonic-distortion measurements for these car amplifiers, I quickly realized that the percentages of THD I was reading were far higher than they should have been. This was especially true when I tried to read THD for high test frequencies. The answer, of course, was that some of the high frequencies generated by the power-supply oscillator mentioned above were leaking into the output signal. This leakage, at frequencies between 20 and 30 kHz, is above the audible range, but still contributes to the reading obtained with a distortion analyzer. Only by inserting a low-pass filter was I able to isolate the actual harmonic distortion from the non-harmonically related high-frequency components generated by the power supply. I used a low-pass filter having a cutoff frequency of 20 kHz.

Most car speakers have nominal impedance ratings of 4 ohms, and car stereo power ratings are normally quoted for that load. A few manufacturers also quote power ratings with respect to 8- or 2-ohm loads. I measured power output at 4 ohms for all eight amplifiers, and at 2 ohms for those whose manufacturers also provided such a rating. Most of the manufacturers that did not do so specifically warned against connecting any speaker or load whose impedance was less than 4 ohms.

Finally, I should mention that I measured all of the performance characteristics that I could, even in those cases where a manufacturer chose, for one reason or another, not to publish their own spec. Any omissions on my part are due entirely to test-facility limitations, such as an inadequate power supply on my test bench. (In that connection, I should point out that many of these amplifiers—especially those having the higher power-output ratings—draw huge amounts of current from a car battery. So don't try to use such amps unless your engine is running, and unless your battery is in good shape and constantly being recharged by the alternator.)

With those preliminaries out of the way, let's take a look at some of the features that are unique to each of these amplifiers, in alphabetical order.



ADS PQ10

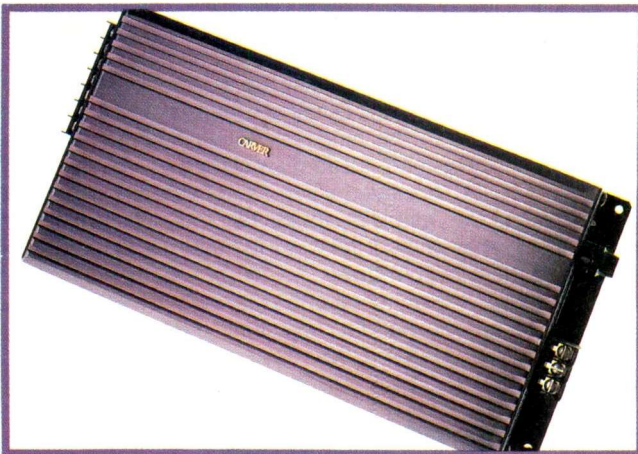
The ADS PQ10 is the only one of the eight amplifiers tested that can be used as a two-, three-, or four-channel unit. In four-channel mode it can drive separate speaker systems in each corner of the car, or two satellites and two

subwoofers. With one pair of its channels bridged together by means of a switch, it can drive two satellite speakers at moderate power while feeding greater power to a single subwoofer. Bridging both channel pairs (separate switches are provided for each) turns it into a stereo amplifier of fairly high power.

The measurements shown in Table I for this amplifier are those obtained with the amplifier operating as a true four-channel component. In the bridged mode (to provide a higher powered two-channel amp) I measured just what ADS claims: A maximum power output of 90 watts per bridged channel, both channels operating into 4-ohm loads, for the rated THD of 0.05%, at any frequency from 20 Hz to 20 kHz.

Connections to this amplifier were easily made, and it seemed they would be secure against loosening when subjected to vibration in a car. Small screws, located between heat-sink fins, must be tightened to keep speaker wires and power wires in place. Input levels are adjusted with screw-driver-slotted controls, also located between heat-sink fins. Input sensitivity is adjustable over a range of about 30 dB, making it possible to use the amp with either preamp- or speaker-level signals from a head unit.

CARVER'S M-240 TAKES UP just 0.1 cubic foot of space but delivers the highest stereo power of any amp tested for this report.



The screws for the ADS's speaker and power connections are concealed between the unit's heat-sink fins.

The necessary installation hardware is supplied with the amplifier in an accessory bag. A small screwdriver with an insulated shaft is included, for use in tightening speaker and power connections and adjusting input levels.

Carver M-240

Carver's first automotive amplifier uses the company's so-called Magnetic Field technology. As a result, it occupies only about 0.1 cubic foot of space but delivers, in stereo mode, the highest power of any of the amplifiers tested. (It can also be bridged.)

For use in biamplified installations, the M-240 has a built-in electronic crossover, with line-level outputs to feed higher frequencies to other amplifiers when the crossover is engaged. The crossover is set at 115 Hz with a slope of 18 dB per octave.

Low-level and high-level input connectors are provided, so the amplifier can be driven by a head unit's preamp-level or speaker outputs. In addition, input level controls provide another 13 dB of attenuation so that proper level-matching with almost any head unit is possible. Carver does not recommend load impedances lower than 4 ohms. The amplifier channels do not share a common ground, so separate hot and ground leads must be used for both speakers. High- or low-level input selection, biamp mode, and bridging are all selected by pushbutton switches.

Carver supplies a set of spade lugs with the amplifier for making power connections, and suggests using #8 or #10 wire for these connections. A handy, full-size mounting template can be cut out of the back of the owner's manual and used for accurate drilling of the four mounting holes required by the M-240. There are also five easy-to-follow wiring diagrams in the manual, covering all of the system alternatives possible with this amplifier.

Hafler MA-1

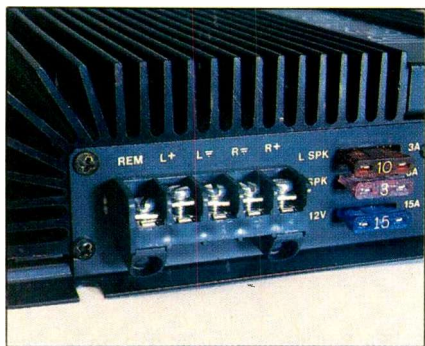
Hafler's MA-1 amplifier employs a Class-AB push-pull circuit that is fully complementary and symmetrical. It is direct-coupled throughout, with the exception of a d.c.-blocking capacitor at the input. The output devices are MOS-FETs. The power supply is a high-frequency MOS-FET switching type, capable of delivering as much as 40 amperes of current to the amplifier circuitry. The chassis itself is a continuous aluminum extrusion. Hafler provides a rating at 8 ohms (60 watts per channel) for the MA-1 as well as the more usual 4-ohm rating.



NOT LONG AGO, 250 WATTS was unheard of in a car unit, but that is what you can get in bursts out of the Hafler MA-1.

This is the only amplifier in the group with built-in speaker fuses—to protect your speakers, not to protect the amplifier itself. On the unit I tested, the external speaker fuses were rated at 3 amperes each, backed up by internal 4-ampere fuses. (Hafler now supplies 5-ampere internal and 4-ampere external fuses.) With the amplifier driven by a continuous test signal, the 3-ampere fuses blew before full rated power could be reached; however, when I substituted larger fuses I could drive the amplifier to its full rated output for a considerable time without blowing the internal fuses or experiencing thermal shut-down.

Theoretically, 4-amp fuses can pass only 64 watts each. However, fuses can handle more than their rating for defined periods of time—in this case, up to 256 watts for periods as short as 5 S. So with music signals, the fuses can



The 12-V sensor wire that turns the Hafler on is right next to the speaker connections; take care not to miswire it.

pass far more short-term power to the speakers without blowing.

The level controls on the MA-1 are continuously variable all the way down to zero, so you should have no trouble matching the amp to preamp-level or speaker-level signals from your head unit. It is interesting to note that the Hafler registered the lowest harmonic distortion at rated power output of any of the amplifiers tested. In fact, throughout my measurement of this amplifier I could not help concluding that here was basically a high-quality home amplifier circuit, reconfigured for mobile use. Just a few years ago, a THD reading of 0.02% for an output of 100 watts per channel would have been unheard of for a car amplifier, yet that's what Hafler's amplifier measured over the entire audio bandwidth.

Harman/Kardon CA260

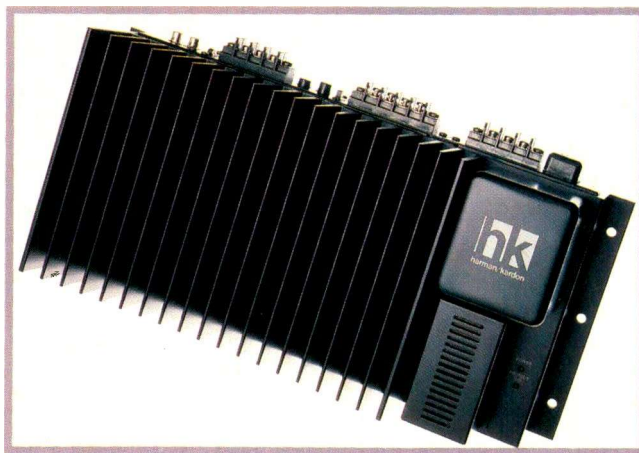
To audio enthusiasts, the name Harman/Kardon brings to mind wide bandwidth, ultra-low intermodulation distortion (generally ascribed to low negative feedback circuitry), and high current capacity. These are the qualities found in H/K home amplifiers, and they are also very much a part of that company's CA260 car amplifier. The CA260 offers 30 amperes of high instantaneous current capability and only about 25 dB of overall negative feedback. It has a built-in active crossover network set at 200 Hz. The high-pass filter has a slope of 12 dB per octave below that frequency, and the low-pass filter offers a 6-dB/octave slope above the crossover point. Bridged mono operation is also possible with this amplifier.



Plastic covers snap over the Harman/Kardon's speaker and power connections, for extra protection against short circuits.

The high-capacity power supply employs two 10,000- μ F capacitors, six 80-watt switching transistors, and a sophisticated transformer coil design that provides stable operating voltage even under high-power-output conditions. Not surprisingly, the CA260 exhibited the widest power bandwidth (for -3 dB) of any of the amps tested; its high-frequency cutoff was at 105 kHz. Response was flat within -1.0 dB to 75 kHz. Like the ADS PQ10, this amplifier uses a 30-ampere power fuse, attesting to its high supply-current capacity. That high current capacity also accounts, in part, for this amplifier being one of only four tested that carries a power rating for 2-ohm impedances: 90 watts per channel with both channels driven. The amplifier actually did a bit better than that, delivering 95 watts per channel for its rated THD of 0.2%.

The crossover arrangement on this amplifier is extremely flexible, thanks to a pair of pushbutton switches that are



used to select between the high-pass and low-pass filters. Thus, if so desired, two CA260s can be operated with two woofers and two mid-high (or full-range) speakers to make up an active system, with both amplifiers being driven by the same head end.

Infinity MRA-150

The MRA-150 has the most conservative power rating of all eight units I tested. Connected to 4-ohm loads, it delivered 81 watts of power per channel, with both channels driven, over the full audio bandwidth from 20 Hz to 20 kHz; Infinity claimed only 60 watts per channel under those conditions. When driving 2-ohm loads, maximum continuous power output was 100 watts per channel as against 90 watts per channel claimed.

The amplifier features adjustable input level controls. Although there are no fuses, an automatic shut-off/recycle circuit protects against dead batteries, short circuits, and

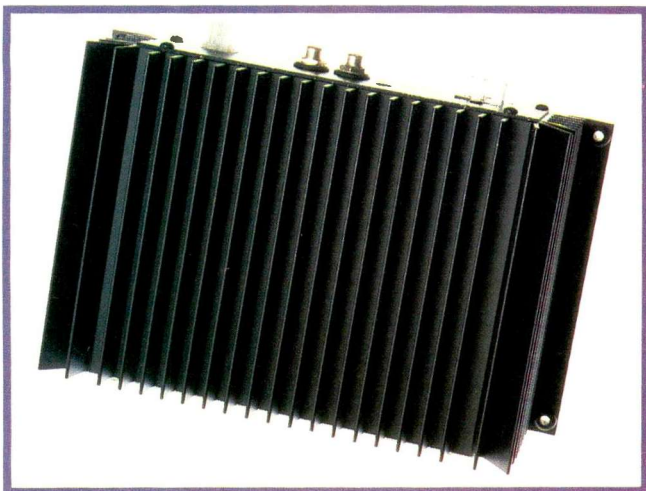


thermal overloads. If car battery voltage drops below 10 V, the amp shuts down.

The MRA-150 is more simply configured than any of the others tested: No provision is made for mono bridging, nor are there any provisions for biamp operation. (Of course, if you do want to install a biamped system, you can always use two of these amplifiers with a separate electronic crossover.) Although this amplifier was not the most powerful of those measured, its fairly high dynamic headroom of 2.0 dB means that during short, transient musical peaks it can deliver nearly 95 watts of undistorted power. I noted too that with no signal applied this amplifier drew less than 1 ampere of current, less than any of the other amplifiers tested.

Linear Power Model 1002

Linear Power's Model 1002 car amplifier is one of six stereo models, which range from 16 to a full 250 watts per channel (referred to 4-ohm loads). The Model 1002, at 50 watts per channel, falls between those two extremes. Its output stages are transformerless, d.c.-coupled, and fully complementary. Two protection circuits are provided. One is a thermal protection circuit that prevents damage from high-frequency oscillation. This circuit is also triggered when an improper input voltage is applied or when ambient temperatures become excessive. The second protection circuit is a current-sensing device which guards against



THE PROTON D275 HAS tremendous dynamic headroom which enables it to push out peaks of 300 watts for short transients.

such abnormalities as short circuits. Both protection circuits reset themselves automatically. Conservatively rated individual components are used throughout the design, as are glass-epoxy circuit boards. A 15-ampere power fuse is incorporated, and users are warned that over-fusing will void the warranty.

Linear Power specifically warns against using the 1002 with speakers having impedances of less than 4 ohms. Where four-speaker systems are to be used, it is permissible to wire a pair of 8-ohm speakers in parallel for each channel. However, if speakers with impedances of 4 ohms (or less) are used, such speakers must be wired in series for each channel. That's rather unfortunate, since this amplifier exhibited one of the highest damping factors for the group, and series wiring defeats the purpose of a high damping factor, which is to keep bass tight and free of any artificial "overhang."



Proton D275

Like Proton's home amplifiers and receivers, the D275 features a design, called Dynamic Power on Demand (DPD), which gives tremendous dynamic headroom. (Proton claims 6 dB, and I measured 5.5 dB.) The D275's steady-state power is rated at 75 watts per channel when connected to 4-ohm loads, but its headroom means that it can actually push out peaks of around 300 watts per channel for short musical transients lasting 20 ms or less.

The amplifier can also be bridged for mono operation by means of a pushbutton switch. In mono, it is rated to deliver a steady-state power level of 150 watts into a 4-ohm load. However, its dynamic headroom in bridged mode, though still impressively high, is not quite as great as when the amplifier is operated stereophonically.

In addition to the switch that selects the correct sensitivity for either preamp- or speaker-level inputs, the D275 has input-sensitivity controls. These can be used to more precisely match the output levels of the signal source in use, or for balancing a biamped or triamped system.

While all of the car amplifiers tested for this report showed

Table I—Manufacturers' and Measured Data

Parameter	ADS PQ10 Rated/Measured	Carver M-240 Rated/Measured	Hafler MA-1 Rated/Measured	Harman/ Kardon CA260 Rated/Measured
Power Output (Watts/Channel)				
8 Ohms	—	—	60/—	—
4 Ohms	35/40	120/120	100/110	60/63
2 Ohms	45/50	—	—	90/95
Bridged	90 (4 ohms, stereo)/—	150 (4 ohms, mono)/—	—	180 (4 ohms, mono)/—
Current Drawn (Amperes)				
At Idle	0.8/0.8	1.0/1.0	2.0/1.8	2.5/2.5
At 5 Watts Output	—/6.0	—/6.0	—/8.0	—/6.0
At Rated Power	30/28	—/35	—/32	30/30
S/N (dB)	93/92	100*/80	100*/76	80*/76
Frequency Response, ±1 dB (Hz-kHz)	20-20/20-20	30-20/35-20	10-70/8-70	10-100/14-70
THD, Rated Power (%)	0.05/0.045	0.15/0.08	0.02/0.02	0.2/0.22
Input Sensitivity, 1 Watt (mV)	45/45	250*/87	54/55	100 or 1,000*/14
Damping Factor, 4 Ohms	100/200	—/71	75/80	—/41
IHF Dynamic Headroom (dB)	2.2/2.0	—/1.0	1.75/1.8	—/1.0
Features				
Power Fuse	30 ampere	20 ampere	15 ampere	30 ampere
Speaker Fuse	No	No	3 ampere (two)	No
Crossover	No	Subwoofer	No	Yes
Protection	Thermal, shorts, voltage	High-frequency, shorts, d.c.	Thermal, shorts	Thermal, shorts, voltage
Dimensions (In.)	11.25 × 2 × 6.12	12.4 × 6 × 2.3	11 × 8 × 2.5	15.6 × 3.9 × 7.1
Price	\$440	\$350	\$400	\$450
Company Address	One Progress Way Wilmington, Mass. 01887 For literature, circle No. 100	P.O. Box 1237 Lynnwood, Wash. 98046 For literature, circle No. 101	5910 Crescent Blvd. Pennsauken, N.J. 08109 For literature, circle No. 102	240 Crossways Park West Woodbury, N.Y. 11797 For literature, circle No. 103
Parameter	Infinity MRA-150 Rated/Measured	Linear Power Model 1002 Rated/Measured	Proton D275 Rated/Measured	Soundstream D200 Rated/Measured
Power Output (Watts/Channel)				
8 Ohms	—	—	—	—
4 Ohms	60/81	50/64	75/90	100/102
2 Ohms	90/100	—	—	120/125
Bridged	—	—	150 (4 ohms, mono)/—	200 (4 ohms, mono)/—
Current Drawn (Amperes)				
At Idle	—/0.7	—/1.0	—/1.5	—/1.0
At 5 Watts Output	—/6.5	—/4.5	—/7.0	—/7.0
At Rated Power	—/24	20/16	—/28	—/32
S/N (dB)	100*/90	95*/77	100*/76	—/76
Frequency Response, ±1 dB (Hz-kHz)	2-100/5-75	12-150/20-90	—/20-20	20-20/13-26
THD, Rated Power (%)	0.25/0.2	0.15/0.025	0.08/0.08	0.1/0.1
Input Sensitivity, 1 Watt (mV)	350*/40	200*/22	200 or 1,000*/80	—/66
Damping Factor, 4 Ohms	25/25	200/150	See text	—/100
IHF Dynamic Headroom (dB)	—/2.0	—/1.0	6.0/5.5	—/1.0
Features				
Power Fuse	No	15 amperes	25 amperes	No
Speaker Fuse	No	No	No	No
Crossover	No	No	No	No
Protection	Thermal, shorts, voltage	Thermal, shorts	—	Thermal, shorts
Dimensions (In.)	2.2 × 7.6 × 10.5	9.5 × 2.8 × 7	7.7 × 11.4 × 2	2.3 × 7 × 6.1
Price	\$319	\$300	\$319	\$449
Company Address	9409 Owensmouth Ave. Chatsworth, Cal. 91311 For literature, circle No. 104	11545 D Ave. Auburn, Cal. 95603 For literature, circle No. 105	737 West Artesia Blvd. Compton, Cal. 90220 For literature, circle No. 106	2907 West 182nd St. Redondo Beach, Cal. 90278 For literature, circle No. 107

*Manufacturer's method of measurement is different from *Audio*'s; see text.

traces of high-frequency power-supply oscillator components at their outputs along with the desired audio signal, the Proton D275 seemed to have more of this ultrasonic component than any of the others. When I measured harmonic distortion without inserting a low-pass filter in the measurement path, I got a reading of 2.0%, as opposed to the true THD reading of only 0.08%, obtained when using the filter in the measurement path. This means that the high-frequency component at the amplifier's output was only about 34 dB below its maximum power output. That's clearly not enough to do damage to any car tweeter that I have ever encountered, but it is, nevertheless, a rather large amount of this type of undesired signal component.

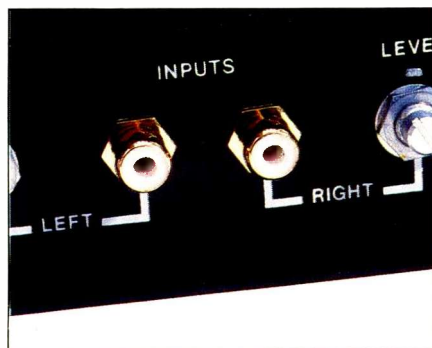
While this amplifier, like all the others tested, has phono jacks for its low-level inputs, speaker-level inputs are connected to colored wires which emanate from the body of the amplifier. Speakers are also connected to colored wires, as opposed to the screw terminals or other fixed-terminal arrangements found on the other amplifiers tested. This should pose no problem even for the neophyte installer, as the chassis itself bears legible print telling you which colored wires go where.



Soundstream D200

This amplifier, which finds itself discussed last for alphabetical reasons only, is rated at 100 watts per channel in stereo when driving 4-ohm loads. It can safely operate into 2 ohms as well, delivering more than 120 watts per channel under those conditions. When operated as a mono (bridged) amplifier, the load impedance should not be less than 4 ohms, but in that mode the amplifier can deliver a full 200 watts of power with less than 0.1% total harmonic distortion from 20 Hz to 20 kHz.

Even a cursory examination of this amplifier discloses that it is a premium product. Gold-plated input jacks, immersible sealed potentiometers, and metal-film resistors are used.



Both the Hafler and Soundstream amplifiers have gold-plated input plugs, to resist corrosion.

EVEN A CURSORY LOOK AT the 100-watt Soundstream D200 discloses that it is a premium product built of high-quality parts.

Input sensitivity is user-adjustable. All gain devices are biased by regulated active current sources so that even low-frequency performance is not adversely affected by supply-line noise and temperature fluctuations. The amplifier has no built-in fuses of any sort, but full thermal protection and protection against short circuits are provided. Of the amplifiers that I tested that can be operated in the bridged (mono) mode, the Soundstream D200 is the only one that cannot be switched to that mode by the user. If you desire bridged operation, you will have to pay a visit to an authorized Soundstream dealer, who will be able to set an internal switch for you.

Conclusion

In an evaluation of this sort, there are no clear winners and losers. Picking the amplifier that is best suited to your needs is something only you will be able to do, based on power requirements, the speakers you intend to use, listening-level preferences, and (of course) your budget. The one conclusion I was able to reach—and it applies strictly to these eight amps, not necessarily to the breed as a whole—is this: Today's basic car amplifiers embody design excellence that few would have believed possible for a mobile audio amplifier as recently as a decade ago. Those of us who love good sound no longer have to leave it at home when we take to the road.—L.F.

Listening Tests

At the start, I wondered how much difference I'd hear among these amplifiers. They all measured well, and I'd never done an automotive amplifier sound comparison before. As it turned out, the listening panel found that audible differences were greater than the measurements would suggest.

For the tests, we used the home system of Tony Igel, an autosound installation expert who operates Stratford Service in New York City. We did most of our listening through Tony's Magneplanar speakers, then rechecked some results with ADS 300 minispeakers, which are more like good car speakers in their sound and their load characteristics. The ADS and Magneplanar speakers have impedances of 4 ohms, like most car speakers. For a signal source, we fed each amp directly from a Revox CD player with built-in volume control. Our four test discs, all chosen for their clear and natural sound, were: Haydn's Op. 76 Quartets (Orlando Quartet, Philips 410 053-2); Chopin's Op. 28 Preludes (Ivan Moravec, piano; Connoisseur Society CD 4051); "You Look Good to Me," band 6 of *We Get Requests* (Oscar Peterson Trio, Verve 810 047-2), and "Dorothy" from Amanda McBroom's *West of Oz* (Sheffield CD-15).

To reacquaint our ears with the Magneplanars' sound—and to make the listening comparison *really* tough—we began our session by listening to all four discs through Tony's regular home system, using an electronic crossover, two Levinson ML-6 preamplifiers, and two Levinson ML-3 amps. Then we switched the Magneplanars from biamp to full-range mode, ran some Levinson speaker cables to the first amplifier under test, switched on the power supply, and began testing the eight units in alphabetical order.

Through the Magneplanars, each amplifier had as individ-

WE'VE PICKED OUR favorites, but remember: Much depends on the speakers, and the road will mask some subtleties.

ual a sound as phono cartridges would, though they were far more alike than speakers would be. Through the ADS minis, the differences were far less pronounced.

ADS PQ10

The difference between the biamplified Mark Levinson system and the first car amp we tested was dramatic. First we listened to the PQ10 with its four channels bridged to two for greater power. In this mode, the sound was smooth but a bit boomy. It sounded over-warm and a wee bit muffled. The bass sounded very loose (despite the PQ10's having the highest measured damping factor in Leonard Feldman's test). The triangles on *We Get Requests* sounded silvery enough, but the high-hat cymbals lacked some of their metallic sibilance. The sound stage was very wide and deep—too deep, Tony felt.

When we switched to four-channel mode, using only two of the channels, the picture improved somewhat. The mid-range and treble became clearer and the bass tightened up, though Tony felt he heard some compression. With the ADS speakers the amplifier sounded a bit better when bridged; this was the only time switching speakers reversed our judgments.

Carver M240

Upon listening to the second unit, it became clear that there could indeed be audible differences among car amplifiers. There was still some over-warmth, with a broad, shallow peak in the upper bass and a roll-off at the very bottom. But the muffling was gone, and treble and transients were excellent. Voices sounded a little bit constricted and distant, but the sound of Moravec's piano was quite accurate. Overall, the sound was clear and sweet, very musical, and the amplifier was very quiet.

Hafler MA-1

Again there was just a touch of loose bass and excess warmth—these seem to be common characteristics of car amplifiers. Amanda McBroom's voice took on a very slight edge. Adjusting the Hafler's input controls to raise its sensitivity changed the sound, adding a bit more warmth and making voices recede a little, but also taking that slight edge off the voice. With this amp, the high-hats lacked sibilance, as they had with the ADS, and the triangles lacked their silvery sheen. The sound was a bit flat, and while the sound stage was very wide, it seemed a bit shallow.

Harman/Kardon CA260

With this amp, the sound was very musical, with good transients, firm bass, and nice ambience. Moravec's piano again was rendered accurately, but as if heard from farther back in the concert hall; that distance is probably due to a slight softness we heard in the very top of the midrange. The sound stage was very deep (too much so, Tony thought again).

Infinity MRA-150

Transients were nice and clean with the Infinity, but the instruments on the Haydn quartets blended together. The

triangles on the Oscar Peterson sounded a bit leaden, and the high-hats went "chuff" instead of "schiff." The bass lacked authority, and there was a slight trace of shrillness.

Linear Power Model 1002

We were especially curious about the 1002. While nearly all the other amplifiers we tested came from companies with reputations for home audiophile gear, this one came from a company that has always specialized in car amplifiers. How would it compare to the audiophile brands?

Rather well, it turned out. The bass was very tight, though perhaps a hair overdamped—it lacked "oomph." Transients were clean and the triangles were silvery. Ambience and sound-stage width were good, though depth again struck Tony as excessive. I heard a slight woodiness, and Tony heard a bit of softness in the mid-bass and upper midrange. Still, we agreed that the Linear Power sounded musical.

Proton D275

"This amplifier is built like a truck," said Tony as he hooked it up. But once hooked up, it didn't work, though it had worked fine on Leonard Feldman's test bench earlier. Damage in transit, perhaps? A second sample worked fine. The triangles were silvery, transients were clear, and the high-hat cymbals sounded metallic, though not quite as bright as on some other amps. Voices were a little bit distant, and there was a slight turn-on thump.

Soundstream D200

Soundstream, like Linear Power, specializes in car stereo. However, several of their products (including this one) were designed by Nelson Pass of Threshold, who has an excellent reputation for home audiophile equipment. On this one, Nelson did himself proud.

The sound was very natural, especially on piano. Transients were exceptionally good, as was clarity. The low bass was substantial, neither too tight nor too loose. Sound-stage depth was excellent too. Overall, the sound was exceptionally musical.

Conclusion

Four of the amps struck us as very musical and a pleasure to listen to. The Soundstream was clearly the best sounding of the group; given good enough speakers, it sings. The Carver and Harman/Kardon weren't far behind, running neck-and-neck for second place; in a biamped system, you wouldn't go wrong using the Carver for your top end and the Harman/Kardon in the bass. The Linear Power sounded almost as good as these two.

There are some medium-size caveats: First, the sound of a system is highly dependent on the interaction between the amplifier and speaker. Therefore, using other speakers very well could reduce the apparent differences among the amps, and might even change their rankings a bit. But we'd expect our four picks to rank among the best using any speaker. Second, on the road, the differences among amplifiers would very probably be less marked. I've heard no car speakers as revealing as the Magneplanars, and road noise does mask some subtleties. I've heard good-sounding car systems using some of the amplifiers that fell below our top four choices. Finally, such factors as cost, size, and special features (such as the Carver's built-in crossover, or the ADS's multi-channel flexibility) might also affect your amplifier choice.

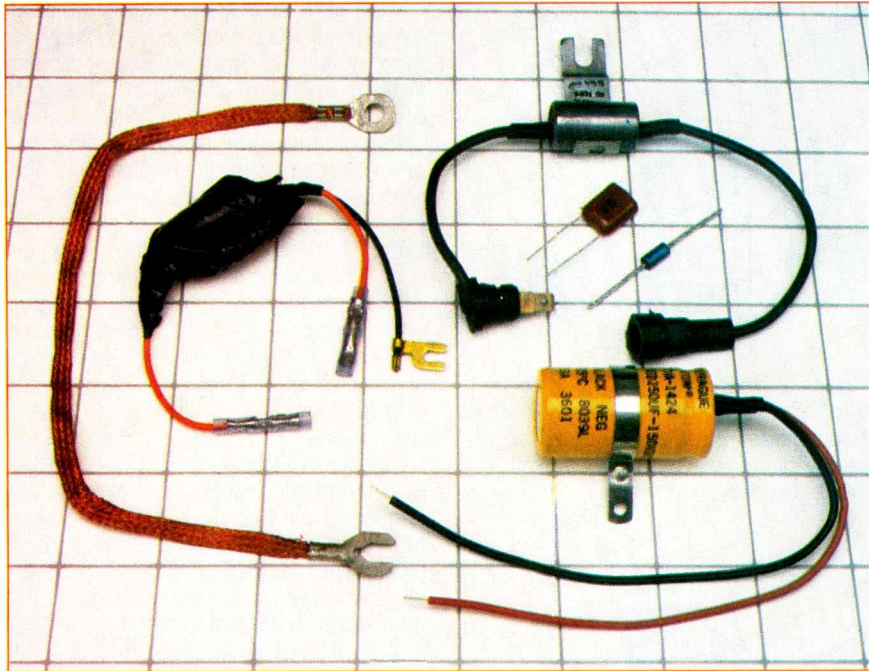
For me, this test session confirmed two things I'd long believed but had not really verified: Amplifiers do sound different. And some of the amplifiers available for use in cars are very good indeed.—I.B.

A

CAR STEREO NOISE:

A Process Of Elimination

MIKE ERGO



Grounding straps, diodes, capacitors and filters, such as these, can help reduce some of the noise problems found in car stereos.

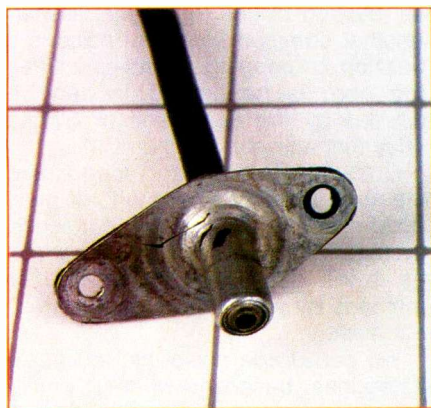
Can you imagine what it would be like to be the only Dallas Cowboy fan sitting in R.F.K. Stadium cheering the Cowboys on as they and the Redskins slug it out? To say you were in a hostile environment would be, to say the least, an understatement. Well, that's exactly the predicament a sound system is in when it's installed in a car. One of the biggest challenges for engineers and installers is how to create sound systems that will operate satisfactorily, let alone in superior fashion, when subjected to all the variables associated with an automotive environment.

An automotive sound system is subjected to extreme temperature ranges, constant vibration, moisture, and dirt, and the antenna system faces environmental hazards (such as corrosion) and vandalism. Moreover, the car is constantly moving in relation to the broadcast tower, giving rise to such phenomena as multipath and dead spots. To top it all off, this delicate system has to operate in close proximity to an a.c. generator (the alternator) and a high-voltage spark machine (the ignition system). As you can see, it's no wonder pops, buzzes, crackles, and whines creep into the system from time to time.

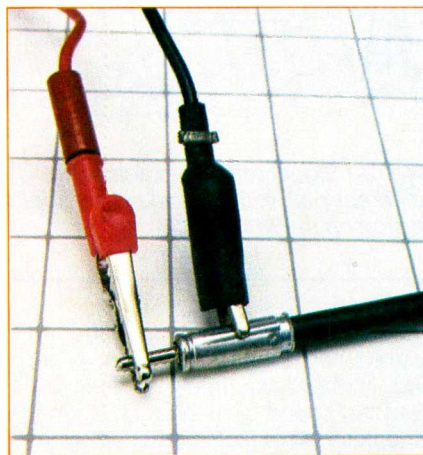
However dismal this scenario may seem, there is hope of enjoying a car sound system that is free of annoying disturbances. But before we get to the remedies, let's examine the different types of noise that your sound system is subjected to.

There are two different types of noise: Those that are a result of conditions inside your car, and those that

Mike Ergo is an automotive electronics consultant, trainer, and writer. He belongs to the Automotive Service Association and the Vehicular Technology Society of Electrical Engineers.



One should measure the resistance of a windshield antenna at the point where the antenna lead from the radio is plugged into it. Look for a jack like this one at the bottom of the windshield cowl.



The resistance measured between an antenna cable's center pin and shield should be at least 10 megohms and may well be greater.

Multipath and dead spots, caused by external factors, are often mistaken for problems in the sound system or in the car.

are created by outside factors. The latter group includes such things as lightning, power lines, radar, or broadcast installations. For the most part, there is not much you can do about these disturbances other than changing your course of travel. Also included in this latter category are multipath and dead spots, and they generate numerous consumer complaints. They are often mistaken for noises generated inside the car or as defects in the sound system itself. Although there is very little the consumer can do to prevent these listening disturbances, it is important to have a good understanding of both.

To understand multipath and dead spots, a quick review of FM radio is necessary. Commercial FM (frequency modulation) broadcast is from 88.1 to 107.9 MHz. In this frequency range, FM radio waves tend to behave very much like light waves. Unlike AM waves, FM waves do not bend, and FM reception is considered to be line-of-sight transmission. Therefore, the range of FM is usually only 25 to 30 miles, depending on the terrain.

Like light waves, FM waves can be blocked or shadowed by objects that get between your car's antenna and the radio station's broadcast antenna; these include buildings, poles, towers, and many other structures (Fig. 1). As you travel down a street or highway, you pass through these signal shadows. Since you are travelling rather quickly in most cases, and the wavelength of an FM signal is short, the shadow appears only momentarily—usually for a fraction of a second. However, during that time your radio experiences a loss of signal and hence has no signal to amplify. What occurs is an audio disturbance referred to as picket-fencing, heard as a high-frequency flutter as the signal comes and goes. This disturbance is often mistaken for a problem in the sound system or a noise being generated in the car, but it is actually due to a loss of signal; it is not the fault of the radio or radio station. Unfortunately, as I've said, there is nothing you can do to prevent this disturbance.

A second external phenomenon associated with FM broadcasts is multipath. This annoying listening disturbance is also often mistaken for a defective sound-system component or a

car-generated noise. It arises when FM radio waves, acting like light waves, reflect off certain objects. Again buildings, poles, and towers are but a few of the objects that can be the culprits. These reflected waves are received at the car's antenna a split second after the original radio wave arrives (Fig. 2). Receiving two identical waves only slightly out of phase can cause very

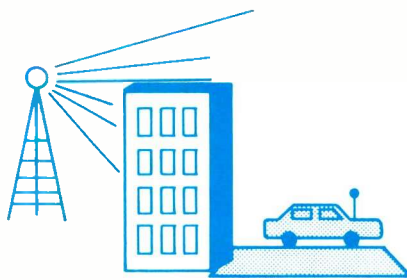


Fig. 1—Picket-fencing is caused by brief signal interruptions that occur as a car moves through the dead spots where buildings and other objects block the radio signal.

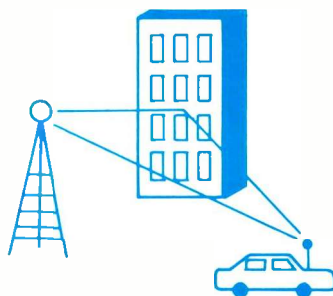


Fig. 2—Signal reflections following different path lengths create multipath distortion in FM.

audible distortion, as though the radio were tuned slightly off-station, or drifting. It may also manifest itself as a garbled sound or as a crackling in the speakers. This same phenomenon is the cause of "ghosts" on television.

While neither picket-fencing nor multipath can be prevented, their effects can be minimized by switching to monophonic reception, if your tuner al-

lows. Tuners with automatic high-blend thresholds which are low should suffer less audibly, as should those with diversity antenna-switching systems. A tuner with greater sensitivity would probably suffer less from picket-fencing, while one with a lower capture ratio and higher AM rejection should be less affected by multipath.

Now let's take a look at some internally generated noises. The most common noises in an automotive sound system are alternator whine, secondary ignition noise, switch pops, and solenoid and relay pops or ticks. One of the first steps in noise diagnosis and remedy is to determine as closely as possible where the noise is coming from. There are several clues you can use. For example, if the sound is a whining or slight buzzing that changes pitch when engine rpms are increased, there's a good chance you are experiencing alternator whine. A ticking or popping sound that speeds up as engine rpms increase is usually ignition noise, such as spark plug firing. A loud pop heard when you turn on such accessories as electric windows or electric seats is usually either a switch pop or a spike caused by energizing or de-energizing a relay or solenoid. (This latter phenomenon is caused by the sudden build-up or collapse of the magnetic field in a relay or solenoid coil, or in some other inductor.) Included among switch pops is a sound heard only when the turn signals are on, caused by the turn-signal flasher. Another common source of noise is a buzzing or popping heard only when the horn is honked. This can be caused by the horn itself or by the relay that activates the horn.

Once we have a good idea where the noise is being generated, we must determine how it is entering our sound system. This step is vitally important, as it will determine the method or methods by which we try to suppress the noise.

We can divide noise into four main categories, based on where it enters the sound system. First are "frontway" noises, those that enter through the radio's antenna input. Second are "sideway" noises, which enter directly into the chassis, by radiation. Sideway noises are among the hardest types of car noise to eliminate. They are rela-

A filter package is a double whammy, blocking a.c. noise with an inductor and shorting the a.c. to ground with a capacitor.

tively rare now, but unfortunately they are growing more common, as radiation sources such as cellular phones, CD players, and digital clocks are installed in more car interiors.

The third category is "backway" noise, which comes through the 12-V power leads of the head unit or amplifier. Unlike noise that enters through the tuner's front end, noise riding on the 12-V lead is input directly to the amplifier stages, and is immediately amplified and heard. (Even though most car stereo components have input filtering, sometimes it is not adequate for all noise levels.)

Ground loops are the fourth major path for noise entry. Ground loops exist where there is more than one ground path between the stereo system and the car battery's negative terminal. To the extent that these paths' impedances or resistances differ—and they always do—each will be at a different potential relative to the battery ground. This difference in potential causes a small current flow, the a.c. component of which is noise. Ground loops represent only a small proportion of noise problems in head units, but a fairly high proportion of noise problems in amplifiers, crossovers, and equalizers. Ground loops can often be eliminated, but there is very little you can do to filter a ground.

Now that we have taken a look at the different ways noise can enter a sound system, let's see how we can determine which way the noises are actually entering. This is simply a process of elimination. Start by unplugging the antenna from the radio. If the noise goes away, it was obviously coming in via the antenna input; if it doesn't, we need to investigate further. Another quick way to determine if the noise is entering in this way is to turn the system's volume all the way down. If the noise does not go away, it cannot be coming from the antenna input, as such noises are processed by the tuner front end and amplified as if they were radio signals. In that case, ground loops are the most likely cause.

A good way to check for noise radiation into the head unit (sideway noise) is to remove the radio from the dash. If the noise diminishes or changes pitch as the chassis is moved in and out, you probably are experiencing sideway

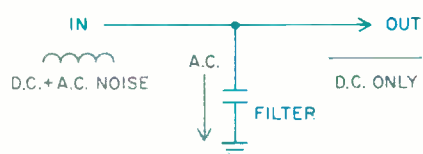


Fig. 3—A capacitor can be used to shunt a.c. noise from the d.c. power line to ground.

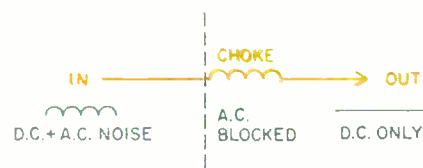


Fig. 4—An inductor, such as this choke coil, also blocks a.c. noise in the d.c. power line.

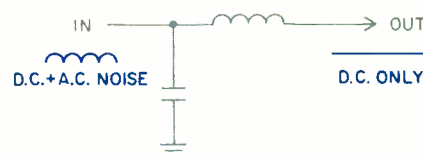


Fig. 5—An inductor and capacitor together make up a filter package.

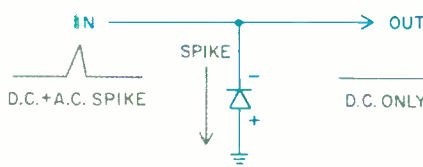


Fig. 6—A reverse-biased diode can shunt large a.c. spikes to ground.

noise. However, it is also possible for interference radiation to affect other components or signal cables and power wires.

Distinguishing between power-line (backway) and ground-loop noise entry can be a little more involved, and requires trying certain fixes which we will get into later. One thing to keep in mind is that noise coming in on the

12-V lead affects head units more commonly than ground-loop problems do, though the opposite is true for other components.

So far we have looked at the different types of noise, how they enter a sound system, and how we determine which way they are entering. Now it's time to start suppressing those annoying disturbances. Before we start putting filters, chokes, and diodes all over the car, we must take a look at these devices and see how they work.

A capacitor, which is two conductors separated by an insulator, is often used to smooth or filter out a.c. signals. To d.c. this filter looks like an open circuit, but to a.c. it looks like a short. Thus, by putting a filter from a d.c. line to ground you can bypass all the unwanted a.c. to ground and leave the d.c. portion virtually untouched (Fig. 3). An inductor, or choke, works in just the opposite way. To d.c. a choke—basically a coil of wire—is a short. However, to a.c. a choke looks like a high resistance, and thus acts as an a.c. block (Fig. 4). By putting a choke and capacitor together we end up with a filter package (Fig. 5). A filter package not only blocks a.c. with the inductor, but also shorts the a.c. to ground with the capacitor—a double whammy.

Finally, we have diodes. These are semiconductor devices that allow current to travel in one direction only. However, all diodes have a peak inverse voltage (PIV) at which they will start conducting in the opposite direction. This makes them especially useful for spike voltage suppression. By inserting a diode backwards (reverse biased) in a circuit—that is, with the anode (+) to ground and the cathode (-) on the positive side—we can suppress noise-causing spikes, as shown in Fig. 6. (The cathode end of an actual diode is usually marked with a silver band.) A spike, like those generated by relays and solenoids, and by switch arcing, usually ranges from 50 to 100 V. This is usually enough to exceed the PIV of the diode and thus the spike is shunted to ground, leaving the d.c. (+ 12 V) portion unaffected.

We are now armed and ready. Let's look at some specific noises and how we can eliminate them. (Keep in mind that many sound system noises can be eliminated by a proper tuneup. Always

There is no magic involved in suppressing car noise; it's a series of educated trials and errors. Basically, if it works, do it!

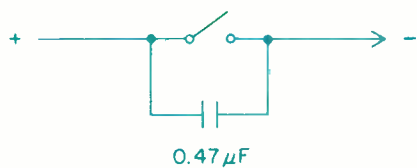


Fig. 7—Placing a capacitor across switch contacts can reduce pops and clicks when the switch is operated.

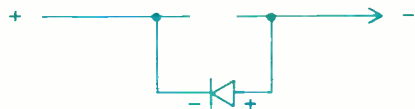


Fig. 8—If a switch operates a motor or other inductive load, a diode across the switch may reduce noise.

make sure your car is tuned and running properly before attempting to eliminate such noises.) Start with frontway noises such as secondary ignition noise and alternator whine, which frequently come in via the antenna. This often indicates a poor antenna ground, so the first check is to make sure the antenna is grounded properly. This can be done with an ohmmeter. Corrosion at the mounting base or a broken braid inside the coaxial cable can cause poor grounding and thus introduce noise into a system. By measuring with an ohmmeter between the antenna base and a good ground, such as the negative battery post or the alternator housing, you can determine how well grounded the antenna is. You should measure less than 1 ohm. Next, check the radio end of the coax. Unplug the antenna lead-in from the radio and measure between the ground case and a good ground. Again, the reading should be less than 1 ohm. This ensures that the ground braid of the antenna is not broken, and that the antenna's ground connection (usually its base) is making good contact with the metal of the panel it is

mounted on. (If it is not, corrosion or sound-deadening material beneath that panel may need to be scraped away.) Finally, check for a shorted coax by measuring between the lead-in tip and coax ground. This reading should be 10 megohms or greater. If by chance your antenna is in the windshield, the above checks still apply. However, since there is no antenna base, the first check must be made at the windshield cowl where the antenna lead plugs in.

Having made sure that the antenna system is properly grounded, we now must try to suppress each individual noise. In the event of secondary ignition noise we should look for broken spark plug wires, a cracked or worn distributor cap, or a bad spark coil. A worn carbon ball inside a distributor cap can play havoc with a sound system. In older cars with points, pitted points can have the same effect. Sometimes grease or carbon film coats the inside of the distributor cap, causing a crackling or frying sound. Simply cleaning the inside of the distributor cap can remedy the problem.

If our noise is a frontway switch pop we might try a 0.47- μ F capacitor across the switch contacts (Fig. 7), or if the switch operates an inductive load (motor, solenoid, relay, etc.) we might put a spike-suppression diode (1N4001) across its terminals (Fig. 8). If the diode has no effect, try a filter. Keep in mind that there is no black magic involved in noise suppression. It is a series of educated trials and errors. When trying a filter, use several values of capacitance to see which one works best. Start with 0.47 μ F, then try 0.1 or 500 μ F. The bottom line is this: If it works, do it!

If you still are experiencing frontway noise, make sure the car's hood is grounded properly to the car's frame by using either a flat, braided ground strap between the hood and firewall or a hood ground clip that makes good electrical ground when the hood is closed. Also make sure the radio or amplifier chassis is properly grounded.

Curing radiated (sideway) noise is, as mentioned above, difficult. Among the possible solutions are moving the affected component (easy for amplifiers and crossovers, but hard for in-dash head units), moving the noise

source, and moving the wires connected to either the sound equipment or the noise source. If the problem is magnetic radiation being picked up by the tape heads, a mu-metal shield between the tape player and the noise source may help. Such shields are sold by some car stereo manufacturers, and may be available through local dealers and installers.

Now let's take a look at some other noise problems which can enter as backway (power-line) noise or via ground loops. Alternator whine (which can also, as we've seen, enter as frontway noise via the antenna input) is one of the most common types. If your stereo consists of a single head unit with built-in amplifiers, this whine is most likely to be backway noise. Your best bet in curing this is to start with a filter package on the 12-V lines to the head unit. (If the unit has a separate unswitched line to keep its memory alive, or a separate line for night illumination, be sure to filter all of them.) Another possible cure is to put a 500-to-1,000- μ F capacitor between the alternator's output line (usually a 12-gauge red or orange wire) and the alternator case.

As for switch pops, relay ticks, and turn-signal pops, the same fixes as described above apply. Try combinations of filters and diodes. When trying to suppress particular components such as relays and switches, the rule of thumb is to always install the suppression devices as close to the source as possible. In other words, a capacitor installed across a switch is more effective when installed directly across the switch terminals than when installed in the wiring harness four inches from the switch.

Finally, we are left with the dilemma of ground loops. If you have separate components such as an equalizer or power amp, this is a more likely noise path than the 12-V line. Filter packages installed on the 12-V line are ineffective, since they filter the hot side and not the ground side of the circuit. Filters and diodes applied to each component may be effective, but they should be used as a last resort (and removed if they don't help—they sometimes can cause problems). The only way to eliminate ground loops is to find all the connections between the

Ground loops pose a dilemma. Filter packages on the 12-V line won't work, and filters and diodes on components can cause new problems.

system and ground, and break all but one of them.

The more complex the system, the more potential grounding points it has. Each component usually has both hot and ground power leads. Screws holding a component in place can also set up ground paths between the component's metal case and the car's body metal. The case may also accidentally contact nearby body parts, and cases that don't quite contact the body when the car is at rest may contact it when the car is moving, causing intermittent noise problems that are hard to track down. The shields of the signal cables between components act as ground paths between those components too. And the antenna must be grounded for good radio reception. (Because of this, the antenna may sometimes serve as the one ground point for an entire sound system.)

To break the extra ground points, try detaching the ground leads of the system components, one by one. (Do not, however, detach the amplifier's power ground, as this can cause the amplifier's ground current to be drawn through the signal cables, creating a fire hazard. If you wish to move the amplifier's power ground, *make sure the system is off while you do so.*) Assuming the system has other ground paths, it should still operate, and its noise level should drop. If the unit doesn't operate with its ground lead clipped, attach the ground wire to the nearest source of ground, making the wire as large in diameter and as short as possible (Fig. 9).

If clipping all ground leads still leaves a noise problem, check for physical grounds between component cases and the car, by direct contact or through fastening screws. If need be, detach and lift each component from the car, and see if the noise disappears or lessens. To cure such a physical grounding problem, you can insulate most components from the car by mounting them on wooden (or similar) boards and using separate screws to attach the boards to the car. In some cases, it may suffice to put insulating bushings between the component's chassis and its mounting screws. Insulating head units from the dash may prove to be difficult; insulating them from braces, ashtrays, ducts, and oth-

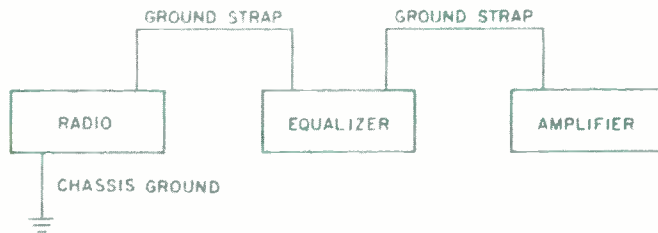


Fig. 9—Shortening the ground path by using the nearest possible ground point may cure ground-loop noise.

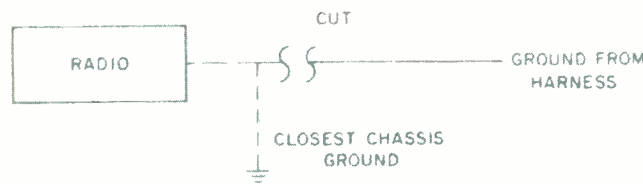


Fig. 10—Another way to reduce ground-loop problems is to tie components together with a low-resistance wire or strap. This may necessitate clipping the shields at one end of each signal cable.

er under-dash metalwork is easier to accomplish.

If the extra grounds can't all be eliminated, reducing the difference in ground potentials may help. This can be done by grounding all components in the system together, with a separate ground wire or strap (Fig. 10). Always use 14-gauge (or heavier) wire or a braided ground strap for this purpose. If this increases the noise, then disconnect the shields from the plugs at one end of each signal cable, so that the ground straps and signal cables will not combine to form new loops.

To review, there are several steps to keep in mind when attempting to eliminate automotive noises in your car's sound system. First determine the origin of the noise. Is it being generated outside the car by normal phenomena such as dead spots or multipath? If it is being generated within the automobile, is it the alternator, the ignition system, a switch, or a relay? After determining the origin, determine how the noise is getting into the system. Is it frontway, through the antenna, or backway, through the power leads? Or is it side-way noise, or possibly ground loop in-

terference? After investigating you can go to work. Remember filters and diodes work well for spikes. Chokes work well on power leads for alternator whine. Keep in mind that suppression components should be put as close to the source as possible. That is, for switch pops, put the filter on the switch itself. Finally, remember that trial and error are your best tools. Good luck and good listening!

(Author's Note: All the noise suppression devices mentioned in this article can be purchased at local electronics stores such as Radio Shack. Make sure that the values you pick are appropriate for automotive use, since the wrong values can create unsafe situations. Capacitor voltage ratings should be *at least* 50 working volts, and each filter package should be rated high enough to handle the current of the device it is filtering. Also, any component used under the hood should be adequately protected from the environment or packaged for external use, as metal-cased capacitors are. If you have questions, ask the salesperson at the electronics store, explaining what you intend to use the device for.) **A**

AUDIO IS 40

Thanks For The Memories



AUDIO is 40 years old! For almost all of those 40 years I've been a reader of this magazine, for more than three-quarters of that time I've been involved in the audio industry, and for more than half that time I have written for this publication. It's a field that is really made up of people, so it's about people that I'd like to write—audio people I've known, and people who have shaped the course of the industry in significant ways.

When I graduated as an electrical engineer way back in the early 1950s, I had already built my first audio amplifier. It was an elegant, chrome-plated unit, offered in kit form by a company called Craftsman. The amplifier was a Williamson circuit and employed negative feedback and push-pull 6V6 output tubes.

Much as I loved audio, my first employment was in the field of video—not as a design engineer but as a service technician charged with repairing Muntz TV sets. (Real engineering jobs were hard to find in those days!) Muntz TVs were noted for having fewer parts than any other sets then on the market. In all, they used about 11 vacuum

LEONARD FELDMAN tubes, as against some 20 to 30 tubes found in other sets. Such a simple TV was therefore rather easy to troubleshoot and repair, and I soon tired of the job. I stayed only about three months and then obtained my first true engineering job in a TV manufacturing firm. (Yes, in the 1950s there were still any number of U.S. brands of TV sets actually made and sold in this country!) The challenges were greater and

the work was more interesting; for instance, I built a prototype of a color TV set that used a spinning "color wheel" to receive the short-lived CBS color TV system. But all of this had nothing to do with my hobby—audio.

When I left that TV firm, an opportunity presented itself that was to change my professional life. Fisher Radio Corp., then with headquarters in Long Island City, N.Y., was looking for a junior engineer to work on government subcontracts. I was interviewed and hired by the then Chief Engineer for Fisher, George Maerke. Mr. Maerke was, it seems, a self-taught audio and r.f. engineer who had not actually earned an engineering degree, but his knowledge of audio and tuner circuitry was awesome. Although I was hired to do government work at Fisher, I poked my nose into what was going on in other departments. I watched with envy as other engineers and George Maerke finished their work on the very first separate, basic amplifier, the Model 50A. A 50-watt monophonic unit, it was the forerunner of a host of separate amplifiers that were to come from such firms as H. H. Scott, Harman/Kardon, Sherwood, and others. Maerke's energies were boundless. In

short order, he designed a matching preamplifier (Model 50C) and a superb AM/FM tuner (Model 50T). As you can see, model numbers were no more imaginative then than they are today.

While performing my duties as a government project engineer, I also managed to become close to the founder of the firm, Avery Fisher. Early on, this dedicated music lover and audio perfectionist recognized that I had some skill with the written word, and he assigned me the task of writing some owner's manuals and brochures for new audio components. I can honestly credit Mr. Fisher with starting my career as a technical journalist. It was Mr. Fisher, too, who encouraged me to get up before an audience and speak about the subject we both loved: Audio technology.

In those days, there were annual High Fidelity Shows held in hotels in major cities. The first shows I attended as a Fisher employee were held in the Hotel New Yorker, on 34th St. and Eighth Ave. in New York City. To this day I can clearly remember how Mr. Fisher would stand at the rear of our exhibit room at that hotel (and in other hotel rooms around the country) and tell us that the sign we were hanging was tilted "about 1/8 inch upward on the right." The man's uncannily sharp eye could detect such asymmetry. After all, his original training had been as a book designer; it was his interest in good music that had inspired him to build audio equipment.

The wonderful thing about those high fidelity shows was the intimacy that they created between the pioneering audio manufacturers and their customers. As my colleague Bert Whyte mentions in his column this month, if

you owned, say, a Fisher amplifier and wanted to know which Fisher preamp to buy, you could come to the show and chat with Mr. Fisher or with his chief engineer, Mr. Maerkle. Or you could talk with any one of us from the factory who manned our exhibit rooms.

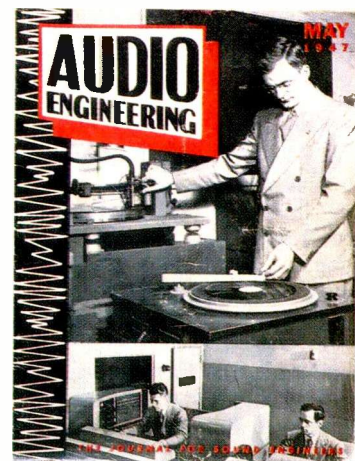
I remember, too, that Mr. Fisher always told customers that they could call him on the phone at any time. Hundreds did—and he always talked to them! If he couldn't answer their more technical questions, he would transfer the calls to an engineer. Try contacting the head of a multinational audio/video/electronics firm today and see how far you get!

Avery Fisher, besides being an extraordinary human being, was a fantastic showman. His rooms at the high fidelity shows always featured some sort of narrated demonstration, and, more often than not, he would call upon me to do the narrating. There was one season in which the Philadelphia show was followed by a Boston show and a New York show with not one day's pause in between. I worked for 19 days straight without a day off, and I didn't mind it a bit!

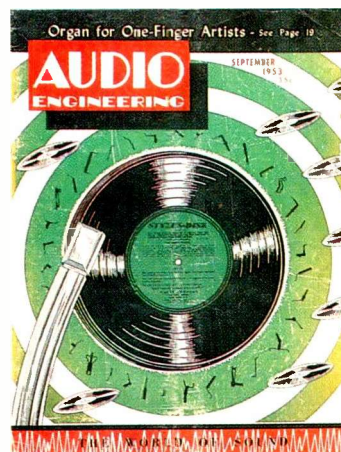
The list of "Fisher Firsts," which used to grace some of the company's advertisements, became longer and longer. With government projects out of the way and the high-fidelity segment of the company becoming ever more important, I was finally allowed to work on audio equipment designs. Some of the products I helped design included a couple of preamplifiers, basic amplifiers, high- and low-pass filters, and phono equalizers with as many as 36 different settings of playback equalization. In those days, the now-standard RIAA playback curve had not been agreed to by all record companies, and each major (and minor) company used its own favorite equalization characteristic for attenuating bass and boosting treble during recording. If you wanted to play all those records correctly, you had to have a selection of playback equalization settings on your equipment—and the more settings, the better!

In Business for Myself

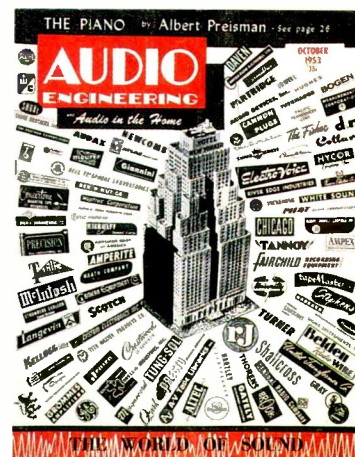
In 1956 I was presented with an opportunity to form my own audio firm with several partners. Much as I hated



May 1947



September 1953

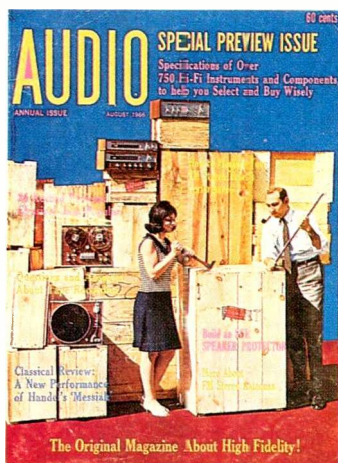


October 1953

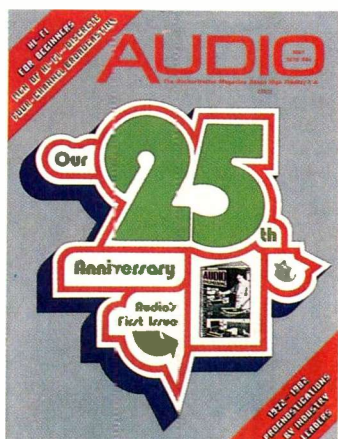


The H. H. Scott 222, one of the separate stereo amps of the 1950s.

While I was one of the first to sign up we have no tests planned for that; we



August 1966



May 1972



February 1987

The wonderful thing about audio is that its progress never ends; even things that don't take the world by storm can be influential.

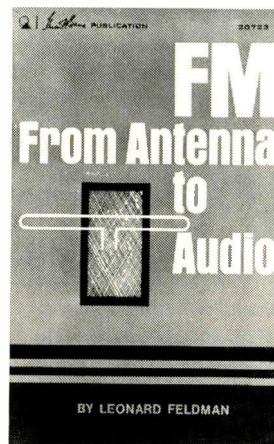
can worry about that later." To be sure, we've been suffering and worrying about FM multipath ever since!

Black Friday at Crosby Electronics

On the morning of April 19, 1961, the FCC ruled—not in favor of Crosby, but in favor of what had by then become the G.E./Zenith system. I won't speculate here about the reasons for the decision. Suffice it to say that prior to 10:00 that morning, Crosby stock (of which I owned a fair amount) had been selling at approximately \$15 per share. By the close of trading that evening, the stock's price had fallen to \$2.38 per share! And with the falling price fell the fortunes of Crosby and his company. There were moments of hope, as it dawned on us that Crosby's patent might in fact apply to the approved stereo FM system. Last-ditch lawsuits were instituted against G.E. and, wonder of wonders, the Federal Court ruled in our favor—only to be overturned on appeal! Undaunted, Murray Crosby continued to work in the field of electronics and communications until his death several years later, and we remained close friends.

Quadraphonic or Quadrophonic?

By the beginning of the next decade, I was becoming deeply interested in yet another audio innovation: Quadraphonic sound. Along with Ben Bauer and Daniel Gravereaux (both of CBS Labs, later the CBS Technology Center), Peter Scheiber, and David Hafler, I became involved with a young fellow named Jon Fixler. Together we came up with one of a host of so-called "matrix" four-channel systems. Our particular system was licensed to Electro-Voice, who sold it under the name of Stereo-4. Meanwhile, I continued to write for *Audio* as well as for several other consumer and trade publications, and my testing laboratory grew in size and complexity as I extended my product-evaluation services to the industry as well as to audio and video publications. Needless to say, the flurry of activity in quadraphonic sound came to an abrupt halt in the late 1970s. Its failure was due, in part, to the confusion over the multiplicity of four-channel systems that were being promoted. Also to blame was the less-than-pleasing quadraphonic software



The author's book for Howard W. Sams & Co. was issued in 1969.

that was being produced by overzealous but not especially artistic record producers. I can take solace in the fact that if Stereo-4 did not succeed in the marketplace, neither did CBS's SQ system, nor Sansui's QS system, nor RCA's and JVC's CD-4 discrete four-channel disc system, all of which enjoyed brief attention in the audio world.

To the Future of Audio—and Audio

All of which brings us pretty much up to today. In some sense, even the audio technologies that didn't take the world by storm have had an enduring influence upon the industry. If four-channel sound didn't succeed as an audio-only medium, its offshoot, surround sound, is alive and well as an audio/video entertainment format. Those of us who saw the digital Compact Disc as the successor to the stereo LP are being proven correct, while the diehards grudgingly begin to admit that a few CD players and a few CDs are okay. The most wonderful thing about audio is that its progress never ends. Now there's DAT on the horizon, and no doubt the ongoing debate concerning that technology will be reported in the pages of *Audio* in the months and years ahead. And when *Audio* celebrates its 50th birthday, or its 80th, or its 100th, I'm certain that those associated with the magazine will have even more interesting and exciting audio experiences to look back on. **A**



The concert continues to get better with Ford JBL Audio Systems.

Announcing another Ford first:
The long awaited Compact Disc
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Start with the very best high fidelity music systems we offer: Ford JBL Audio Systems.

- 12 JBL speakers including 2-6" x 9" woofers, 2-3½" midrange speakers and 2-7/8" tweeters located in the rear deck; 2-5¼" woofers mounted in the doors; and 2 tweeters and 2 midrange speakers in the instrument panel. Selective frequency fading so all woofers remain in operation at controlled levels when faded front/rear.
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The Compact Disc not only lets you experience the total capacity of a Ford JBL Audio System, it establishes all new standards for clarity, realism and dynamic range in automotive sound.

- Performance features of the Compact Disc player include frequency response at 5 to 20,000 Hz with less than .05% THD, dynamic range greater than 90 dB, signal-to-noise ratio greater than 90 dB and channel separation greater than 85 dB.
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Hear for yourself just how much better an audio system can really be, exclusively at your Lincoln-Mercury dealer today.



AUDIO SYSTEMS

Audio

DOWN MEMORY LANE

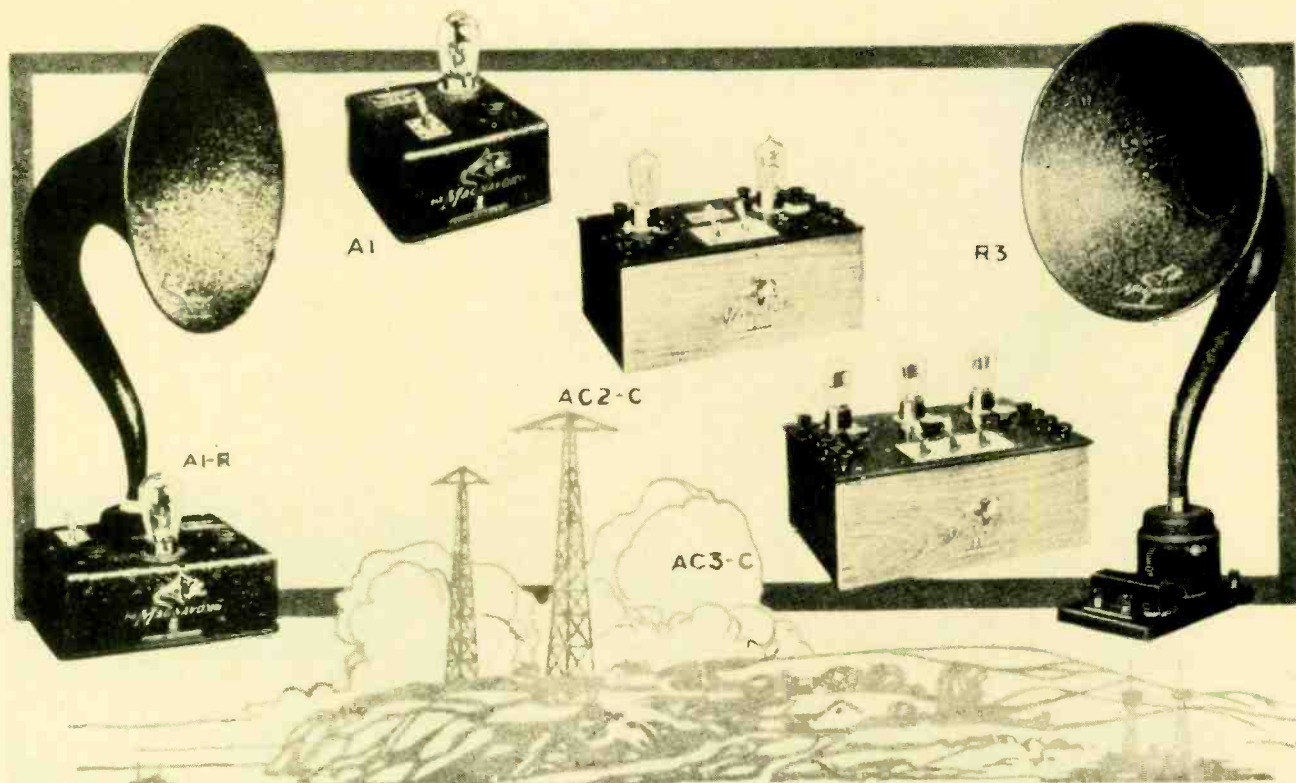
1947-1987

Several months ago, my four-year-old son asked me, "How far is old, Daddy?" I told him that I didn't know because I hadn't gotten there yet. I hope you, Gentle Reader, have not gotten there yet either.

I do know that *Audio* is 40 this month, that we were begun as *Audio Engineering* in May of 1947, and that I have been on the editorial staff for more than a third of the time since then. I also had the pleasure of working with the long-time Editor-owner-publisher of this magazine, C. G. "Mac" McProud. We "hot chaired" the production desk during the last six months of his in-office term, which lasted from the start-up through the fall of 1970. I have always thought of Mac as the Editor Emeritus, for it is on his model that the magazine still prospers.

One way to see how far you have to go is to turn around and see how far you've come. In the case of *Audio*, the mileposts are put in place by equipment, which is the core subject matter of this magazine. We are helped in this look over our shoulder by a handful of firms who have inserted "vintage" ads in this section, and we thank them for their support of our mutual hobby over the years. We hope that you will find this retrospective interesting and join us in celebrating *Audio's* entry into a fifth decade.—E.P.

SPECIAL ANNIVERSARY ADVERTISING SECTION



**New Magnavox
Combination Set**

A1-R insures convenient and perfect Radio reproduction. Consists of Magnavox Reproducer and 2-stage Magnavox Power Amplifier, as illustrated.

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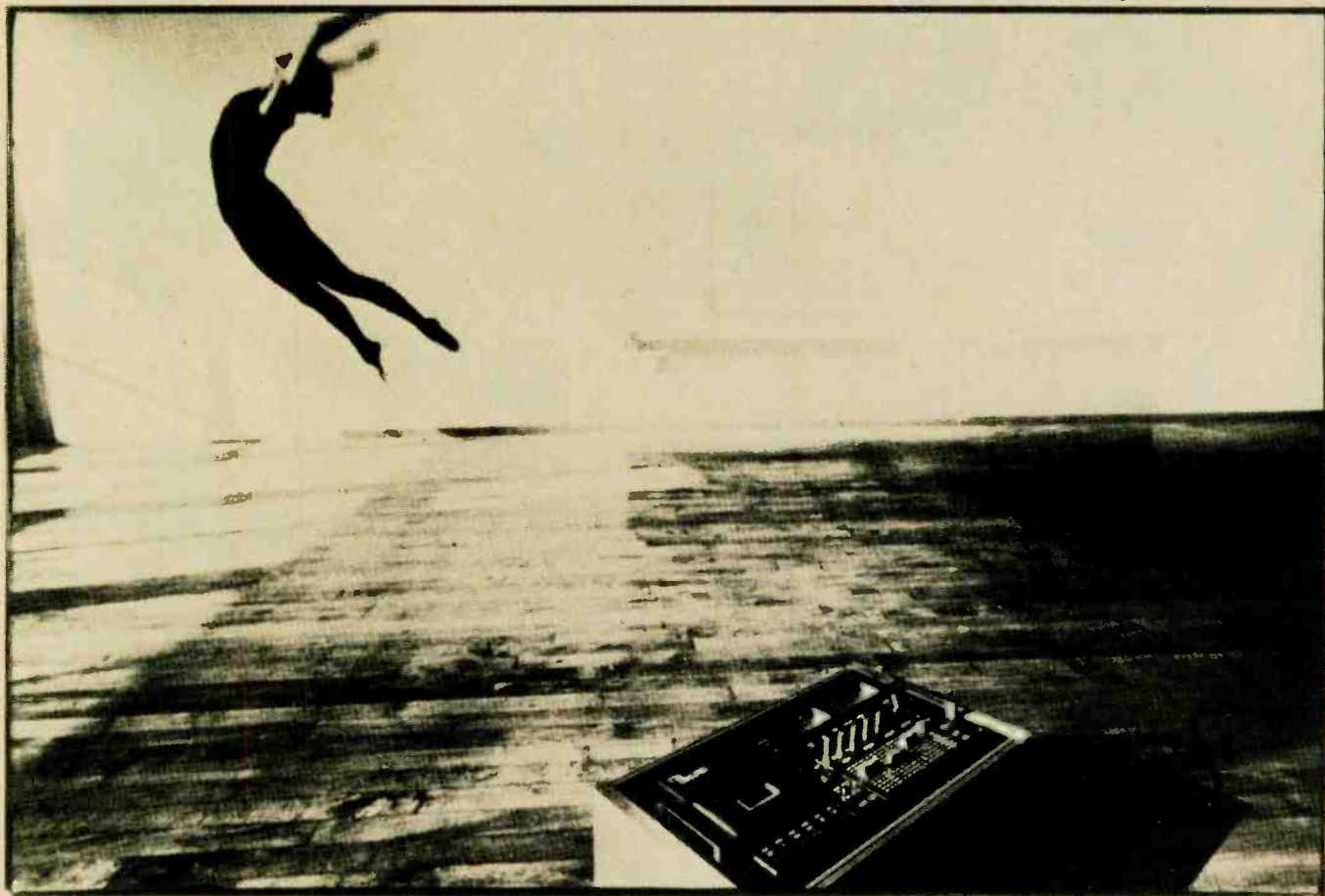
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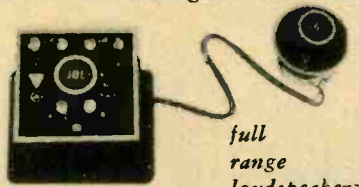
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Products of unusual creativity and competence...

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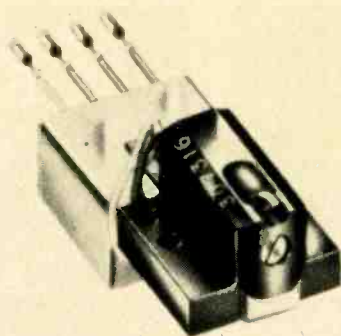
Hear it all with *Ortofon* Stereo Cartridges

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A lot of money? You bet it is. But that's what it cost Sansui to develop the world's most advanced receiver. The Sansui G-9000 super fidelity DC receiver. Never before has music reproduction been so clean, brilliant and true. When you listen to a G-9000 you'll actually hear a difference. When you look at the specifications, you will understand why.

The amplifier section is DC and direct coupled to achieve a frequency response of zero Hz to 200 kHz (from man-in, -3dB). A slew rate of 80V/ μ sec., achieved through the unique Sansui amplifier circuitry (patent pending), ensures ultra-fast transient response. And we've virtually eliminated distortion. THD is all the way down to 0.02% at full rated power, 160 watts per channel min. RMS, both channels driven into 8 ohms from 20-20,000Hz.

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tening conditions. Sensitivity is 1.5 μ V (8.7dBf), and capture ratio is a very low 0.9dB.

More advanced than nearly every separate amplifier and tuner available today, the Sansui G-9000, with simulated woodgrain cabinet, is certainly more convenient, especially when you look at and handle its full complement of "human engineered" controls. They are beautifully positioned, superbly smooth and outstandingly accurate. We've even placed all the input, output and speaker terminals at the sides with rails for hiding the cables.

Interested? Then visit your nearest Sansui dealer today. You'll be surprised to learn that our suggested retail price is only \$1,050. And that we also offer the G-8000 pure power DC receiver, with nearly all the advantages of the G-9000, but with slightly less power, at a suggested retail price of only \$900. Which isn't a lot when you consider that these super fidelity components are easily worth a million.

The Sansui G-9000 pure power DC receiver.



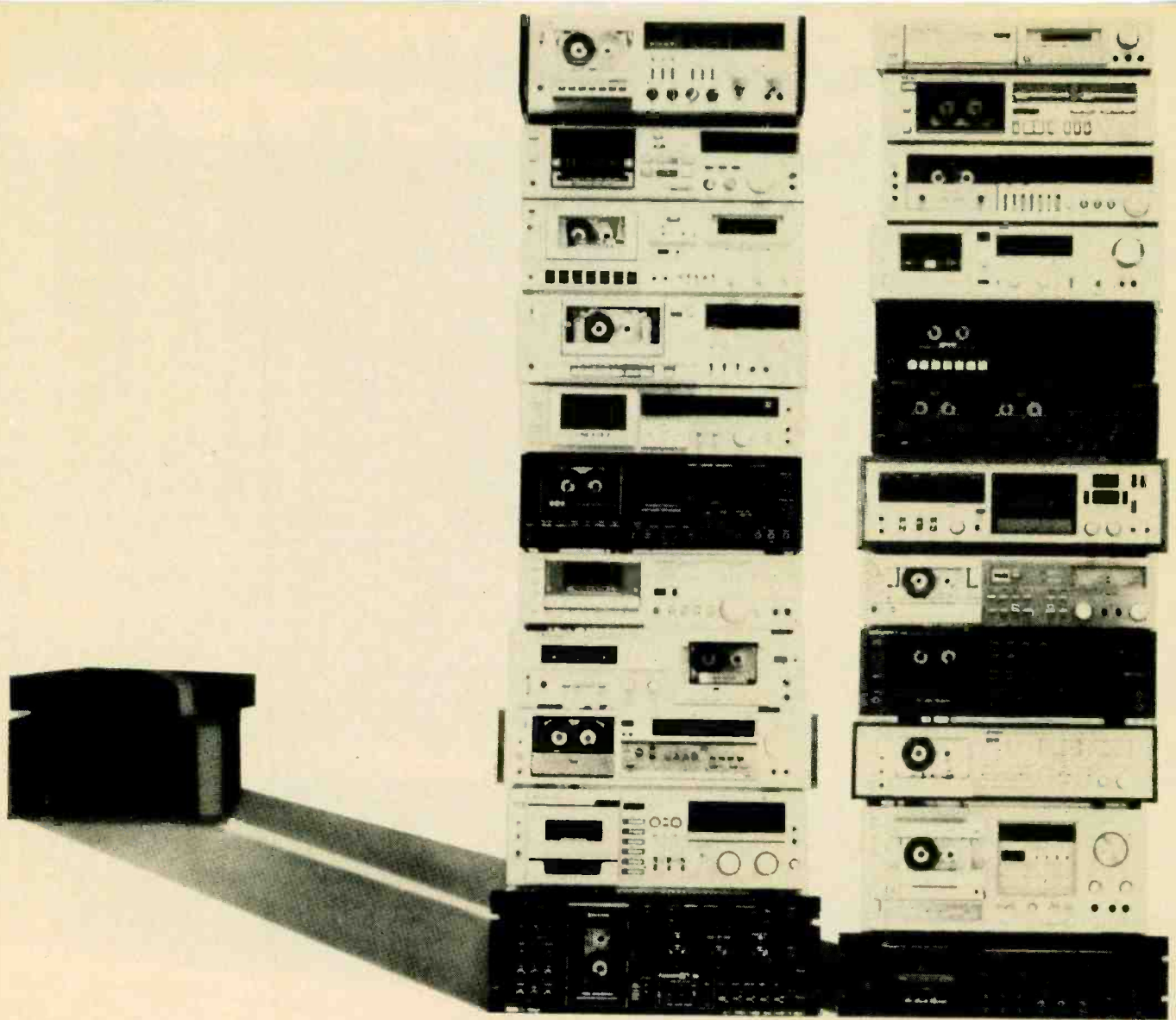
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23 deck makers bias with TDK metal. That doesn't leave many for the competition.

When it comes to the critical bias adjustment, the vast majority of manufacturers won't use anything but TDK Metal Alloy cassettes. TDK metal excels in two different cases. The MA-R has the Reference Standard Mechanism, with a unique metal unibody frame. MA uses the Laboratory Standard Mechanism, designed to deliver the smoothest possible flow of music.

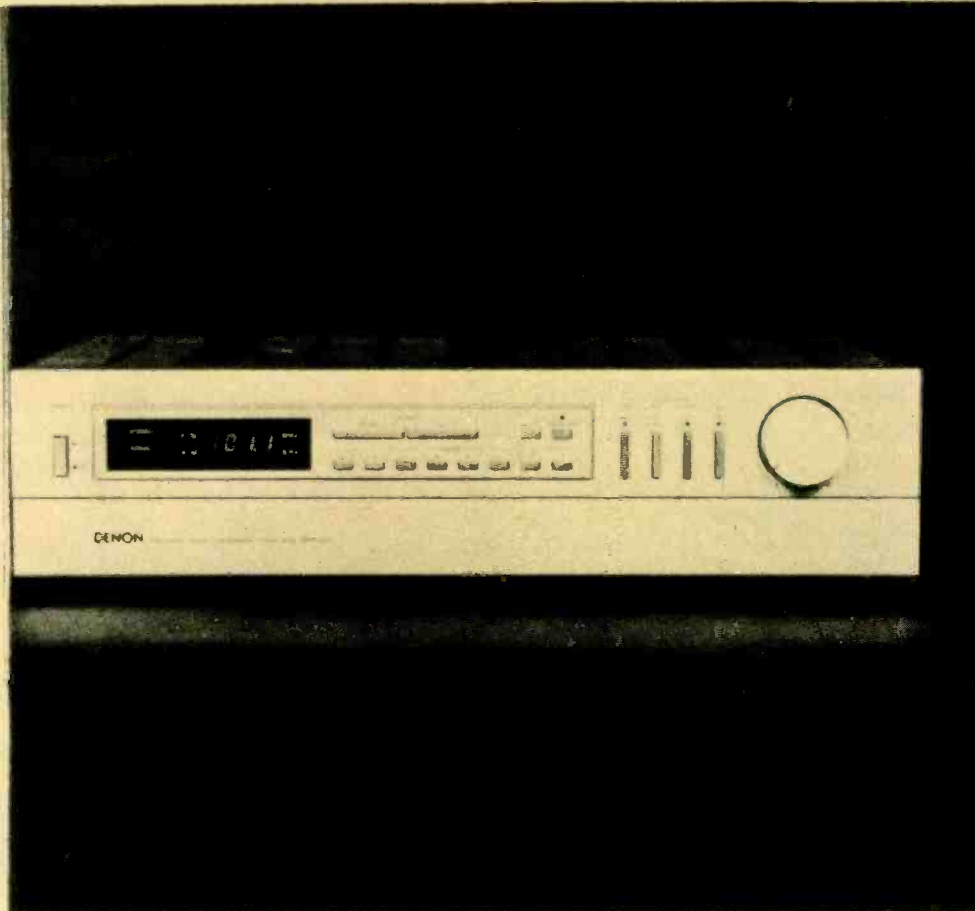
Both MA-R and MA incorporate TDK's remarkable tape formulation, FINAVINX, a metal particle with extremely high coercivity and remanence for high frequency response and low distortion. TDK metal has the widest frequency range and highest MOL of all cassettes rated in an independent test.

It's not easy to get 23 quality deck makers to reach the same conclusion. If you use TDK metal, you'll be in good company.

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The machine for your machine



1939...FIRST DIRECT-DRIVE TURNTABLE SYSTEM.
1951...FIRST MOVING-COIL CARTRIDGE.
1972...FIRST DIGITAL (PCM) RECORDING.



Direct drive. Moving-coil. Pulse Code Modulation. All synonyms for technological innovation in the high-fidelity field, these phrases fill the pages of the audio magazines and the conversations of serious music enthusiasts. But aside from being major breakthroughs in audio engineering, they have one other element in common. They are all innovations developed by one company. Denon.

While other companies have just begun to offer products incorporating these new technologies, Denon originated them. And only Denon has had 41 years to refine direct-drive turntables, 29 years to perfect moving-coil technology, and almost a decade to further develop their invention of PCM digital recording.

1981...DENON DRA-600. THE FIRST RECEIVER FROM A TRUE AUDIOPHILE COMPANY.

The Denon DRA-600, a synthesis of Denon's greatest technological strengths.

From our thirty years of experience with moving-coil cartridges, we gave it a moving-coil preamplifier stage sonically as transparent as our renowned separate head-amps.

From our fifty-plus years of electronics design experience, we powered the DRA-600 with a proprietary Denon Class-A power amp, a design that delivers unparalleled definition and openness, yet avoids the excessive heat, size and cost of traditional Class A amplifiers.

And, from our decade of experience since our invention of commercial digital recording (PCM), we equipped the DRA-600 with a digitally synthesized tuner stage for the most precise station tuning with the lowest distortion. Plus, we added the convenience of eight AM and eight FM presets with automatic station scanning.

Denon. 70 years of audio design experience. An extraordinary history of technological firsts and advances in the state of the high-fidelity art. All embodied in the surprisingly affordable DRA-600. A most important first from Denon, where innovation is a tradition.

DENON
*Imagine
 what we'll
 do next.*

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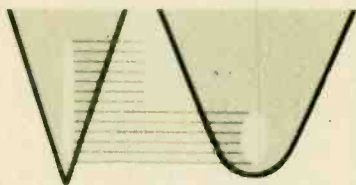
The Adcom Crosscoil XC. The finest high output moving coil cartridge yet devised.

The new van den Hul stylus. The most far reaching improvement in stylus design since the invention of the phonograph.

Now, these two signal contributions to audio technology have been combined to create the ultimate phono cartridge.

The Adcom Crosscoil XC/van den Hul.

Relative groove contact area (in white) van den Hul (L) vs. elliptical stylus (R)



Staying on track

Anyone with even a casual knowledge of phono cartridge design recognizes that the interface between the stylus tip and the record groove is of paramount importance. For if the stylus tip is unable to accurately trace the microscopic undulations of the record groove, the result must inevitably be something less than faithful reproduction.

Obviously, the shape or contour of the stylus tip is the critical performance factor. Just how critical, may be inferred from the proliferation of stylus designs in recent years.

Ideally, the perfect stylus would have the same shape as the stylus used to cut the record master. Unfortunately, this rather obvious solution has proved to be impractical, for such a stylus tends to "recut" the groove with each play and hasten record wear.

Clearly, what is required is a modified tip shape which closely approaches that of the cutter stylus, yet avoids its potentially destructive drawbacks.

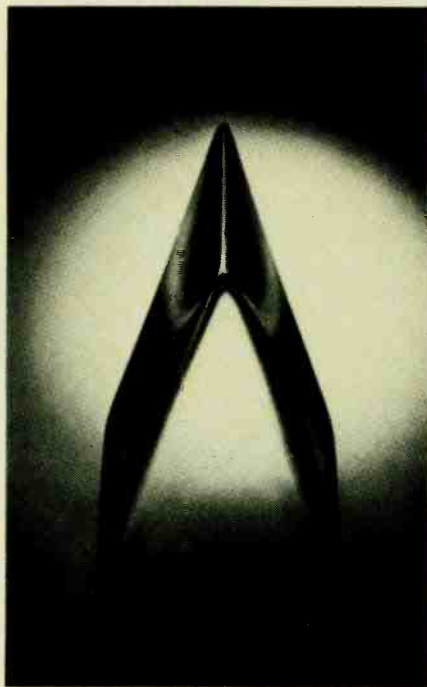
Enter the van den Hul Stylus.

Employing advanced computer optimization techniques, A.J. van den Hul, a Dutch scientist, has developed a new stylus shape that achieves this most elusive goal.

The shape of the new van den Hul stylus tip is the closest, practical approximation of the cutter yet devised. Its contact radius is only 3.5 microns (front to back), while vertical groove contact is extended to 85 microns.

As a result, the new stylus can trace frequencies as high as 85 kHz. So, reproducing 20Hz to 20 kHz signals is no problem at all.

But extended frequency response is only the beginning.



Exhaustive testing has revealed that the new van den Hul stylus materially reduces record and tip wear. And thanks to the extended vertical contact radius, records actually play more quietly with less groove deformation.

Tip mass is extremely low, achieved via a programmed grinding pattern that removes excess diamond from front and rear surfaces. An added benefit is the reduction of tracing distortion at all levels of groove modulation. Finally, a square diamond shank insures precise alignment of the tip in respect to the cantilever.

But in order to fully realize all of the performance benefits conferred by this truly innovative stylus, it must be coupled to a demonstrably superior cartridge capable of translating extraordinarily complex mechanical movement into a precise electrical analog.

Happily, the Adcom Crosscoil XC is just such a cartridge. Experts have been unstinting in their praise, citing the Crosscoil for its extremely flat and extended frequency response, low distortion, superb dynamic range and above all its unflinching musicality.

In combination, cartridge and stylus seem to transcend their individual capabilities. A synergism that fully justifies the expression, "the ultimate cartridge."

Surely, one day someone will create a cartridge to equal it, but if you would like to experience the future now, listen to the Adcom Crosscoil XC/van den Hul. It is truly the shape of things to come.

For additional information and the name of your nearest Adcom dealer write: Adcom, 11 Elkins Road, East Brunswick, New Jersey 08816 U.S.A.

THE SHAPE OF THINGS TO COME.



THE ADCOM CROSSCOIL XC/VAN DEN HUL

The quality and versatility of custom sound with the installation ease of compact package equipment!

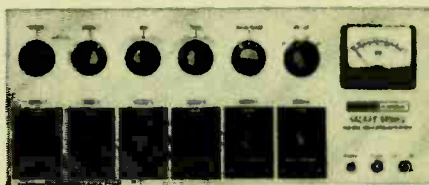


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More power, more features, more sales potential! Harman-Kardon has created a dramatic new concept in professional sound equipment—a modularized line with performance, flexibility and value unmatched in its price range. For the first time, you can offer amplifiers combining

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Division, Harman-Kardon, Plainview, L. I., New York.

Just a few features found on the GALAXY Series: Remote control of level, AC power and standby operation; Monitor jack as well as optional monitor speaker or VU meter; Constant voltage outputs, both balanced and unbalanced; Bridging connections; Low Cut Filter, Speech Filters; NARTB Mic Inputs; All plug-in accessories; Response and distortion specs that satisfy the most stringent requirements.

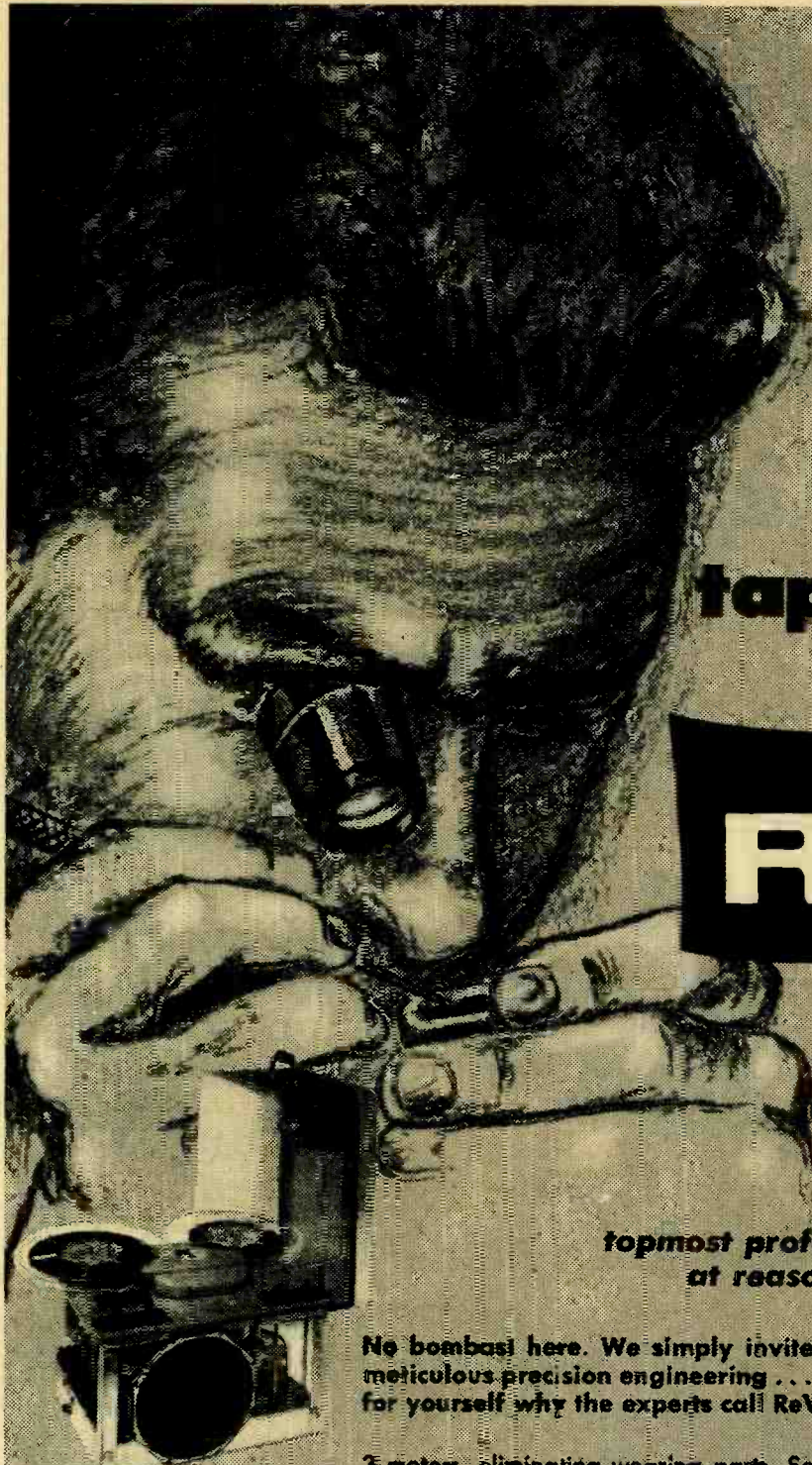


GALAXY Power Booster

Built by Sound Men for Sound-Men

harman kardon

HK-71



NEW—

**from the heritage
of Swiss precision**

tape recorders.

by

REVOX

**topmost professional quality
at reasonable cost**

No bombast here. We simply invite you to inspect the ReVox *critically*. In meticulous precision engineering . . . and in listening quality . . . you will see for yourself why the experts call ReVox the new leader.

3 motors, eliminating wearing parts. Separate recording and playback hard-alloy toroid heads. Separate recording and playback amplifiers permitting simultaneous and continuous monitoring. High quality 8" coaxial speaker. Precision "turret assembly" wiring. Wow and flutter well within NARTB professional standards for studio machines at $7\frac{1}{2}$ in/sec: 0.15 to 0.25% rms max. measured at either 5000 or 3000 cps and including all sources. Frequency response at $7\frac{1}{2}$ in/sec (1000 cps reference): 40-12,000 cps ± 1 , -2 db, roll-off to 15,000 cps under -4 db. Speeds are $3\frac{1}{4}$ and $7\frac{1}{2}$ in/sec with pole-switching hysteresis synchronous capstan drive (outside rotar). 8 tubes: 4 ECC83/12AX7, 1-ECC81/12AT7, 1-ECC82/12AU7, 1-EL84, 1-EM71, 3-selenium rectifiers. Overall size with carrying case is $18\frac{1}{4}$ " x $11\frac{1}{16}$ " x $13\frac{3}{8}$ "; model also available for custom installation. Large reels accommodate over 2400 feet of normal tape in each direction.

Dual Track, \$399.00 net

Single Track, \$429.00 net

REVOX

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WILLI STÜDER
Manufacturer of magnetic tape recorders

October, 1957

Write for complete literature and name of nearest dealer



Revox B226: Digital at the Vanishing Point

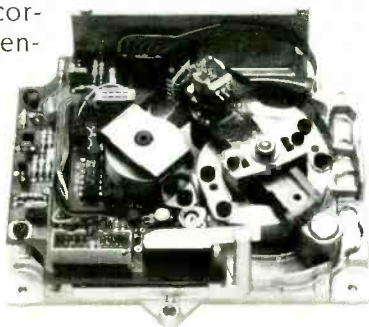
Connect a new Revox B226 CD player to a very high quality home audio system. Load it with a superbly recorded disc. Sit back, press "play" on the IR remote control . . . and something peculiar happens.

The B226 virtually disappears.

What you hear is pure music. Nothing added, nothing taken away. No harshness, no grittiness, no coloration, no shrinking, no softening, no etching. Nothing except all the depth, dynamics, and subtle nuances of a live musical performance.

This "vanishing act" does not come easily. For example, the B226 transport chassis is made from solid die-cast aluminum alloy to provide long-term stability. The entire mechanism is suspended on damped isolation mounts to minimize potential problems from vibration or resonance.

Also, the B226 incorporates the newest generation of European-developed LSI chips for D-A conversion, interpolation, error correction, and digital filtering. Resolution is full 16-bit, with quadruple oversampling and dual D-A converters for precise phase linearity. New adaptive error correction selects



the best error correction strategy (from 60 possibilities) to greatly improve performance on dirty or damaged discs.

In the crucial analog output stages, Revox uses strictly professional grade components. B226 circuit boards meet the same performance and reliability standards as boards made for our Studer professional mastering recorders. Little wonder, since both come from the same plant in the Black Forest of West Germany.

Essentially, then, the B226 delivers a purity and transparency of sound that challenges "custom conversion" units. But without sacrificing convenience and flexibility.

With Revox you still get full programmability of virtually every imaginable function, plus digital outputs for audio or auxiliary data, fixed and adjustable audio outputs with ample voltage for directly driving power amps, and the convenience of infrared remote control with multi-room capability.

For a convincing demonstration, visit your nearest authorized Revox dealer. Slip your favorite CD into a B226, sit back, and listen to digital audio at the vanishing point.

STUDER REVOX

1425 Elm Hill Pike, Nashville, TN 37210
615-254-5651

1

LINN AXIS TURNTABLE

Manufacturer's Specifications

Drive System: Belt.

Motor Type: 24-pole synchronous,
300 rpm.

Speeds: 33 $\frac{1}{3}$ and 45 rpm.

Speed Accuracy: 0.1%.

Wow & Flutter: 0.05%.

Rumble: -75 dB, DIN weighted.

Dimensions: 17 $\frac{1}{2}$ in. W x 13 $\frac{3}{4}$ in. D
x 5 $\frac{1}{2}$ in. H (445 mm x 349 mm x
140 mm); height with lid open, 15 $\frac{3}{4}$
in. (400 mm).

Shipping Weight: 17.6 lbs. (8 kg),
including arm.

Price: \$425; \$575 with Linn Basik
arm.

Company Address: c/o Audiophile
Systems, 8709 Castle Park Dr., Indi-
anapolis, Ind. 46256.

For literature, circle No. 90



For years we heard most experts tell us that the loudspeaker was the weakest link in the sound reproduction chain. Other experts told us that the cartridge was the most important element to consider when buying a system. When Ivor Tiefenbrun of Linn Products Co. began to demonstrate that the seemingly unobtrusive turntable could also color reproduced sound, most experts were skeptical at first. He set up demonstrations and compared the Linn Sondek LP-12 with other turntables of the day, and the coloration caused by these turntables was apparent—but only because it was absent in the LP-12. I think that Tiefenbrun can be credited with focusing, in recent years, more attention on the turntable.

I am sure there are still many audio readers who wonder why such a fuss is made about turntables. Even the editor of this magazine admitted to me that he had been a bit skeptical about the relative emphasis to be assigned to turntables, until a recent demonstration at which we both were present.

For Linn Products and Ivor Tiefenbrun in particular, it must have been difficult to decide to bring out a turntable which would be lower in cost than the LP-12. How could this be achieved? What could be done to make the turntable less expensive without seriously compromising its quality? One thing which helped to allow a lower cost turntable even to be considered was the fact that the LP-12 has undergone a series of significant improvements since its introduction. Therefore, Linn set out to produce a turntable which provided a level of performance at least equal to that of the original LP-12. Another goal was that the new turntable should be

audibly better than other, competitively priced turntables. Thus the Axis was born. While many other companies appear to build turntables for different price points, the price of the Axis was determined by the cost necessary to produce a specified level of quality. Some insiders know that Linn has aborted, at least a couple of times, the introduction of designs which didn't quite meet their goals.

First Impressions

Whenever I receive an audio product to test, I form certain impressions as I set it up and adjust it. Sometimes the high level of performance of a product overcomes the negative feelings initially generated during a difficult setup. Other times, the appearance of a product causes a positive or negative prejudice. In the case of the Linn Axis turntable, there were some things which tended to make me think that it would provide a lower level of performance than it actually did provide. After testing a number of difficult-to-set-up turntables which provided excellent performance, setting up the Linn Axis was so easy that I naturally thought, "How can a turntable that is this easy to set up be capable of great performance?" The simple styling and light weight also contributed to this false impression. The Axis weighs only about 17½ pounds with the arm, detachable line cord, and phono cable included. I always attempt to keep an open mind when I evaluate any product, but the fact that I rely on the aural judgments of a listening panel helps considerably. In the case of the Axis, it was invaluable.

Features

Because of its similarities to the Sondek LP-12 turntable, which was evaluated in the November 1983 issue of *Audio*, it seemed logical to me that I should compare the Axis to it, looking at each major part one by one. The spindle and its associated thrust-plate bearing have always been considered by Linn to be the principal feature of any turntable, and they have lavished attention on these parts, machining and polishing them to a degree never even considered by most turntable manufacturers. Rather than go into detail here about the specific operations, I will say only that I have never seen anything comparable—except in the aerospace industry.

The spindle on the Axis turntable is less complicated than that of the LP-12, but the tip and the sides, which rotate against the thrust plate and well bearings, are machined and polished to the same degree of perfection. Linn engineers have found a way to eliminate some of the 14 steps necessary in manufacturing the LP-12 spindle, by simplifying the way the Axis spindle is attached to the turntable platter. Both spindles are made from hardened steel. Rather than using a separate ball bearing, as some other turntables do, they are machined to a conical shape with a precision radius at the end. The advantage of this technique is that instead of having a flat spindle bottom rotating on a ball which then rotates against a flat thrust plate, only the tip of the spindle rotates on the thrust plate. This means that the spindle tip must be perfectly centered so that it does a perfect pirouette on the thrust plate, rather than engraving a circle. The thrust plate, also made of hardened steel, is lapped and polished to a mirror finish. Such precision en-

MEASURED DATA

Parameter	Measurement		Comment on Axis
	Axis	LP-12*	
Speed (at 33⅓ rpm)	+0.25%**	+0.13%**	Very Good
Speed Stability	±0.10%	±0.22%	Excellent
Wow, Unwtd.	0.13%	0.25%	Excellent
Wow, DIN Wtd.	0.07%	0.10%	Excellent
Flutter, Unwtd.	0.11%	0.15%	Very Good
Flutter, DIN Wtd.	0.03%	0.02%	Excellent
Wow & Flutter, Unwtd.	0.18%	0.24%	Excellent
Wow & Flutter, DIN Wtd.	0.08%	0.11%	Excellent
Long-Term Drift	0.11%	0.12%	Excellent
Rumble, Unwtd.	-67 dB	-59.0 dB	Excellent
Rumble, Wtd.	-87 dB	-66.0 dB	Excellent
Suspension Resonance	†	5.8 Hz	Excellent

*This data has been updated from that which appeared in *Audio*'s original Profile for the LP-12 (November 1983).

**Measured with the B & K 2010 test record, whose 3,150-Hz tone may not be exact.

†Accurate measurement not possible because of the turntable's low Q.

Three custom-designed silicone-rubber mounts act as springs with inherent damping. I've never seen anything like them.

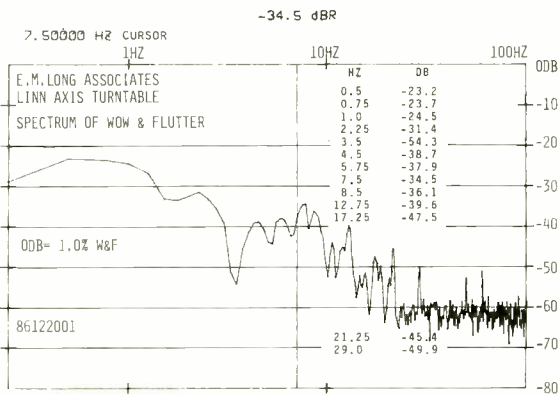


Fig. 1—Computer plot of wow-and-flutter spectrum, from 0 to 100 Hz. The major output at 0.56 Hz is related to the rotational speed.

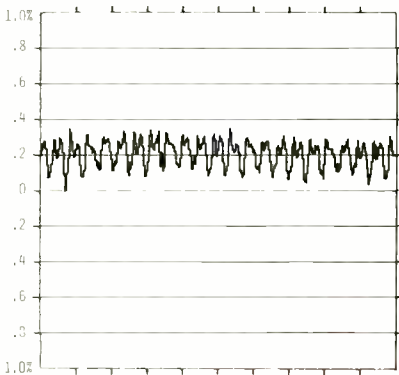


Fig. 2—Speed drift over 42-S period.

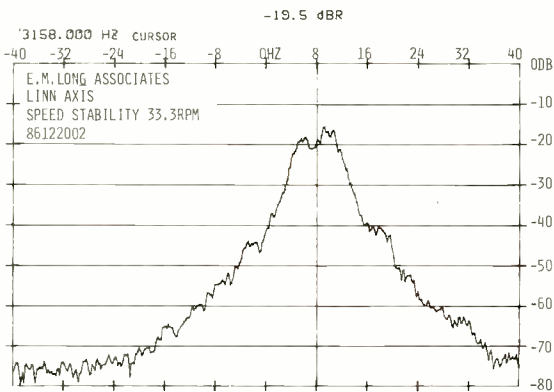


Fig. 3—Speed stability referenced to 3,150-Hz test tone on B & K 2010 test record. The tone may be a bit high (see text); speed stability is excellent.

ures that rotationally related vibration, which would color the reproduced sound, is reduced to an insignificant level.

The two-piece platter of the Axis is aluminum rather than the more costly Mazak alloy used on the LP-12. Both parts of the Axis platter are gravity cast and then machined, as is the LP-12 platter. The outer platter, 11 $\frac{3}{4}$ inches in diameter, rests upon an inner platter which is 6 $\frac{3}{8}$ inches in diameter. Both are covered by a felt record mat. The precision-ground, $\frac{3}{16}$ -inch-wide, flat neoprene drive belt is looped around the inner platter and an aluminum pulley which is mounted on the motor. The motor, a 24-pole a.c. type made to order by Philips, runs at 300 rpm. This allows Linn to machine a large-diameter pulley and press-fit it to the motor shaft. The motor's 300-rpm speed is equivalent to 5 Hz; this low frequency, which is below the useful audio range, is much easier to filter out than the 30-Hz vibration which is produced by a four-pole a.c. motor running at 1,800 rpm.

While the main platform of the LP-12 is stainless steel with a separate wood mounting board for the tonearm, the Axis uses a high-density, $\frac{1}{2}$ -inch-thick fiberboard material which has a laminate veneer on both sides to eliminate any tendency to warp. This base is less expensive to produce than the LP-12's, and probably does change the character of the reproduced sound; the question is whether the change is acceptable as a trade-off to achieve a lower cost. The visible side of the platform is dark gray laminate.

The turntable base, made of particleboard with a vinyl laminate veneer, is constructed using V-groove, fold-up techniques. The vinyl veneer is black with a wood-grain pattern. This base is obviously less expensive than the selected hardwood base of the LP-12.

Rather than employing the usual springs-with-damping type of suspension system, the Linn Axis uses three silicone-rubber mounts which act as springs with inherent damping. These are custom designed and molded and I have never seen anything like them on any other turntable. Each is cleverly designed as one long part, and together they act as the suspension of the turntable/tonearm platform and as feet for the base. Each mount consists of two thick-walled rubber tubes, connected by a thin rubber diaphragm, all parts of a single molding. The large, tubular bottom section has a 2 $\frac{3}{4}$ -inch outer diameter and a 2-inch inner diameter, and projects $\frac{1}{2}$ inch below the base to form the foot. This section is crowned by a molded-on metal flange ring, which is held to the base by four screws. The large tube is closed at the top by the molded-in diaphragm, to which the smaller tube, with an outer diameter of 1 $\frac{1}{8}$ inches, is joined. This tube, which is about 1 $\frac{1}{8}$ inches high, supports the platform on which the arm and platter are mounted. The rubber diaphragm allows for up-and-down motion of this platform while limiting any tendency to rock or sway. Rocking and swaying are further limited by a bolt that passes through the upper tube, through a 3 $\frac{1}{2}$ -inch-diameter washer below the platform, into a captive nut.

By molding each foot/suspension part as one continuous piece of the same material, three things are accomplished. First, energy transmitted from the turntable/tonearm platform to the surface upon which the turntable rests flows through the material with no change in velocity, which could result in reflection of energy back to the platform. Second, using one

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The Axis' contribution to the rumble spectrum is negligible; most of what appears is a product of the arm/cartridge resonance.

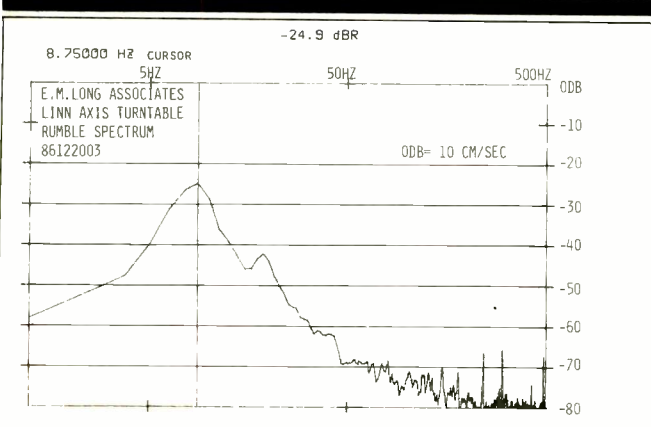


Fig. 4—Rumble spectrum. The output is extremely low, except for that which is caused by the arm/cartridge resonance.

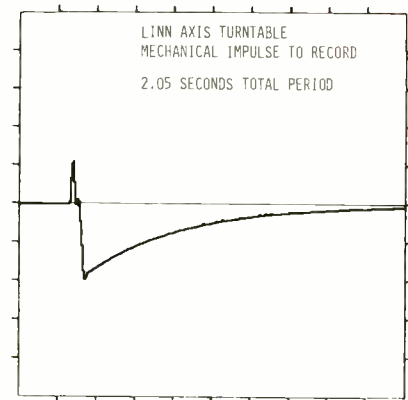


Fig. 5—Output vs. time for mechanical shock applied to edge of a stationary record, with stylus resting in groove. The felt mat causes a very smooth decay.

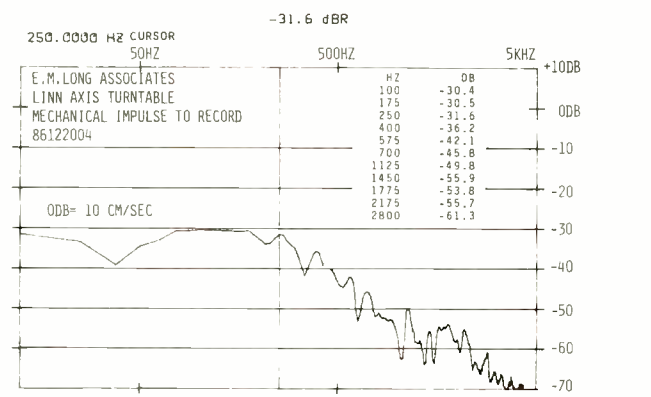


Fig. 6—Spectrum of output caused by a series of mechanical impulses applied to edge of stationary record, with stylus resting in groove.

solid part reduces the chance for assembly errors and possible misadjustment. Third, the parts and assembly-time costs are reduced significantly.

The tonearm mounts directly to the platform. The bottom of the base has a hole and slot, in the shape of a keyhole, to allow the exit of the tonearm phono leads. The turntable can be supplied without a tonearm or with the Linn Basik LXV. The unit that I tested had the Basik LVX tonearm and a Linn K9 moving-magnet cartridge. The a.c. power cord is an IEC standard detachable type with a separate three-pin plug; it is 2 meters (6½ feet) long. It appears that a simple wiring change on the circuit board will allow either 110- or 220-V operation. I am not sure about the motor speed for 50- or 60-Hz operation, but I assume the electronic circuitry provides for this.

The most obvious feature of the Axis—and the one which most clearly indicates that Linn is not just out to make a “cheap” turntable—is the large, 11-fin heat-sink which projects ¾ inch from the rear of the base. This heat-sink is for the two Class-A amplifiers which are used to drive the motor coils. Seeing this heat-sink makes an inquisitive person like myself want to get inside the turntable to see what is going on. Well, I wasn't disappointed; there is a large p.c. board with many parts, including seven ICs and four transistors. There are also four power transistors mounted on the heat-sink and connected to the p.c. board. This circuitry is designed to provide clean a.c. power to the motor and to allow both 33⅓- and 45-rpm speeds. A unique feature of the electronic circuitry is that it provides 110 V for starting and about 20 V for steady operation, thus reducing the hum and vibration produced by the motor. Pressing the button on the left front of the base lights a red LED and causes the turntable platter to rotate at 33⅓ rpm. Holding the button down for 2 S causes a green LED to light and changes the speed to 45 rpm.

The Axis is very light, as I mentioned before, so finding a place for it will not be the problem it is for some of the heavyweight turntables I have tested. A clearance of 16 inches between the shelf upon which the turntable is placed and the shelf above is necessary to allow the lid to remain open on its spring-loaded hinges. The shelf should be about 16 inches deep.

Measurements and Listening Tests

The listening panel auditioned the Linn Axis as compared to my reference system, and their comments apply to that comparison, but I also had a chance to hear the Axis alongside a recent version of the Sondek LP-12. The LP-12 has an advantage over the Axis in terms of musical clarity and articulation of detail. In the Measured Data table, for comparison purposes, I have included data for the LP-12 (based on my original 1983 measurements) along with the data for the Axis. (As originally published, some of the LP-12 measurements were in error; they have been corrected here.) I have always felt that the raw data shown in the Figures is much more valuable than single numbers for such things as wow and flutter and rumble. Comparing the graphs of the original report with the graphs in this report can be useful, but I wish I had been able to run tests on a recent Linn Sondek LP-12.

The Linn remained synchronized with the reference turntable over the whole side of an LP, very nice performance.

Figure 1 shows the wow-and-flutter spectrum in the range from 0 to 100 Hz when reproducing the 3,150-Hz tone on the B & K 2010 test record. The system was calibrated so that a 1% modulation of the test signal produced an output at the top of the scale. Each division represents 10 dB, so 10 dB down represents 0.316%, -20 dB is 0.1%, and so on to the bottom, which is -80 dB or 0.0001%. (Figure 1 of the LP-12 is calibrated to show 3% at the top of the scale, so you will have to make a visual adjustment if you compare it to Fig. 1 here.) The major output is at the rotational-speed related frequency of 0.56 Hz, with some additional output in a broad range around the tonearm/cartridge resonance, which was about 8.75 Hz. Piano recordings seem to be the most revealing of wow and flutter, and the Axis elicited no adverse comments by the listening panel when reproducing them.

Figure 2 shows the drift in speed over a 42-S interval with the Axis running at 33 $\frac{1}{3}$ rpm. The cyclical speed variation is related to the rotational speed of the turntable platter and is within $\pm 0.18\%$. The overall drift over the 42-S period shows a variation of only $\pm 0.11\%$. This is better than other, higher priced turntables that I have measured, but the jaggedness means that the speed is not changing in a smooth manner. I don't think this effect was discernible when the Axis was compared to the reference system, since I found no comments by the listening panel which I could correlate to it.

Figure 3 analyzes changes in speed in another way. The spectrum shown is due to the frequency variation of the 3,150-Hz test tone, graphed with a Nicolet 660-2D Fast Fourier Transform (FFT) analyzer in zoom mode with a window 80 Hz wide. The data was taken over 16 samples with the Axis running at 33 $\frac{1}{3}$ rpm. The cursor was set at 3,158 Hz because either the Axis is 0.254% fast or the tone on the B & K 2010 test record is not precisely 3,150 Hz. Comparing this data with data on other turntables that I have tested, I have to say that it shows excellent speed stability. This was an advantage during the listening tests, when I would synchronize the reference turntable with the Axis to allow simultaneous playing of copies of the same record on both. The Axis stayed synchronized with the reference turntable over the whole side of an LP. Very nice.

Figure 4 shows the rumble spectrum for the Axis; except for what is contributed by the tonearm/cartridge resonance, the output is extremely low. If the Q of the tonearm/cartridge resonance were lower, then the rumble would be reduced considerably. In any case, the contribution to the total rumble caused by the turntable is negligible. I am certain that this is due to the precision polish of the shaft and its bearings, and the main bearing and its thrust plate.

While other turntable manufacturers have implemented various methods of removing internally reflected or delayed energy from records, Linn has continued using a simple felt mat on the Sondek LP-12. The same felt mat is supplied with the Axis. The output caused by a mechanical impact to the edge of a stationary record (Fig. 5) shows a sharp rise with a smooth decay of energy. The total time window is 2.05 S. (For those of you comparing this with Fig. 6 of the LP-12 report, I noticed that the caption on the latter says the time window is 0.205 S. This is incorrect; it should say 2.05 S.) This curve for decay versus time is very distinctive, and I

have seen it only when a felt mat is used. The only comments made by listening panel members which I could correlate to the felt mat were that certain instruments such as trumpet and violins were brighter, and that individual piano notes during staccato passages were not as clearly defined on the Axis as on the reference turntable.

Figure 6 shows the spectrum of the output caused by 16 mechanical impulses like that of Fig. 5. The value of such a spectral analysis is in the fact that peaks and dips can be seen even though the impulse in Fig. 5 might not indicate that they are present. The energy which appears in the spectrum between 11.25 and 28 kHz might be related to panel members' comments about brightness in the sound. It should be emphasized that these comments were made when comparing the sound with that produced using the reference turntable.

I was able to listen to a large number of recordings using the Axis over long periods of time. I do this with all the

Fig. 7—
Output vs. time
for mechanical
shock applied
to heavy platform
on which the
turntable rested.
Isolation was
impressive.

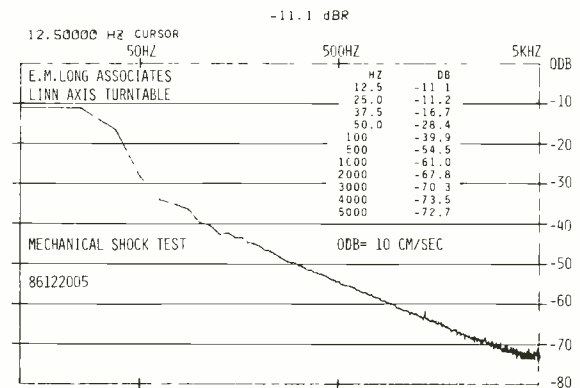
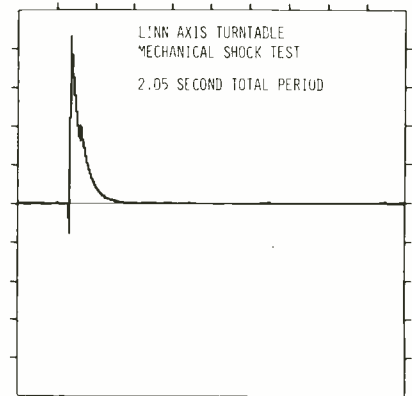


Fig. 8—Spectrum (to 5 kHz) of the vibrations caused by mechanical shock applied to platform supporting the turntable.

If *Audio* had a "best buy" rating, I would vote that it be awarded to the Axis because of its low cost and high performance.

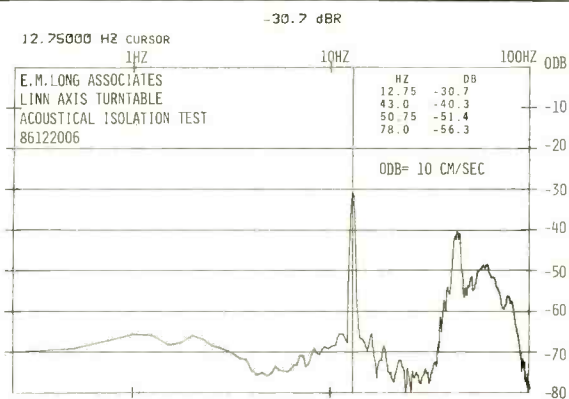


Fig. 9—Spectrum (to 100 Hz) of the vibrations from a 100 dB SPL acoustic field at the surface of a record. Stylus is resting in a groove near the middle of the record.

turntables that I test to check for "listening fatigue." The Axis passed this test easily.

Figures 7 and 8 show the reaction of the Axis to a mechanical shock applied to the heavy platform upon which the turntable rested. The isolation was impressive, and remained so during numerous repetitions of this test.

Figure 9 shows the spectrum of the output generated by a slow sweep of frequencies from 20 to 100 Hz, which produces an acoustical level of 100 dB SPL at the surface of a record on the turntable. I am not sure what produced the sharp increase in output at 12.75 Hz, and I don't want to speculate. There was nothing strange in the sound during any listening tests which I could correlate with this 12.75-Hz output. The output at higher frequencies, up to 100 Hz, is similar to that seen in other reports, and shows that the Axis has good isolation from external sound fields.

Conclusions

It is apparent that both Linn Products Co. and its U.S. distributor, Audiophile Systems, are dedicated to the enjoyment of reproduced music via records. I think the Axis is a very good turntable, especially when its price is considered, and anyone thinking of purchasing a turntable should audition it. In fact, if *Audio* had a "best buy" rating I would vote that it be awarded to the Axis, because of its combination of high performance and low cost.

Edward M. Long

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SINGULAR SENSATION



Every Breath You Take/The Singles Collection: The Police
A & M CD 3902.

Every move they made was magic, album after album. Do you remember hearing "Roxanne" for the first time, or the plaintive, almost eerie "Message in a Bottle"? I remember that one—vividly. It was a rare musical epiphany for me, one of those moments when something unique and wonderful makes itself known in a blinding flash. And I hadn't even seen Sting yet, so my response wasn't colored by his personal allure.

Every Breath You Take/The Singles Collection is a compilation of cuts from five Police albums released between 1978 and 1983 (except for "Don't Stand So Close to Me '86," an updated version of the 1981 original). The album is remarkable in that every one of the 12 selections is nothing less than splendid. Each sounds as fresh and vibrant as it did the day it was recorded, and each remains intriguing and compelling, as Sting's one-of-a-kind vocals and bass riffs, Andy Summers' atmospheric guitar, and Stewart Copeland's intricate drumming weave together in the distinctive patterns that so strongly influenced popular music in the '80s.

The transference of this material to the Compact Disc format highlights a

running characteristic of these extraordinary pop songs. Although The Police's reggae bent was tempered over time by the influences of funk, Arab, Indian, and African music, one of the constants in all of these cuts is a sophisticated understanding of the value of silence. Part of what makes that first cry of "Roxanne" so dramatic and memorable, for instance, is the way it rolls forth from empty space and hangs there, quivering and exposed. Great chunks of silence act as punctuation to the exclamatory instrumental climaxes of "Every Little Thing She Does Is Magic." Throughout this compilation, shifting layers of sound that slip over and under each other like clouds in the upper atmosphere are kept clean and defined by the silences between them.

This enterprise shows the presence of a sophisticated hand at the production wheel. Although the sound picks up a new vibrancy with the arrival of Hugh Padgham in 1981 on "Every Breath You Take," the earlier studio work of The Police by themselves and with Nigel Gray is quite remarkable.

The digitalization of these original analog recordings opens the listener's ear to brilliant details that escaped totally unheard in the vinyl disc or cassette tape formats. Most dramatic is the appearance of a tiny saxophone squawk in the introduction of "Spirits in

the Material World" and the oh-so-faint synthesizer figure that materializes in the right channel at the beginning of "Walking on the Moon."

"Message in a Bottle," "Can't Stand Losing You," "Wrapped Around Your Finger"—title after title elicits sparks of recognition. This Compact Disc is a superb memento of a not-so-distant golden age when The Police were creating magically entrancing popular music of lasting value. *Paulette Weiss*

J Mood: Wynton Marsalis
Columbia CK 40308.

It's been five albums and about as many years since Wynton Marsalis, the wunderkind of jazz, released his first solo album. And he's only gotten better. Marsalis plays textbook-perfect jazz: It's well crafted, mature, and swinging; most important, it's played with conviction. *J Mood* is another collection of hard-edged, post-bop treatises by Marsalis, who is both working in the tradition and passionately reinventing it for himself.

Whether declaiming and moaning on the gangly blues ballad of "J Mood" or running high-energy, upper-register storms in "Insane Asylum," Marsalis exhibits total mastery of his instrument, producing a full-bodied tone that is shaped and caressed with smooth precision. He's capable of flash but isn't a flashy player—unless it's needed, of course. There are no furious runs or solos that end in predictable high-register squeals.





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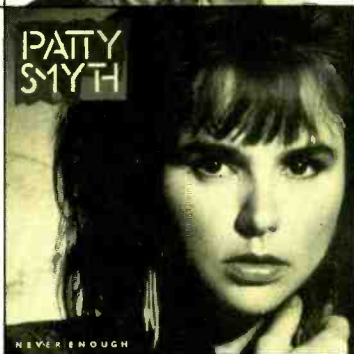


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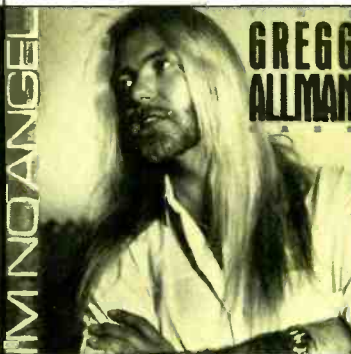


8



PATTY SMYTH

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14

15

18

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"Belkis" might remind you of a vulgar Hollywood film score, but the recording is a sonic blockbuster, just the same.

J Mood finds Marsalis with a new group; he's retained only drummer Jeff Watts, who's become a formidable force. Watts' blustering cymbal crashes and rolls drive you to the "Insane Asylum," and his rapid-fire brush strokes cut a kinetic groove on "Much Later." He can also lay out, providing

just the right punctuation on the ballads included here.

Pianist Marcus Roberts and bassist Robert Leslie Hurst III round out the unit. Roberts is a graceful accompanist, holding his own against Watts' drums in "Skain's Domain." Hurst suffers from the mix, however; his bass is

down far too low when it should be punching through. That is the only audio fault I find with this digital recording, and it detracts little from Marsalis' forceful energy.

Yes, *J Mood* is textbook-perfect jazz, and Marsalis has more than lived up to the hype he's generated. While he has yet to move jazz into any new directions, he's a distinctive and commanding voice.

John Diliberto

Respighi: Belkis, Queen of Sheba Suite; Metamorphoseon. The Philharmonia Orchestra, Geoffrey Simon. Chandos 8405.

Respighi was a master of orchestral color, as anyone who has heard his famous trilogy of "The Pines of Rome," "The Fountains of Rome," and "Feste Romane" can readily attest. As one listens to the rarely performed "Belkis, Queen of Sheba," it is obvious that Respighi's penchant for spectacular and colorful scoring got a bit out of hand. The four-part suite heard on this CD was extracted from his massive 80-minute ballet of "Belkis." If one can believe reports, on the occasion of the ballet's premiere at La Scala in January 1932, with the enormous augmented orchestra, off-stage brass choirs, huge chorus and all the other participants, over 1,000 performers were on the stage!

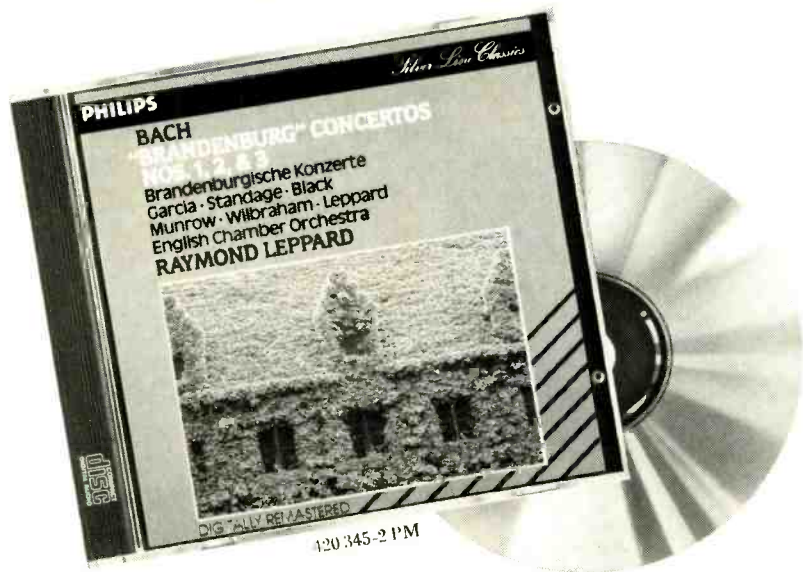
The music of "Belkis" is replete with vastly bloated brass fanfares, piercing woodwinds, frenetic string passages, and in the "War Dance" section a tumultuous assault from a variety of drums and assorted percussion instruments. The "Belkis" music reminds one of the most banal, vulgar type of Hollywood film score. Maybe Respighi had his tongue in his cheek, because there are sections here which are quite similar to the "hoochy kootchy" music of the old-time carnival sideshows!

Whatever your feelings about the music, the recording is a sonic blockbuster, good enough to win an award from *Gramophone* magazine for best engineered recording in 1986. It was made in the very reverberant acoustics of All-Saints Church in London. Credit must be given to the Chandos engineers, who have managed to provide very clean, brilliant, and well-defined sound in spite of this notoriously diffi-

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THE INSIDE STORY

cult venue. Credit must also go to conductor Geoffrey Simon, who does a good job of guiding the Philharmonia through the convolutions of this flamboyant music.

The "Metamorphoseon" work is a theme and variations for orchestra, and is cast in a more conservative mold. There is some clever and interesting writing here.

If you don't mind the excesses of Respighi's music, with a properly robust amplifier/loudspeaker combination this disc does indeed make a helluva sound, and in its own way can provide some fun and excitement!

Bert Whyte

Schubert: Quintet in A Major for Piano and Strings, Op. 114 ("Trout"); String Quartet No. 12 in C Minor, Op. posth. ("Quartettsatz"). The Smetana Quartet with Josef Hála, piano; František Posta, double bass.
Denon 38C37-7239.

The "Trout Quintet" of Schubert has been virtually No. 1 among works of European chamber music for around 150 years, and with good reason. It is, for one thing, prime Schubert, the easiest and best. And it incorporates a set of variations on one of the favorite Schubert songs, the "Trout" of the title—an obvious bid for popularity on the composer's part (he was 22) but no less pleasing for it. Then there is that rare instrument in such music, the double bass, oddly replacing one of the usual two violins of a quartet. It gives a remarkable sound to the music; it is never loud but always noticeable, far down in the bottom (assuming your equipment can cope, which plenty cannot). Finally, there is the special Schubert piano writing, when he uses this instrument with strings, creating an unforgettable and decorative effect not unlike that of our modern marimba-vibraphone-xylophone family, all glassy and tinkly in octaves.

There are 24 listed current recordings of this music in Schwann. It has been that way since the beginning of electrical recording. The "excuse" for still another performance is (a) the digital medium, and (b) the well-known Japanese label, first ever into digital via PCM, expanding its own European repertory.

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*130 watts per channel, min. RMS, both channels driven into 8 ohms from 20-20kHz with no more than 0.005% THD.



The recording itself is of the kind that is so good as to be unobtrusive. The three elements of the musical ensemble are ideally balanced: The trio of higher strings—violin, viola and cello—the very different sound of the Schubert piano, playing mostly in octaves, and the surprisingly gentle double bass down in the lowest bottom, sometimes barely audible but in that low

range remarkably powerful (with proper equipment!). It works to perfection, this balance, throughout the recording. I've never heard it better.

The Smetana Quartet members are veterans of many years and know the traditions of this music well, though they do a modern type of performance with no nonsense or sentimentality (as we would describe some of the playing

THE OUTSIDE STORY

The Vintage performance story continues on the outside. Sansui's AU-X901 features a double chassis to reduce resonance and provide heavy shielding, plus a strategically placed fifth foot to further reduce resonance. Coupled with gold-plated terminals and balanced inputs, the result is sound clarity.

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of past generations). I found a few cherished spots treated a bit casually, for my dotting ear, but on the whole the music moves along well, complementing the excellent recording.

There are a few things to note in the CD version. As always, the editing has had to cope with unwanted background, especially difficult with the CD silence. The first loud chord at the be-

ginning, for instance, sounds harsh and abrupt; it is shaved exactly to the beginning of the music, with total silence before. But absolute silence is *not* a natural musical sound! We need to establish a sense of space, somehow, before we can tolerate a sudden burst of music. I have a feeling that the LP version of the recording, with its very discreet subliminal background

sound, may do better for the ear in this opening chord.

I also note that the recorded level, as I began this CD, seemed very high, a hundred times as big as the Beethoven Ninth Symphony, which I had played immediately before. Or was the Beethoven a bit low? Everything is relative as we listen, in spite of engineers' precisions. We must ourselves do what we can to avoid that sort of contrast, between "big" and "small" music, by the use of our own volume controls. Not a new problem at all, but the CD, with its ultra-wide dynamic range, makes it more difficult.

Edward Tatnall Canby

Bach-Vivaldi: Double Concertos, Violin Concertos. The St. Paul Chamber Orchestra, Pinchas Zukerman; Zukerman and Midori, violins.
Philips 416 389-2.

Midori is the name of a most extraordinary Japanese girl who, at the tender age of 15, is an accomplished and internationally acclaimed violin virtuoso. She has already performed with such illustrious orchestras as the Philadelphia, the Cleveland, and the New York Philharmonic.

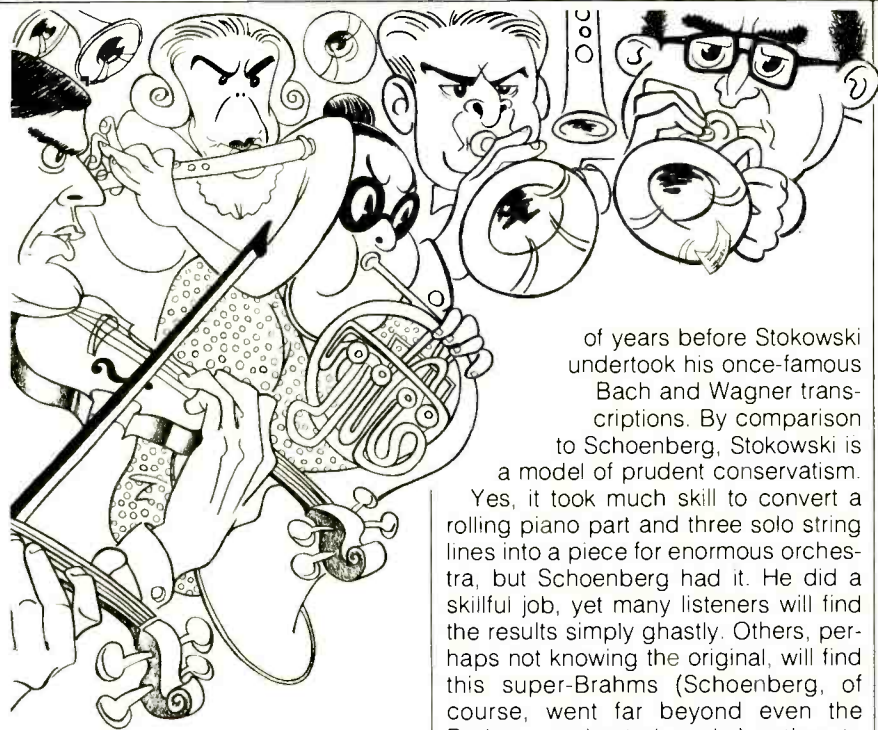
On this CD she is paired with renowned violinist Pinchas Zukerman, who also happens to be conductor of the prestigious St. Paul Chamber Orchestra. In the two double violin concertos included here (Bach's "Concerto in D Minor for Two Violins, Strings and Continuo" and Vivaldi's "Concerto in A Minor for Two Violins, Strings and Continuo"), it is obvious that Zukerman and Midori have established a fine rapport. They both provide technically secure, musically well-structured performances of these works. It is in no way denigrating the skills of Mr. Zukerman to state that young Midori plays very impressively and can more than hold her own. She proves this point again in her fine solo traversal of the Bach violin concerto in E major. (The fourth piece here is Vivaldi's violin concerto in C minor, "Il Sospetto.")

The recording is particularly good, a nice balance between soloists and orchestra. It is big and bright and quite assertive, with splendid and clean string tone from soloists and orchestra alike.

Bert Whyte

EDWARD TATNALL CANBY

SCHOEN' OFF



Brahms-Schoenberg: Piano Quartet, Op. 25; Bach-Schoenberg: Two Chorale Preludes. Sinfonierorchestre des Bayerischen Rundfunks, Michael Tilson Thomas. **CBS IM 42129.**

Controversy—this recording is its essence, and maybe you'll find it a lot of fun. Schoenberg, that reprobate genius whose atonal revolution single-handedly affected the entire music world, was also both an incurably excessive Romantic and an absolutely tasteless meddler into things he should have left alone (as *some* of us think ...). One thing he was *not* was an amateur or a weakling—whatever this man did, sublime or ridiculous, he was strong, very strong.

Here is Schoenberg's fond idea, skillfully carried out, of what should be done with a Brahms quartet for three strings and piano to make it more "accessible," to realize its Greater Potential, etc.—namely, recompose it for giant turn-of-the-century orchestra. Wow, what a sound! Also here are two short organ chorale preludes, similarly converted, à la Stokowski, into enormous orchestral showoff pieces. The great Schoenberg did these only a handful

of years before Stokowski undertook his once-famous Bach and Wagner transcriptions. By comparison to Schoenberg, Stokowski is a model of prudent conservatism.

Yes, it took much skill to convert a rolling piano part and three solo string lines into a piece for enormous orchestra, but Schoenberg had it. He did a skillful job, yet many listeners will find the results simply ghastly. Others, perhaps not knowing the original, will find this super-Brahms (Schoenberg, of course, went far beyond even the Brahms *orchestral* works) rather to their liking. Arguments will never cease; I stand firm, myself, on the anti-Schoenberg side, though I admit his ingenuity and skill. Note that *on records* the original, for four instruments, is precisely as big and loud as the enormous orchestral version, and much, *much* clearer! This knowledge Schoenberg chose to ignore, as though audio did not exist.

It did. Though the whole style and thinking of this orchestral transcription is in the manner of the earliest years of our century, when such monster music was commonplace and appropriate to the day, Schoenberg, believe it or not, did his augmenting of Brahms in the year 1937! Into that genius head, not a thing that had happened outside his own realm had penetrated in all that time, or so I see it.

Michael Tilson Thomas conducts this enormous music with pep and a rigid

beat that I find lacking in finesse. Either he hates the stuff and just wanted to pick up his check and go home, or else he is insensitive to the really sensuous melodies, full of expressive hesitations, that were set forth by Brahms in his small-scale original. But there is one big plus. The last movement of the erstwhile Piano Quartet was a showpiece of dancelike music in gypsy style, and this movement, alone, works in its augmented form wonderfully well. Indeed, it sounds very much like Brahms' own younger protégé, Antonin Dvořák, who wrote very similar music for his own big post-Brahms orchestra. I enjoyed this final movement and so will you. It is an all-out success.

Not a good LP technically, this is one of those pressings that has a constant metallic rattle in the background, as though the table were scraping against something. And too many pops and ticks for *my* taste.

Bach: Partita No. 4 in D, Three-Part Inventions. Jeffrey Kahane, piano. **Nonesuch 79121**, digital, \$10.98.

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Jeffrey Kahane's playing is wonderfully sane and perceptive; his training has gone far beyond mere finger gymnastics.

The explanation for Jeffrey Kahane's wonderfully sane and perceptive playing is surely in the very wide background of experience he shows—read his own excellent comments on the album jacket. This man has gone far beyond mere finger gymnastics in his training. I think he is absolutely right in mentioning the tiny clavichord, an intimate instrument that was a Bach favorite as well as the special instrument of Bach's son Carl Philipp Emanuel and many other musicians of the day. Responding to differences in touch, as the harpsichord does not, this tiny keyboard instrument was proto-Romantic in its expressiveness. If you understand Bach on the clavichord, you can play him on the piano. Glenn Gould was another pianist who seemed to have understood this connection.

Play side two of this recording first, the relatively uncomplicated (but demanding) "Three-Part Inventions." Every piano student, probably including your own reluctant children, eventually

runs into them as learning material. Want to hear how they really should sound? You'll be surprised and maybe even pleased.

The "Partita" is on side one, with its "French" overture at the beginning, followed (as in the big orchestral suites) by a tail of dances. There's a somewhat dry, slightly thumpy piano sound, but it's not bad for the music. This is keyboard virtuoso stuff on any instrument, and it is here that Kahane shows he has more than just sanity and understanding. His finger work is effortless. Best of all, the music has rhythm. It really dances. This is what counts!

Beethoven: Sonata for Cello and Piano. Yo-Yo Ma, cello; Emanuel Ax, piano.
CBS IM 42121.

Here come those cheerful, round-faced players again—if they were a pop duo, the name would have to be "Max."

Max is a first-rate team. Behind Ax's wide grin lies tempered steel, in the musical mind and down there in the fingers. Ma too can go to it when the moment comes, though his outstanding characteristic seems to be a cheerful musical modesty, somewhat rare among virtuoso cellists. They are exactly right for this almost-late-period cello sonata, a relaxed and cheerful work on its own, not very long, not very profound. And for three sets of salon-type variations, two on opera tunes by Mozart and one on Handel.

Ah yes, LP versus CD. This release gives an excellent illustration of where we are now at. More and more, due to greater capacity, the CD versions of such works are differently arranged from those on LP and often contain more of the music, or different. On CD there are four cello sonatas on two Compact Discs, but the variations, a nice part of this LP, are missing. And on the LP we have but one of the sonatas. Aside from that, this is an excellent

Sony just extended the range of



Emanuel Ax and Yo-Yo Ma are exactly right for this relaxed and cheerful work for cello and piano.



Feghali
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The Van Cliburn International Piano Competition, spawned in Texas, is one of those high-powered affairs that rival such puny undertakings as Emmys and Oscars and the Superbowl in lesser parts of the country. The Texas trickle-down, or pour-down, is enormous, with hundreds of pre-arranged concerts for the piano winners, complete with management and big PR, more than two years' worth. And, of course, recordings for the Gold, Silver, and Bronze Medalists. Here is Mr. Gold, José Feghali, for your home delectation. After all the hoopla, you might be suspicious, but believe me, he's good! Just forget the big-time stuff and listen, person to person.

The recording was made live, of course, during the actual competition. (Applause blasts forth at the endings too quickly to be edited and is immedi-

LP, and the quality differences between the two alternatives are minor. The content difference is actually more important.

The recording puts Yo-Yo just a bit behind the piano in terms of distance,

and at a very modest volume level—indeed quite correct for this primarily piano music. This is in nice contrast to the old-line historic cello recordings that made the instrument sound like a musical bull in a china shop.

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This is a great job of musical communication by José Feghali, who shows an infallible ear for harmony, melody, and emphasis.

ately squelched via volume control.) We are therefore subject to fits of nerves, slips of the finger and anything else that may have happened in that super-tense atmosphere, assuming no re-takes afterwards. The pleasure here is that José Feghali, after the first explosively difficult item, offers nothing

but pure musical communication, crisp and clean and, in the Schumann "Carnaval," with a lovely sense of humor and a feeling of joyful discovery.

I was impressed by the big Prokofiev Sonata No. 7, out of the war years, combining the hard, tough rhythms of the pre-war "modern music" with the

composer's inveterate yen for good tunes and sweet harmonies. It is an utterly natural medium for Feghali, and you can hear it. As for "Carnaval," the much-played work fared badly in our more hard-boiled days not long past, when pianists were supposed to frown and pound that keyboard with hammer precision. Now we have neo-Romanticism, and young pianists can again indulge in poetry, whimsy, and the elaborately poetic imagery of Schumann's troupe of fictional characters, all with lightness and even hilarity. Where earlier pianists by the hundreds huffed and puffed and tried to bring out portentous symbolisms, Feghali skips through the whole with sheer pleasure and love for the music. "Carnaval" is back!

In both Schumann and Prokofiev, Feghali has an infallible ear for harmony, for melody, and for the right Romantic emphasis at the right places—rare today—made all the better by a dancer's sense of rhythm. The little dances in "Carnaval" take off with a hop, skip and jump and even—an extra whimsy—a touch of the Latin, as light as a feather! The whole work flows along quickly from one item to another with perfect timing. The slow central segment of the Prokofiev has the soulfulness of a blues singer with plunky banjo-like accompaniment; that music also never had it so good.

All in all, this is a great job of sheer musical communication, except, I must say, in the inevitable showpiece, which inevitably comes first. It is Chopin's Scherzo No. 1, two shocking piano bangs followed by a fiery cascade of notes at jet speed. The best interpretation makes these notes as smooth as vinyl and thereby all the more wrenching; Feghali's are helter-skelter, barely in line, full of the temporary edge of hysteria. One can move past this in a concert performance as the pianist gets safely on course. But on a record, hopefully to be repeated, it is poison. Not a good beginning.

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The most unlikely Bach is chosen, and brilliantly "scored" for the various synthetic processes used. First comes the "Italian Concerto in F for Harpsichord," which itself is a daring transcription of a Vivaldi-style orchestral work onto the keyboard instrument. Not an actual transcription; it was composed for keyboard. But it deliberately sounds like an orchestral piece. Then we have a long series of the very short two- and three-part "Inventions" for keyboard, known to everyone who has tried piano as well as to all harpsichordists. Then comes a set of short, scholarly canons of varying complexity based on the familiar "ground bass," eight notes long, which underlies the "Goldberg Variations." Last (instead of first!) comes the ultra-familiar "Tocatta and Fugue in D Minor."

Sounds forbidding? Far from it. The refreshingly bright colors of Dorsey's synthetic tonal palette are precisely what Bach would have used where he had them—in the sharply colored organ pipes of his time. Everything glistens and sings and shines. And the playing, if it can be called that, is astonishingly good. This music has been realized from a keyboard, all of it, but was it one note at a time, laboriously, or do we hear Dorsey's (or somebody's) fingers in real time? That's how it sounds.

Yes, there are added sounds. Occasionally a thumpy rhythm section chimes in, or dizzy whorls of sound revolve about the notes. No harm done. No excess. No compromise at all with the basic sense of the Bach notes. I loved every bit and, indeed, found it instructive to see how the inventions blossom out when given the super-color treatment. Bach's similar sonatas for trio have exactly this sort of high color when played on the organ, which has the facilities.

Only one flub. The album ends, a bit melodramatically, with the familiar "Jesu, Joy of Man's Desiring." Here the music is an improvisation, sort of, around the Bach ideas, but Dorsey is no Bach. Like so many musicians these days, on this record he is a wonderfully understanding and tasteful performer—of somebody else's notes.

Steve Reich: Sextet/Six Marimbas. Nonesuch 79138-1.

Sound: B+ Performance: A-

After the large-scale lushness of "Desert Music" and the incantatory ritualism of "Tehillim," Steve Reich's newest offering reminds us of the sim-

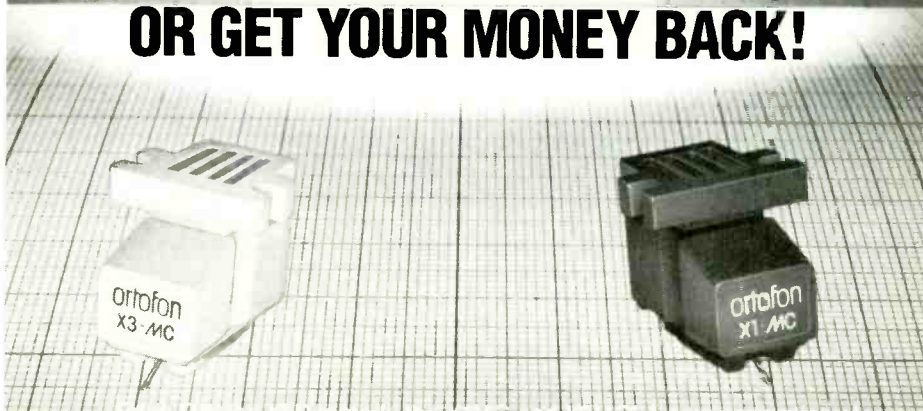
pler roots that made his brand of minimalism so attractive in the first place. These two works return to the small-ensemble formats of "Drumming" and "Octet"; the result is a clearer etching of Reich's intricate music.

"Six Marimbas," in fact, is a rescoring of Reich's "Six Planos" of 1973. As

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"Six Marimbas" is Reich's reworking of a piece for pianos, and the shortened sustain of the instruments sharpens the work's focus.

he has with other reinvestigations, Reich discovers new facets in his canonic phase-delay sound. The shortened sustain of marimbas lends the piece a sharper focus, something like a crystallized frost pattern, compared to the relative verdant lushness of "Six Pianos."

The short melodic and rhythmic patterns of "Six Marimbas" move in and out of phase. New phrases arise triumphantly out of the interlocking designs, only to be engulfed by the constantly evolving structure that remains mesmerizing over the course of the piece's 16 minutes.

"Sextet," on the other hand, comes in five distinct movements, connected by an ominous declarative thud sounded by piano and vibes at the juncture of each part. Intricate patterns bounce and dance, locked in the perfect symmetry of a pointillist web woven by a computerized spider. But make no mistake, there are no computers here. Reich extracts an almost primitive, ritualistic quality out of this percussion-oriented music. Synthesizers are used sparingly to create ethereal atmospheres; along with some inventive bowed vibes, they form back-sliding trails against the time-stepping piano figures.

At its best, Reich's music is mesmerizing but not mind-numbing. His deftly shifting patterns are endlessly fascinating, with a subtlety that sustains many listenings (and, in the case of "Six Marimbas," reworkings). After having expanded on his original thesis with "Tehillim" and "Desert Music," Reich validates the longevity of his earlier forms with this recording.

John Diliberto



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During the last decade, Signet engineers have greatly extended the limits of phono cartridge and stereophone performance. Their own need to eliminate the variables of interconnect wiring in the lab has led them to research the properties of available wire and the subtleties of interconnect technology.

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double-layer polyethylene dielectrics, conductive polypropylene, or Litz wires to assure loss-free, distortion-free, noise-free signal transmission. Lavish use of gold plating of all mating surfaces also insures minimum loss and long, trouble-free service.

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signet
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Mozart: Music for Basset Horns. Members of the Chicago Symphony Winds, vocal soloists.

CBS 12M 42144, digital, two-record set.

Music for basset horns! This curiously appealing tenor clarinet with its mournfully nasal sound was best known in the time of Mozart, who wrote a lot of small works and some very big parts for basset horn. It has persisted because of the excellent music written for it, even unto Stravinsky and Roger Sessions, not to mention Beethoven and R. Strauss. The basset horn is one of those in-between affairs, like the oboe d'amore used by Bach or the viola in string quartet and orchestra. I ran into the basset horn in some of Mozart's most profound late music for the Masons, the "Requiem"; it is unforgettable as a solo voice.

The many small pieces here recorded—two LPs' worth—are less important as music, mostly light entertainment stuff, than in their use of bassets, sometimes a whole passel. This is a comprehensive collection, a compendium of all of Mozart's efforts for the instrument (excluding the big works) and as such it is not very listenable.



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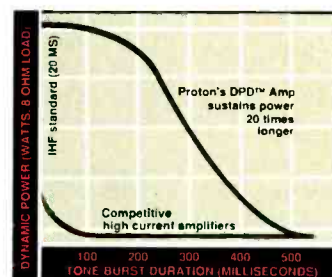
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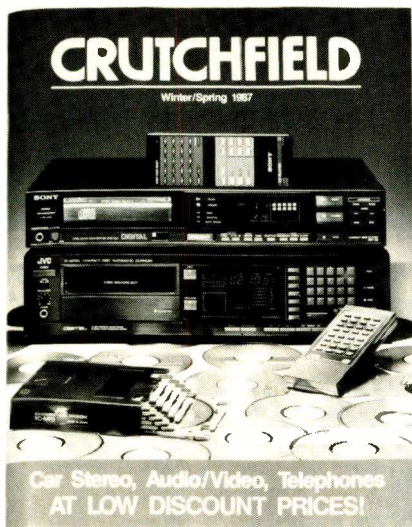
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CRUTCHFIELD

1 Crutchfield Park, Dept AU, Charlottesville, VA 22906

A good ambience surrounds the brass, but the soprano sounds as if she is singing from inside a padded booth.

Too much! Too much alike, and never intended to be played all at one throw. It's like a feast of artichokes. Four little five-movement divertimenti, for instance, all in B flat, are all alike when heard too close to each other.

The programming of this somewhat indigestible mass of basset-horn sound is not ideal. A few of the pieces are striking—some short fragments, isolated movements. Good! But the four nocturnes, short little songs for three vocalists, two sopranos and baritone, with bassets as accompaniment, present problems. The voices are intelligent but wholly unsuited to the music. The two ladies have hefty vibratos; the three singers do not blend with each other. Nor do they blend with the instruments—which have absolutely *no* vibrato. Worse, the four songs are distributed throughout the recording, perhaps to dilute their sameness. Each time they appear, it is a sudden musical shock, after the smooth ensemble of the instruments. Wiser programming might have put them all together, with a solid pause between each, so that the ear might adjust (it would) and thereby allow the musical sense to come through.

All in all, this is a worthy pair of LPs, but quite uncomfortable to plow through at length.

Synthesis. Annapolis Brass Quintet; Elaine Bonazzi, mezzo-soprano; Heidi Lehwalder, harp; John McDonough, narrator.

Crystal S219.

Among the one-man small labels, Crystal is surely one of the most aggressive and apparently successful. Crystal never fails to challenge in the listening, if not always ending up on the positive side.

Brass—everybody loves brass. So here we go, with a batch of unpronounceable composers who write for brass plus unexpected extras—a soprano, a harp (of all unlikely combinations!), and a male narrator.

Robert Starer's "Annapolis Suite" has very dissonant academic brass, with that harp. It's a bit pretentious, I'd say, with lots of pregnant silences (*not* good for recording) and plenty of brass hoots, honks and blats, against the delicate sounds of the harp.



Jerzy Sapiyevski is a man out of Poland, now a music professor in Washington, D.C. He is represented here by the "Aesop Suite," with narration, not the first music to take up the familiar fables. Shades of "Peter and the Wolf"! Very dry, somewhat Copland-like brass music is behind the stories, the usual academic-professional type. It left me unmoved, where Prokofiev is forever endearing. Sorry. *You* might think quite differently; as I say, Crystal's recordings do challenge.

Elam Sprenkle's three tiny fanfares are loud and brassy-jazzy—nothing much, if academically stylish. But his songs on Emily Dickinson poems are something else. On these he reveals his true talents, a fine sense of melody and an excellent feeling for the song, even bordering on the old-fashioned. His music is nice. Above all, it is direct and simple, matching those curious and unique little Dickinson poems, so baffling in the choice of words, so deeply meaningful when you begin to get the idea. Sprenkle does these songs proud, six of them.

But what is that soprano doing in a padded telephone booth? The brass (in a church) is resonant with a good ambience, but not the lady who sings. Her volume level is okay—not too loud, so you can enjoy. But why the odd acoustic? Maybe they put her in one of those triangular portable isolation corners you see in pop-style recordings. Don't ask me why.

ANYTHING ELSE IS JUST UN-PROFESSIONAL



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Pictured above, left to right are: The T95, T55, T65, and, the TL900, TL500, TL600.



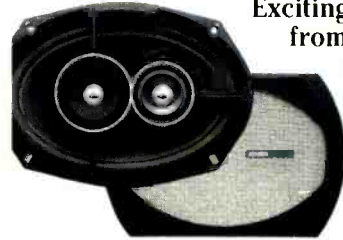
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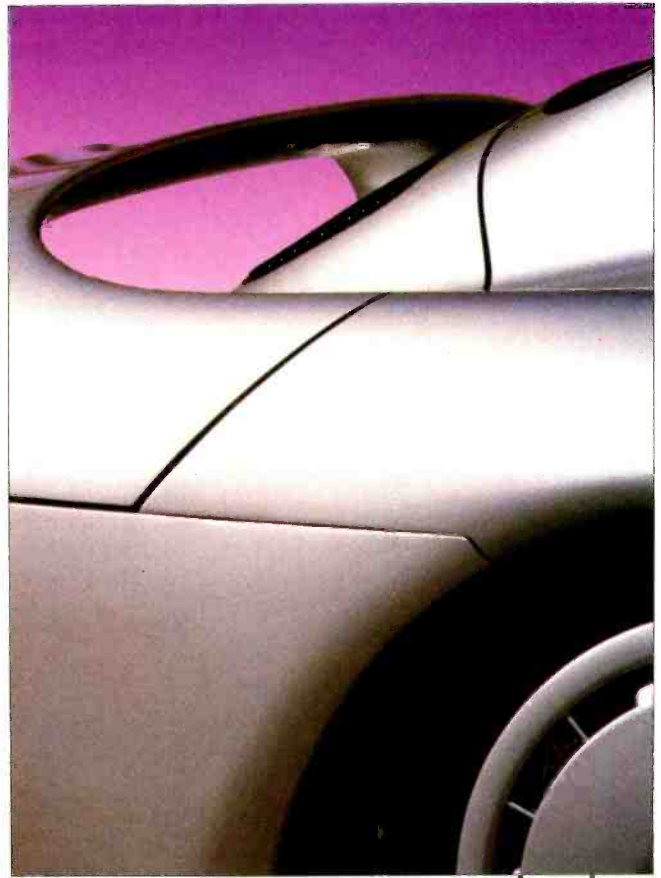
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13th ANNUAL CAR STEREO DIRECTORY



Photograph: Martyn Goddard

Car stereo shows continued growth: This 13th Annual Directory has information on 2,085 models, nearly 12% more than in 1986. Car speakers make up more than half of the equipment listed, and many models are apparently very sophisticated designs. All data has been supplied by manufacturers; this year we've asked them to indicate which components have RCA phono plugs to simplify installation. Our special thanks to Bill Kirkpatrick for his help in editing and proofreading.

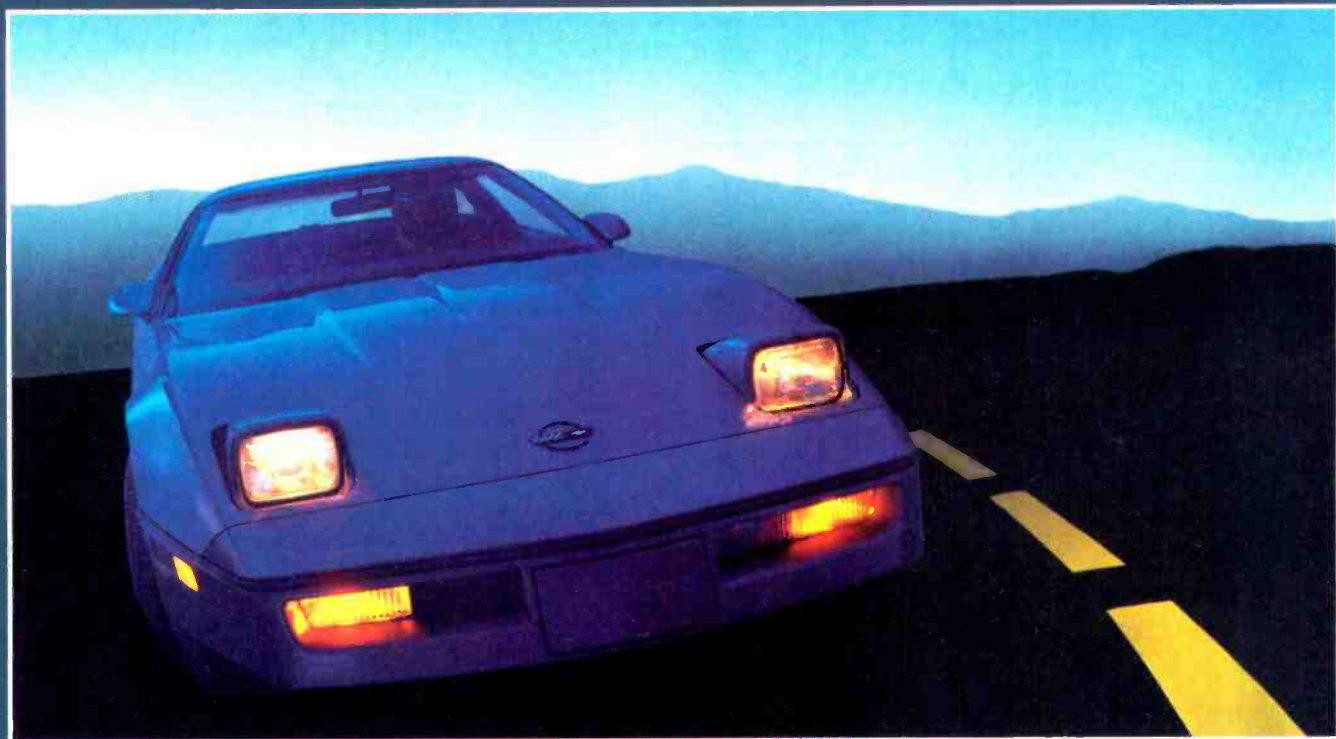
AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/W Ratio, dB	Watts Channel into 4 Ohms, per EM RS-490	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, Hz to kHz per EM RS-490	Input Level, Range (P), Sensible (S), Continuous (C)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, inches	Notes
ADS	PS5	270.00	A		105	40 x 2.	20-20	0.05	Var.			Yes	7 ⁷ / ₈ x 1 ¹ / ₄ x 5 ¹ / ₈		
	PQ8	200.00	A		105	90 x 1	20-20	0.2	Var.			Yes	9 ³ / ₄ x 1 ⁷ / ₈ x 5 ⁷ / ₈	†Two-channel mode, 80 watts x 2; three-channel, 80 watts x 1 and 40 watts x 2; four-channel, 40 watts x 4.	
	PQ10	440.00	A		105	20 x 4	20-20	0.05	Var.			Yes	11 ¹ / ₄ x 2 x 6 ¹ / ₈		
	PQ20	690.00	A		105	†	20-20	0.05	Var.			Yes	14 x 2 ³ / ₈ x 8 ¹ / ₄	†Two-channel mode, 150 watts x 2; three-channel, 150 watts x 1 and 70 watts x 2; four-channel, 70 watts x 4.	
	PH12	310.00	A		105	20 x 6	20-20	0.2	Var.			No	9 ³ / ₄ x 1 ⁷ / ₈ x 7 ³ / ₄	†Three-channel mode, 80 watts x 3; four-channel, 80 watts x 2 and 40 watts x 2; five-channel, 80 watts x 1 and 40 watts x 4; six-channel, 40 watts x 6. Fixed parametric EQ via plug-in modules.	
	PH15	580.00	A		105	†	20-20	0.05	Var.			No	14 x 2 ³ / ₈ x 8 ¹ / ₄		
	EQ1	200.00	E	16	110			0.05	Var.			No			
ALPHASONIK	A-2018 II	60.00	A		75	18	20-20	1	Var.	No	No	Yes	1 ¹ / ₄ x 4 x 4 ³ / ₄	Bridgeable. As above; Class A. Bridgeable. As above. As above; Class A. As above. As above; optional fan.	
	A-4018	90.00	A		75	18 x 4	20-20	1	Var.	No	No	Yes	1 ¹ / ₂ x 5 ¹ / ₄ x 6 ³ / ₈		
	MA-2025	125.00	A		90	25	20-20	0.05	Var.	No	No	Yes	2 ¹ / ₈ x 7 ¹ / ₈ x 7 ¹ / ₂		
	MA-2035	185.00	A		90	35	20-20	0.01	Sel.	No	No	Yes	2 ¹ / ₈ x 7 ¹ / ₈ x 7 ¹ / ₂		
	MA-2050	200.00	A		90	50	20-20	0.05	Var.	No	No	Yes	2 ¹ / ₈ x 7 ¹ / ₈ x 7 ¹ / ₂		
	MA-2070	270.00	A		90	70	20-20	0.05	Var.	No	No	Yes	2 ¹ / ₈ x 7 ¹ / ₈ x 10		
	MA-2100	395.00	A		98	100	20-20	0.01	Var.	No	No	Yes	2 ¹ / ₈ x 7 ¹ / ₈ x 11 ¹ / ₂		
	MA-2150	500.00	A		98	150	20-20	0.01	Var.	No	No	Yes	2 ¹ / ₂ x 8 x 14 ¹ / ₈		
	MA-2300	900.00	A		98	300	20-20	0.01	Var.	No	No	Yes	2 ¹ / ₈ x 8 x 16 ¹ / ₈		
	(Continued)														

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamplifier (P)	Number of EQ Bands	Boost/Cut Range, ± dB	S/N Ratio, dB	Watts Channel Into 4 Ohms, Per ICA RS-490	Full-Power Bandwidth, Hz to kHz	T/D at Rated Output, Hz to kHz Per ICA RS-490	Impedance (Sel.)	Includes Active Crossover?	RCA Input Jacks?	Dimensions, Inches	Notes		
ALPHASONIK (Continued)	MAS-1060	145.00	A/E	1	12	90	60 x 1	15-160 Hz	0.05	Var.	No	Yes	2 x 6 1/2 x 8	Subwoofer amp; parametric EQ.		
	MAS-1100	250.00	A/E	1	12	90	100 x 1	15-160 Hz	0.05	Var.	No	Yes	2 x 6 1/2 x 8	As above.		
	PEQ-7A P-1	100.00 230.00	E E	7 4	18 12	95 95			0.02 0.01	Sel. P	Yes Yes	No No	Yes Yes	1 3/8 x 6 x 4 1/4 1 3/4 x 7 x 3 1/2	External processor loop.	
ALPINE	3537	470.00	A			110	80	10-50	0.04	Var.	No	No	Yes	11 7/8 x 2 1/4 x 7 7/8	Bridgeable.	
	3533	370.00	A			100	60	10-50	0.08	Var.	No	No	Yes	11 3/4 x 2 x 7		
	3530	430.00	A			105	40 x 4	10-50	0.08	Var.	No	No	Yes	11 7/8 x 2 1/4 x 7 7/8	Bridges to two channels.	
	3528	330.00	A				30 x 4	10-50	0.08	Var.	No	No	Yes	10 7/8 x 2 1/4 x 6 7/8	As above.	
	3521	270.00	A			105	50	10-50	0.08	Var.	No	No	Yes	9 1/2 x 2 1/4 x 6 1/4		
	3520	300.00	A			105	150 x 1	10-40	0.08	Var.	No	No	Yes	9 1/2 x 2 1/4 x 6 1/2	Two units bridge to 500 watts x 1 with Model 4082 adaptor.	
	3519	220.00	A			105	30	10-50	0.08	Var.	No	No	Yes	9 1/2 x 2 1/4 x 5 1/2		
	3517	170.00	A			100	30	10-50	0.08	Var.	No	No	Yes	7 7/8 x 1 5/8 x 5 1/8		
	3510	130.00	A			90	18 x 4	30-20	8	Sel.	No	No	No	7 7/8 x 1 1/2 x 4 3/8		
	3505	85.00	A			90	18	30-20	8	Sel.	No	No	No	5 7/8 x 1 1/4 x 2 3/4		
	3337	370.00	P/E	7	12						Var.	Yes	No	Yes	†	†Main unit, 7 x 5 7/8 x 1; control unit, 5 1/2 x 2 x 5/8. Four EQ memories; includes spectrum analyzer.
	3318	480.00	P/E	7	††	95					Var.	Yes	Yes	Yes	7 x 1 x 5 7/8	††At 60, 125, and 250 Hz, ±18 dB; at 500 Hz, 1 kHz, 3.5 kHz, and 10 kHz, ±12 dB. Four EQ memories. Four EQ memories.
	3317	350.00	P/E	7	12	95					P	Yes	No	No	7 x 1 x 5 1/4	
	3311	230.00	P/E	7	††	100					P	Yes	Yes	No	7 x 1 x 4 1/8	
3215	260.00	A/E	7	††	80	18 x 4	40-20	8	Sel.	Yes	No	No	7 x 1 x 5 1/8			
3213	200.00	A/E	7	††	80	18	30-20	8	Sel.	Yes	No	No	7 x 1 x 5 1/8			
3210	130.00	A/E	7	12	75	18	30-20	8	Sel.	Yes	No	No	7 x 1 x 5 1/4			
3330	160.00	P/E	7	12	95					P	Yes	No	No	†††	†††Main unit, 4 3/4 x 1 1/8 x 2 3/8; control unit, 5 3/4 x 2 x 5/8.	
ALTRIC LANSING	ALA-435	400.00	A			95	35 x 4	10-40	0.1	Var.	No	No	Yes	12 3/4 x 8 1/2 x 2 5/8	Bridgeable.	
	ALA-270	360.00	A			95	70	10-40	0.1	Var.	No	No	Yes	12 3/4 x 7 7/8 x 2 5/8	As above.	
AR	GCS 80/40	365.00	A			100	40 x 4	10-50	0.2	P	No		Yes	10 5/8 x 2 1/8 x 8 5/8	Bridges to two channels.	
AUDIA	EQX 700	329.95	E	7	12	90				P	Yes	No	Yes	7 x 1 x 6 1/4		
	EQX 70	199.95	E	7	12	90				P	Yes	No	Yes	7 x 1 x 5 3/4		
	AFX 80	299.95	A			90	40	20-20	0.09	Var.	No	No	Yes	2 1/2 x 8 x 8		
	AFX 40	229.95	A			90	20	20-20	0.09	Var.	No	No	Yes	2 1/2 x 8 x 6		
	AFX 20	99.95	A			90	5 x 4	20-20	1	P	No	No	Yes	7 x 1 x 5 3/4		
AUDIO CONTROL	EQX	299.00	P/E	12	18	110			0.005	Var.		Yes	Yes	2 1/4 x 9 1/2 x 6 7/8		
	EQL	189.00	P/E	12	18	110			0.005	Var.		Yes	Yes	1 5/8 x 9 1/2 x 6 7/8		
AUDIOMOBILE	SA452	290.00	A			100	30	20-20	0.1	Sel.	No	No	No	7 1/2 x 5 x 2	40 watts x 2 into 2 ohms.	
	SA1200	490.00	A			100	†	20-20	0.1	Sel.	No	Yes	No	14 x 5 1/2 x 2	†20 watts x 2 into 4 ohms and 40 watts x 2 into 2 ohms.	
	SA1600 SP300	550.00 290.00	A P/E	3	15	100 90	30 x 4	20-20	0.1	Sel. Var.	Opt.	Yes	No No	14 x 5 1/2 x 2 4 1/2 x 1 5/8 x 4 1/8	40 watts x 4 into 2 ohms.	
AUDIOVIX	AMP-500	30.00	A			80	20	20-30	10	S	No	No	No	4 1/8 x 1 1/8 x 5		
	AMP-525	65.00	A			85	25	30-40	10	Sel.	No	No	Yes	8 x 2 x 6		
	AMP-535	110.00	A			85	50	30-40	10	Var.	No	No	Yes	8 x 2 1/2 x 8		
	AMP-760	50.00	A/E	7	12	80	15	50-20	10	S	Yes	No	No	6 1/8 x 1 x 4		
	AMP-770	100.00	A/E	7	12	80	18	20-30	10	S	Yes	No	No	7 x 2 1/4 x 6 1/2	CD input.	
	AMP-780	120.00	A/E	7	12	80	18	20-30	10	S	Yes	No	No	7 1/8 x 1 1/8 x 7	Includes spectrum analyzer.	
	AMP-785	95.00	A/E	7	12	80	18	20-30	10	S	Yes	No	No	6 1/4 x 1 3/4 x 5 1/2		
	AMP-790	165.00	A/E	7	12	80	30	20-30	10	Sel.	Yes	No	Yes	6 1/4 x 2 x 6 1/4	As above.	
	AMP-795	215.00	A/E	7	12	80	30 x 4	20-30	10	Sel.	Yes	No	Yes	7 x 2 x 7	As above; four EQ memories.	
AUTOTEK	A-161	79.95	A			75	18		1.0	Var.	No	No	Yes	1 1/2 x 4 x 4 3/4		
	A-181	189.95	A			90	25	20-20	0.05	Var.	No	No	Yes	1 3/4 x 6 1/2 x 7	Bridgeable.	
	A-231	219.95	A			90	40	20-20	0.05	Var.	No	No	Yes	1 3/4 x 6 1/2 x 8 1/4	As above.	
	A-441	299.95	A			85	30 x 4	20-20	0.12	Var.	No	No	Yes	3 x 8 1/2 x 9	As above.	
BGW SYSTEMS	302B	229.00	P/E	3	18, 22	77			0.05	S	No	No	Yes	1 1/8 x 4 5/8 x 3 1/2	EQ bands at 60 Hz, 180 Hz, and 16 kHz.	
	600B	299.00	A			90	50	20-20	0.1	S	No	No	Yes	3 3/4 x 7 1/8 x 7		
	602B	369.00	A			90	75	20-20	0.1	S	No	No	Yes	3 3/4 x 7 x 7 1/2		
BLAUPUNKT	BEQ-MS	100.00	E	5	12	80				Sel.	Yes		No	3.6 x 1.3 x 2.4		
	BEQ-80	140.00	E	7	12	80				Sel.	Yes		No	5.6 x 1.8 x 6		
	BEQ-65	210.00	E	5	12	80				Sel.	Yes		No		Stalk mounted.	
	BEQ-FR	180.00	E	†	12	80				Sel.	Yes		No		†Nine front and nine rear EQ bands.	
	BEA-40	130.00	A/E	†	12	80	20	20-20	3	Sel.	Yes		No	5.6 x 1.9 x 6		
	BEA-80	180.00	A/E	7	12	80	20 x 4	20-20	3	Sel.	Yes		No	5.6 x 1.5 x 5.8		
	BSA-40MS	80.00	A			90	20	40-20	0.1	P	No		No	5.6 x 1.8 x 6		
	BPA-420	110.00	A			89	20 x 4	80-20	1	P	No		No	4.7 x 1.8 x 7.2		
	BPA-430	270.00	A			90	30 x 4	10-30	0.1	P	No		No	7.2 x 2.3 x 10.6		
	BPA-230	200.00	A			90	30	60-30	0.1	P	No		No	5.9 x 2.4 x 9.6	Bridgeable.	
	BPA-260	270.00	A			90	60	10-30	0.1	P	No		No	7.2 x 2.3 x 10.6		
CARVER	M-240	350.00	A			100	120	20-20	0.15	Sel.	No	Yes	Yes	2.3 x 12.5 x 6	Magnetic Field Amp.	
CERWIN-VECA	DB-10C	54.95	E	1	†					P			Yes	7 1/2 x 2 3/4 x 1 1/4	† +5 or +10 dB at 30 Hz. Includes subsonic filter.	

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AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts Channel Into 4 Ohms, per IEC RS-430	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, % per IEC RS-430	Input Level, Preamp (P), Sweeper (S), Selectable (Sel.), Continuously Variable (Var.)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, Inches	Notes
CLARION	900EQA	239.95	A/E	9	12	75	12.5 x 4	20-20	1	Sel.	Yes	Yes	Yes	1 1/2 x 5 1/8 x 7 1/8	DNR noise-reduction circuit.
	700EQA	179.95	A/E	7	12	75	12.5	20-20	1	Sel.	No	Yes	Yes	1 1/2 x 5 1/8 x 6 1/4	
	500EQA	129.95	A/E	5	12	75	12.5	20-20	1	Sel.	No	Yes	Yes	1 1/2 x 5 1/8 x 5 1/2	
	280EQB	239.95	A/E	7	12	75	12.5	20-20	1	Sel.	Yes	No	Yes	1 1/2 x 5 1/2 x 6 1/4	
	100EQB-5	99.95	A/E	5	12	75	12.5	20-20	1	S	Yes	No	Yes	1 1/2 x 5 1/4 x 5 1/2	
	50EQ	89.95	E	5	12	75					Yes	No	Yes	1 1/2 x 4 1/4 x 5 1/2	
	1300A	249.95	A			45		20-20	1	Sel.			Yes	2 x 9 1/2 x 7 1/2	
	800A-III	129.95	A			75	13.5 x 4	20-20	1	Sel.			Yes	1 1/2 x 6 3/8 x 5 1/2	
400A-III	79.95	A			75	13.5	20-20	1	Sel.			Yes	1 1/2 x 6 3/8 x 4 3/4		
CONCORD	HPA26	99.95	A			86	18		0.8	P	No	No	Yes	5 1/2 x 4 x 1 3/4	
	HPA51	179.95	A			100	50		0.5	S	No	No	Yes	8 3/4 x 6 1/4 x 2 3/8	
	HPA71	259.95	A			100	70		0.5	S	No	No	Yes	9 x 8 x 3 1/2	
COUSTIC	EQ-1030	449.95	P/E	7	12	90			0.02	Var.	Yes	Yes	Yes	2 1/8 x 7 1/4 x 7 1/8	Detachable active crossover; includes pink-noise spectrum analyzer. Six EQ memories; dbx NR; CD input.
	EQ-1020	249.95	P/A/E	7	12	65	25 x 2, 12 x 2	30-30	0.9	Var.	Yes		Yes	5 3/4 x 1 5/8 x 6 3/8	
	EQ-1010	199.95	A/E	7	12	65	25	30-30	0.9	Var.	Yes		Yes	5 3/4 x 1 5/8 x 5 3/8	
	EQ-1007	149.95	A/E	7	12	65	25	30-30	0.9	Var.	Yes		Yes	5 3/4 x 1 5/8 x 5 3/8	
	EQ-1000	124.95	P/E	7	12	90			0.9	Var.	Yes		Yes	5 3/4 x 1 5/8 x 6 3/8	
	EQ-990	109.95	A/E	7	12	65	12	40-25	0.9	Var.	Yes		Yes	6 1/8 x 1 1/4 x 6 3/8	
	EQ-970	89.95	A/E	7	12	65	12	40-25	0.9	Var.	Yes		Yes	6 1/8 x 1 1/4 x 6	
	AMP 560	1199.95	A			92	250 x 4	20-20	0.05	Var.			Yes	39 3/8 x 12 x 2 3/8	
	AMP 380	309.95	A			92	75	20-20	0.05	Var.			Yes	13 1/2 x 7 7/8 x 2 3/8	
	AMP 190	199.95	A			92	35	20-20	0.05	Var.			Yes	9 1/2 x 7 7/8 x 2 3/8	
AMP 120	139.95	A			92	30	20-20	0.05	Var.			Yes	7 1/4 x 7 7/8 x 2 3/8		
AMP 100	59.95	A			90	18	50-20	0.9	Var.			Yes	6 1/8 x 5 1/2 x 1 3/4		
CRAIG	V506A	39.95	A/E	5	12	70	12	80-15	5.0	S	Yes	Yes	No	3 3/8 x 1 1/4 x 5 1/2	Bridgeable.
	V508	49.95	A/E	7	12	70	12	80-15	5.0	S	Yes	Yes	No	5 x 1 1/8 x 5	
	V509	104.95	A/E	7	12	70	20	50-20	5.0	Sel.	Yes	Yes	No	6 3/8 x 2 x 6 3/8	
	V511	69.95	A/E	10	12	70	20	40-20	5.0	Sel.	Yes	Yes	No	6 3/8 x 1 1/4 x 5 1/2	
	V510	159.95	A/E	7	12	70	18 x 2, 35 x 2	20-20, 80-10	3.0	Sel.	Yes	Yes	No	7 x 2 x 7 1/4	
	V530	59.95	A			75	20	50-20	5.0	Sel.	No	No	No	3 3/4 x 2 x 7	
	V540	79.95	A			75	35	50-20	3.0	Sel.	No	No	No	7 x 2 1/4 x 5 1/2	
V541	149.95	A			75	65	10-20	1.0	Sel.	No	No	No	10 1/4 x 2 x 7 1/4		
CYBERNET	CMS 4050	549.00	A/E	5	10	80	50	50-50	0.4	Var.	No		Yes	7 1/2 x 3 x 11 3/8	
DELTA SONIK	D-360	475.00	A			95	180	20-20	1.0	Var.	No	No	Yes		Three- and four-channel capability. As above.
	D-200	295.00	A			90	100	20-20	2.0	Var.	No	No	Yes		
	D-90	140.00	A			90	45	20-20	1.0	Var.	No	No	Yes		
	PS-7	165.00	E	7	18	95		20-20	0.05	Var.	Yes	Yes	Yes		
DENON	DCA-3100	105.00	A			90	12	15-100	0.5	Sel.	No	No	Yes	6 x 1 x 7	Class A; no negative feedback. As above.
	DCA-3175	180.00	A			90	28		0.05	Sel.	No	No	Yes	8 1/2 x 2 x 8 1/2	
	DCA-3250	280.00	A			95	40		0.08	Sel.	No	No	Yes	8 1/2 x 3 x 9	
	DCA-3400	400.00	A			90	28 x 4		0.05	Var.	No	No	Yes	8 1/2 x 2 x 14 1/2	
	DCA-3500	500.00	A			90	†		0.05	Var.	No	Yes	Yes	8 1/2 x 2 x 16	
	DCE-2150	170.00	E	7	10	97			0.05	P	Yes	Yes	Yes	7 x 1 x 5 1/2	
DCE-2200	140.00	E	7	10	97			0.05	P	Yes	Yes	Yes	6 1/2 x 2 1/2 x 5 1/2		
DIGITRON	PEQ500	64.95	A/E	7		70	12	30-20	1	Sel.	Yes	No			
	PA200	84.95	A			85	15 x 4	10-20	1	Sel.	No	No			
FUJITSU TEN	UM-116	29.95	A			70	3	100-15	5	P	No		Yes	3 x 1 x 2	
	UM-132	84.95	A			100	15	50-50	1	Sel.	No		Yes	6 x 1 1/4 x 5 1/8	
	QM-582	219.95	A			98	35	20-60	0.5	Var.	No		Yes	5 7/8 x 2 x 6 1/4	
	UE-116	169.95	E	7	12	90			0.05	P	Yes	Yes	Yes	7 x 1 x 5 1/8	
FULTRON	15-0727	49.95	A/E	2	12	50	13		5	Sel.	No		Yes	3 5/8 x 1 1/8 x 4 7/8	Includes spectrum analyzer. As above; programmable EQ presets. As above.
	15-0732	89.95	A/E	7	12	50	13		5	Sel.	Yes		Yes	6 3/8 x 1 1/4 x 4 3/4	
	15-0735	129.95	A/E	7	12	50	14 x 4		5	Sel.	Yes		Yes	6 3/4 x 1 3/4 x 6	
	15-0738	179.95	A/E	7	12	50	15 x 2, 30 x 2		5	Sel.	Yes		Yes	7 1/8 x 2 x 7 1/8	
	15-0750	149.95	A			65			1	Sel.	No		Yes	8 1/4 x 2 3/4 x 8 1/4	
DAVID HAFNER CO.	MA-1	400.00	A			100	100	10-70	0.02	Var.	No	No	Yes	11 x 8 x 2 1/2	Bridgeable; MOS-FET output.
HARMAN/KARDON	CA205		A			90	3.5	10-100	0.20	P	No	No	Yes	1 1/2 x 7 x 4 1/4	Bridgeable. As above.
	CA215		A			84	12	10-100	0.20	Sel.	No	No	Yes	1 3/4 x 8 1/4 x 6 1/8	
	CA240		A			72	40	10-100	0.10	Var.	No	Yes	Yes	2 3/4 x 12 1/2 x 8	
	CA260		A			80	60	10-100	0.10	Sel.	No	Yes	Yes	3 7/8 x 15 5/8 x 7 1/8	
HI-COMP	HCB-818	60.00	A			75	18	20-20	1	Sel.			Yes	4 x 1 1/2 x 4 3/4	Bridgeable. As above. As above.
	HCB-840	150.00	A			90	40	20-20	0.05	Sel.			Yes	2 3/4 x 6 3/4 x 7 1/2	
	HCB-865	200.00	A			90	65	20-20	0.05	Sel.			Yes	2 3/4 x 6 3/4 x 11 3/4	
	HCB-880	250.00	A			90	40 x 2, 80 x 2	20-20	0.05	P			Yes	3 x 8 1/2 x 10	
	HCE-760	120.00	A/E	7	12	75	13	20-20	1	Sel.	Yes	Yes	Yes	6 1/4 x 1 1/8 x 6	
	HCE-765	100.00	E	7	12	80				P	Yes	Yes	Yes		

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AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/N Ratio, dB	Waits/Changes into 4 Ohms, per EIA RS-450	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, per EIA RS-490	Input Level: Preamp (P), Speaker (S) Selectable (Sel.), Continuously Variable (Var.)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, Inches	Notes
HITACHI	MA-D4 MA-9A	89.00 399.95	A A			75 100	20 80	20-45 5-30	0.1 0.1	P P	Yes No	No No	Yes Yes	7 x 1 x 6 1/8 8 3/4 x 2 7/8 x 8 7/8	
IMPACT INDUSTRIES	DA-60 DA-150 DA-200	239.95 399.95 479.95	A A A			98 98 98	30 75 100		1 1 1	P P P	No No No	No No No	Yes Yes Yes	8 x 2 x 6 8 x 2 x 8 8 x 2 x 10 1/8	Bridgeable via accessory module. As above.
INFINITY	MRA-90 MRA-150	199.00 319.00	A A			100 100	45 75	2-100 2-100	1 1	Var. Var.	No No	No No	Yes Yes	2 1/4 x 7 5/8 x 8 1/2 2 1/4 x 7 5/8 x 10 1/4	
JENSEN	EQA5000 EQA2500 A35	189.95 119.95 89.95	A/E A/E A	7 5	+18, -6 12	80 80 80	15 10 15	20-20 20-20 20-20	0.3 0.5 0.3	Sel. Sel. Sel.	Yes Yes No			1 1/2 x 6 x 4 1/2 1 1/2 x 4 7/8 x 4 5/8 1 3/4 x 3 1/4 x 4 1/2	
JSE	210 212 214 261 1010 1030	69.95 89.95 119.95 129.95 199.95 239.95	A/E A/E A/E A/E A A	5 7 5 7	12 12 12 12	20 25 25 25 100 120	20-25 20-25 20-25 20-40 20-30 20-30	0.1 0.1 0.1 0.1 0.1 0.1	Var. Var. Var. Var. Sel. Sel.	Yes Yes Yes Yes No No	Yes Yes Yes Yes Yes Yes	Yes Yes Yes Yes Yes Yes	7 1/8 x 1 x 6 7 1/8 x 1 x 6	Bridgeable. As above.	
JVC	KSEA31 KSEA51 KSA51 KSA101 KSA201 KSE6 KSE8	120.00 170.00 90.00 200.00 330.00 120.00 230.00	A/E A/E A A A E E	5 7	12 12	90 90 90 90 90 90	12 12 12 30 60 x 2, 12 x 2	40-20 40-20 40-20 40-20 40-30	0.8 0.8 0.8 0.8 0.5	Sel. Sel. Sel. Sel. Sel. Sel. Sel.	Yes Yes No No No No No	No No No No No	Yes Yes Yes Yes Yes Yes Yes	5 7/8 x 1 1/4 x 5 7/8 5 7/8 x 1 1/4 x 5 7/8 6 x 1 1/4 x 3 1/4 7 1/8 x 2 x 8 1/8 8 3/4 x 2 3/8 x 9 1/2 4 x 1 3/4 x 4 5 7/8 x 1 1/4 x 5 7/8	Night illumination. As above.
KENWOOD	KAC-5020 KAC-7020 KAC-8020 KAC-8070 KAC-9020 KGC-4030 KGC-4400 KGC-6040 KGC-9400	109.00 279.00 399.00 339.00 529.00 219.00 169.00 259.00 329.00	A A A/E A A A/E P/E P/E P/E			100 98 100 100 100 97 100 100 100	15 37 80 20 x 2, 37 x 2 100 15 15 100 100	20-30 20-30 20-30 20-30 20-30 20-30 20-30	1.0 1.0 1.0 1.0 1.0 1.0	Var. Var. Var. Var. Var. Sel. P P P	No No No No No Yes Yes Yes Yes	No No Yes No No Yes Yes Yes No	No No No No No No No No No	5 x 1 3/8 x 4 3/8 5 7/8 x 2 1/8 x 5 7/8 9 1/2 x 2 1/4 x 7 1/8 7 1/2 x 2 1/4 x 6 3/4 11 1/2 x 2 3/4 x 8 3/4 7 1/8 x 1 x 5 7/8 3 1/2 x 1 x 4 3/8 7 1/8 x 1 x 5 7/8 7 1/8 x 1 x 5 1/2	60 watts x 2 into 2 ohms. 165 watts x 2 into 2 ohms. Mono subwoofer output. As above. Includes spectrum analyzer.
KRACO	KE-6 KE-4 KPA-100	99.95 89.95 109.95	A/E A/E A	7 5	12 12	70 65 75	20 15 42	15-10 12-10 12-15	10 10 10	S S Var.	Yes Yes No	No No No	No No Yes	5 x 5 x 1 1/4 4 x 4 1/2 x 1 1/4 7 7/8 x 7 7/8 x 2 1/2	
LINEAR POWER	"The Runt" 452 952 1752 3002 5002 2602 2121 4225 1752 S PA-II	120.00 230.00 300.00 480.00 700.00 1000.00 400.00 750.00 350.00 1000.00 400.00	A A A A A A A A A A			16 22.5 47.5 87.5 150 250 30 x 2, 60 x 1 60 x 2, 120 x 1 22.5 x 4 175 x 1	20-20 20-20 20-20 20-20 40-20 40-20 70-20, 20-70 Hz 20-20 20-20 20-100 Hz	0.75 0.12 0.05 0.09 0.20 0.12 0.04 0.10 0.12 0.09	Var. Var. Var. Var. Var. Var. Var. Var. Var. Var.	No No No No No No No Yes No No	No No No No No No No Yes No No	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	1 3/8 x 4 x 4 1/2 2 x 7 3/4 x 5 1/2 2 x 7 3/4 x 7 1/2 3 x 9 1/2 x 9 3 x 9 1/2 x 12 3 x 9 1/2 x 14 1/2 3 x 8 x 10 3 x 9 1/2 x 12 2 x 7 3/4 x 7 1/2 3 x 9 1/2 x 9 7 8 x 6 x 3 1/2	Bridgeable. As above. Servo subwoofer amp; includes four 8-inch woofers.	
MAGNAT	MCA 100DS MCA 100S MCA 200S	139.95 259.95 349.95	A A A			70 95 95	17 x 4 40 70	10-35 10-30 10-30	1 0.1 0.1	Var. Var. Var.	No No No	No No No	Yes Yes Yes	5 x 5 x 1.4 5 x 5 x 1.4 8 x 9.5 x 1.3	
MAGTONE	CPA-60 CPA-130 CEQ-710	129.95 229.95 99.95	A A A/E	7	12	65 70 60	30 65 15	20-20 20-20 20-25	0.1 0.1 0.25	Var. Var. Var.	No No Yes	No No No	Yes Yes Yes	9 x 2.8 x 6.6 13 x 2.8 x 6.6 6.3 x 1.9 x 7.3	Bridgeable. As above. Includes spectrum analyzer.
MAJESTIC	MA550HD MA770HD MA200HD MA110HD MA500HD MEB8070CD	149.95 269.95 79.95 79.95 249.95 99.95	A A A A A A/E			70 70 65 65 65 65	50 70 35 18 100 40 x 4		0.1 0.1 1 0.7 0.7 0.7	Sel. Sel. Sel. Sel. Sel. Sel.	No No No No No Yes	No No No No No Yes	Yes Yes Yes Yes Yes Yes	7 7/8 x 7 7/8 x 2 1/2 7 7/8 x 6 5/8 x 3 3/8 7 3/8 x 6 5/8 x 2 8 5/8 x 3 3/4 x 2 3/8 8 5/8 x 10 5/8 x 2 3/8 6 5/8 x 6 1/8 x 1 3/4	Bridgeable. As above. As above. CD input; includes spectrum analyzer.
MEI	PA705H PA300H PA400H PA600H EA825B EA837H EA840H EA850H EA860E EA718P	34.95 89.95 149.95 229.95 64.95 79.95 134.95 149.95 219.95 119.95	A A A A A/E A/E A/E A/E A/E P/A/E	5 7 7 7	12 12 12 12	60 70 75 75 60 70 64 60 70 70	16 30 30 50 13.5 12.5 20 x 4 25 17.5 x 2, 35 x 2, 12.5	80-18 80-18 80-18 80-18 80-18 80-18 80-18 80-18 80-18 40-18	0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8 0.8	Sel. Sel. Sel. Sel. S Sel. Sel. Sel. Sel. Sel.	No No No No Yes Yes Yes Yes Yes Yes	No No No No No No No No No Yes	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	4 1/8 x 1 x 5 6 1/8 x 2 1/2 x 6 7/8 7 x 2 3/4 x 6 5/8 7 x 2 3/4 x 9 1/2 5 5/8 x 1 1/2 x 5 6 1/2 x 1 1/4 x 5 3/8 6 1/2 x 2 x 6 1/8 6 3/8 x 1 1/8 x 5 7/8 7 1/8 x 2 x 7 1/4 5 7/8 x 1 3/8 x 5 5/8	Bridgeable. As above. Night illumination. Includes spectrum analyzer; floating and common ground.

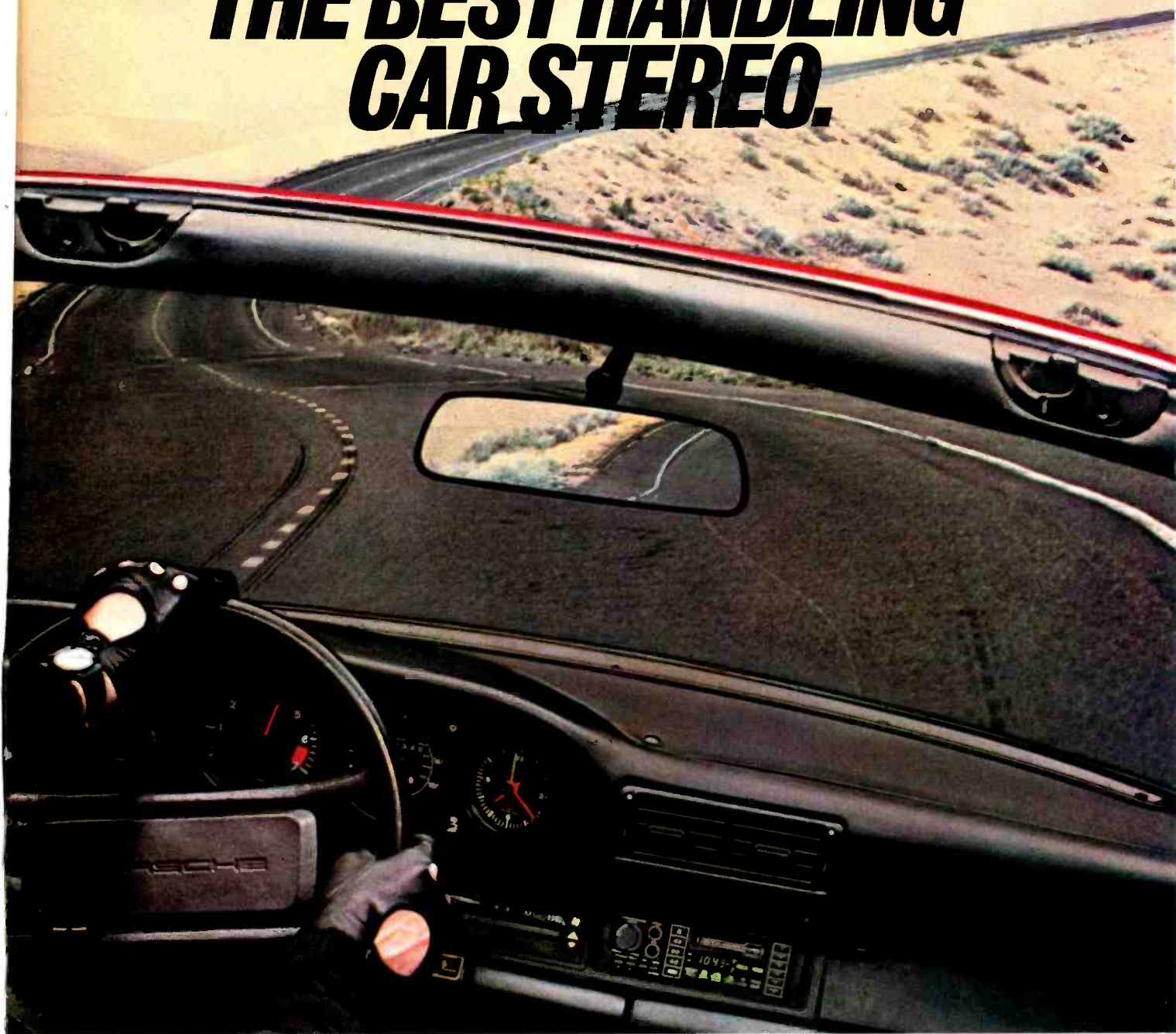
AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts/Channel into 4 Ohms, per IEC RS-490	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, % per IEC RS-490	Input Level, Preamp (P), Speaker (S), Sensitivity (S ₁), Continuously Variable (Vcr.)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, inches	Notes
METRO SOUND	EQ376	249.95	A/E	7			30 x 4			P	Yes	Yes	Yes	6 3/8 x 2 x 4 1/2	
	EQ375	169.95	A/E	7			30 x 4			P	Yes	Yes	Yes	6 3/4 x 1 7/8 x 5 3/4	
	EQ362	149.95	A/E	7			50			P	Yes	Yes	Yes	6 1/4 x 1 3/4 x 6 1/2	
	EQ322	99.95	A/E	10			36			P	Yes	Yes	Yes	5 7/8 x 1 7/8 x 5 3/4	
	EQ314	54.95	A/E	7			30			P	Yes	Yes	Yes	5 7/8 x 1 1/4 x 5 1/4	
MILBERT AMPLIFIERS	BaM-230	1395.00	A			90	30	5-60	2	Var.		Yes	Yes	18 x 6 3/4 x 4 1/2	Tube design.
MITSUBISHI	CVX-10	379.00	A			105	65 x 4	7-50	0.1	P	No	No	Yes	2 3/8 x 9 1/8 x 15 3/4	Bridges to two channels. As above.
	CVX-5	259.00	A			102	35 x 4	7-50	0.1	P	No	No	Yes	2 3/8 x 9 1/8 x 10 5/8	
	CVX-3	209.95	A			75	40	70-20	1.0	P	No	No	No	2 x 7 x 9 1/8	
	CVX-2	109.95	A			80	17	70-20	1.0	P	No	No	No	1 x 6 7/8 x 5 5/8	
	CV-261	59.95	A			70	14	25-15	1.0	S	No	No	No	1 7/8 x 5 1/2 x 4 3/8	†Part of CD-100 System I (see "CD Players" section). Includes outboard power fader. †Part of CD-100 System II.
CV-232	†	A/E	6	12	70	13	70-20	1.0	P	Yes	No	No	2 x 5 5/8 x 6 1/4		
MONOLITHIC SOUND	PA-100	99.00	A			95	25	20-200 Hz	0.1	S		Yes	No		Wooler amp.
	PA-200	139.00	A			95	25	20-20	0.1	P		Yes	Yes		Mono subwoofer output.
	PA-300	199.00	A				25 x 3	20-20	0.1	P	Opt.	Yes	Yes		
	PA-400	229.00	A				25 x 4	20-20	0.1	P		Yes	Yes		
	PA-500	289.00	A				50	20-20	0.05	P		No	No		
	PA-700	359.00	A				70	20-20	0.05	P		Yes	Yes		
	PA-1600	499.00	A				100	20-20	0.05	P		Yes	Yes		
	PA-1600M	499.00	A				240 x 1	20-20	0.05	P		Yes	Yes		
	PA-2400Q	559.00	A				60 x 4	20-20	0.05	P		No	No		
	PA-2400X	599.00	A				60 x 4	20-20	0.05	P		Yes	Yes		
	PA-4000	1099.00	A			90	240	20-20	0.05	P		Yes	Yes		Dual mono. Bi-FET.
	EQ-4 TUNEQ	289.00	P/E	4	15	90			0.01	P		Yes	Yes		
NAKAMICHI	PA-400M	449.00	A			110	140 x 1	5-50	0.002	Var.	No	No	Yes	12 5/8 x 2 1/8 x 6 3/8	220 watts x 1 into 2 ohms; L + R summing circuit.
	PA-350	429.00	A			110	35 x 4	5-50	0.005	Var.	No	No	Yes	12 5/8 x 2 1/8 x 6 3/8	Direct or low-cut inputs.
	PA-300II	395.00	A			115	75	5-50	0.003	Var.	No	No	Yes	12 5/8 x 2 1/8 x 6 3/8	
	PA-200	249.00	A			110	30	10-50	0.005	Var.	No	No	Yes	7 1/2 x 1 3/4 x 6 3/8	
	PA-150	220.00	A			100	14 x 4	20-20	0.05	Var.	No	No	Yes	5 7/8 x 1 1/4 x 4 1/2	
	PA-100	129.00	A			100	14	20-20	0.05	Var.	No	No	Yes	3 3/4 x 1 1/4 x 4 1/2	
	LA-50	50.00	P			110		20-20	0.003	Var.	No	No	Yes	4 1/2 x 1 1/2 x 3	Line amp with level control.
PANASONIC	CY-S660EU	129.95	A/E	7	12	83	12.5	20-40	0.8	Sel.	Yes	No	Yes	7 x 5 1/2 x 1	Bridgeable. As above. As above.
	CY-SA30EU	89.95	A			85	12.5	20-40	1	Sel.	No	No	Yes	5 1/2 x 4 1/4 x 1 1/2	
	CY-SA61EU	249.95	A			100	30	5-140	0.05	Sel.	No	No	Yes	7 1/8 x 1/2 x 2	
PHILIPS	EN 265	299.95	A			95	65	20-20	0.05	P		No	No		
	EN 2100	349.95	A			95	100	20-20	0.05	P		No	No		
	AP 165	199.95	A			95		20-20	0.05	Sel.	Yes	No	No		
	AP 363	169.95	A/E	7	12	85	20	20-20	0.5	Sel.	Yes	No	No		
	AP 364	199.95	A/E	7	12	85	20	20-20	0.5	Sel.	Yes	No	No		
	AP 264	129.95	A			85	20 x 4	20-20	0.5	P		No	No		
	AP 210	299.95	A			85	70	20-20	0.5	Sel.		No	No		
PIONEER	GM-A200	340.00	A			100	70	30-20	0.3	Var.		Yes	Yes	9 1/2 x 2 3/4 x 10 5/8	Three EQ memories; includes spectrum analyzer. Front and rear EQ; surround sound circuit. Phase reverse switch; surround sound circuit. Front and rear EQ. As above.
	GM-203	270.00	A			97	45	30-20	0.3	Var.		Yes	Yes	9 1/8 x 2 3/8 x 10 5/8	
	GM-123	200.00	A			95	28	30-20	0.3	Var.		Yes	Yes	9 1/8 x 1 5/8 x 10 5/8	
	GM-43A	80.00	A			93	13	30-20	0.8	Sel.		Yes	Yes	5 7/8 x 1 x 5 7/8	
	GM-41A	75.00	A			93	13	30-20	0.8	Sel.		No	No	5 7/8 x 1 x 5 7/8	
	EQ-E303	300.00	E	7	12	85				P	Yes	No	No	5 7/8 x 1 x 5 3/8	
	EQ-220	240.00	E	9	12	85				P	Yes	No	No	7 1/8 x 1 x 5 3/8	
	EQ-5000	170.00	E	9	12	85				P	Yes	Yes	Yes	7 1/8 x 1 x 4 7/8	
	EQ-3000	140.00	E	9	12	85				P	Yes	No	Yes	7 1/8 x 1 x 4 7/8	
	EQ-100	135.00	E	9	12	85				P	Yes	No	No	7 1/8 x 1 x 5 3/8	
PRECISION POWER	PPI-3050	395.00	A			102	30 x 2, 50 x 2	10-50	0.02	Var.	No	No	Yes	2 x 8 x 12	50-watt channels bridge to 150 watts.
	PPI-4050	550.00	A			102	40 x 2, 50 x 2	10-50	0.02	Var.	No	Yes	Yes	2 x 8 x 15	Parametric; CD input with volume control. Mid-bass plus shelving bass and treble EQ; volume control. Shelving bass boost/cut plus mid-bass notch filter. 52 watts x 2 into 2 ohms; bridgeable. As above but 75 watts into 2 ohms. As above but 125 watts into 2 ohms. As above but 185 watts into 2 ohms. Dual mono. As above.
	PAR-224	345.00	P/E	4	18	110			0.002	Var.	Yes	No	Yes	1 1/2 x 4 3/4 x 4 1/4	
	PEQ-223	160.00	P/E	3	12	104			0.005	Var.	No	No	Yes	1 1/4 x 4 1/4 x 3 1/4	
	EQM-300	70.00	P/E	2	+10, -6	102			0.008	P	No	No	Yes	1 1/2 x 3 3/4 x 3	
	PPI-2030	198.00	A			102	30	10-50	0.02	Var.	No	No	Yes	2 x 8 x 5	
	PPI-2050	320.00	A			102	50	10-50	0.02	Var.	No	No	Yes	2 x 8 x 8 1/2	
	PPI-2075	395.00	A			102	75	10-50	0.02	Var.	No	No	Yes	2 x 8 x 10	
	PPI-2125	540.00	A			102	125	10-50	0.02	Var.	No	No	Yes	2 x 8 x 12	
	PPI-2200	650.00	A			102	200	10-50	0.02	Var.	No	No	Yes	2 x 8 x 18	
PPI-2300	800.00	A			102	300	10-50	0.02	Var.	No	No	Yes	2 x 8 x 24		

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts (Channel into 4 Ohms, per EA RS-490)	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, % per EA RS-490	Input Level: Preamp (P), Speaker Selector (S), Combination Variable (V)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, inches	Notes
PROTON	D275	319.00	A			90	75	20-20	0.04		No	No		7 3/4 x 2 x 11 3/8	Bridgeable. Operates into 2 ohms.
	D230	199.00	A			90	30	20-20	0.04		No	No		7 3/4 x 2 x 6 1/4	
	220	59.00	A			78	18			Sel.	No	No		7 1/8 x 2 3/8 x 2	
	222	129.00	A			90	22		0.02	Sel.	No	No		7 1/2 x 1 5/8 x 5 3/8	
	250	219.00	A			50	50		0.02	Sel.	No	No		12 x 1 1/8 x 5 1/2	
	271	149.00	E	7	18	95	18		0.005	Sel.	Yes	Yes	Yes	6 3/8 x 1 5/8 x 5 7/8	Bridges to 150 watts.
	272	149.00	A/E	7	12	82	18		0.03	Sel.	Yes	Yes	Yes	6 3/8 x 1 5/8 x 5 7/8	
PYLE	A50	189.95	A			100	25	10-50	0.01	Sel.	No	No	Yes	2 x 8 x 7	Bridgeable. As above. As above. As above. As above. CD input.
	A100	309.95	A			100	50	10-50	0.01	Sel.	No	No	Yes	2 3/8 x 10 1/4 x 7	
	A200	459.95	A			100	100	10-50	0.01	Sel.	No	No	Yes	2 3/8 x 12 1/4 x 7	
	A400	649.95	A			100	200	10-50	0.01	Sel.	No	No	Yes	2 3/8 x 12 1/4 x 10	
	A140.4	349.95	A			100	35 x 4	10-50	0.01	Sel.	No	No	Yes	2 3/8 x 12 1/4 x 7	
	PA1	199.95	P/E	4	12	100	35 x 4	10-50	0.01	Sel.	Yes	No	Yes	1 1/2 x 5 3/8 x 4 3/8	
REALISTIC	12-1953	79.95	A/E	7			30							1 7/8 x 7 1/8 x 6 1/4	
	12-1952	34.95	E	5										1 3/4 x 5 x 6	
	12-1954	54.95	E	7						Yes				1 1/4 x 5 1/8 x 5 3/4	
ROADSTAR	PEQ500	64.95	A/E	7		70	12	30-20	1	Sel.	Yes	No			
	PA200	84.95	A			85	15 x 4	10-20	1	Sel.	No	No			
ROCKFORD FOSGATE	Punch 45 MOSFET	200.00	A/E	2	†	80	22.5	15-100	0.05	Sel.	No	No	Yes	8 x 5 1/8 x 2	† + 18 dB at 45 Hz, + 12 dB at 20 kHz. Bridgeable; 35 watts x 2 into 2 ohms. All as above but 60 watts into 2 ohms. All as above but 90 watts into 2 ohms. All as above but 75 watts x 4 into 2 ohms. Bridgeable; operates into 2 ohms. CD input.
	Punch 75	315.00	A/E	2	†	80	37.5	15-100	0.05	Sel.	No	No	Yes	8 x 7 1/4 x 2	
	Punch 150	435.00	A/E	2	†	80	75	15-100	0.05	Sel.	No	No	Yes	8 x 9 1/4 x 2	
	Power 300	900.00	A/E	2	†	80	50 x 4	15-100	0.05	Sel.	No	Yes	Yes	8 x 15 1/4 x 2 1/2	
	MOSFET	1500.00	A			80	125 x 4	15-100	0.05	Sel.	No	Yes	Yes	8 x 19 1/4 x 2 1/2	
	Power 650 MOSFET PA-1	325.00	P/E	3	†	80			0.01	Sel.	Yes	No	Yes	6 3/4 x 3 1/2 x 1 1/2	
ROYAL SOUND	PB-500	30.00	A			80	50	20-30	0.35	S	No	Yes	No	4 1/4 x 1 3/8 x 6	Night illumination. As above. As above.
	EA-400M	50.00	A/E	5	12	80	25 x 4	20-30	0.35	S	Yes	Yes	No	4 1/8 x 1 x 4 3/8	
	EA-700MII	75.00	A/E	7	12	80	38 x 4	20-30	0.35	S	Yes	Yes	No	5 3/4 x 1 1/4 x 4 3/4	
	EA-1000	100.00	A/E	10	12	80	50 x 4	20-30	0.35	S	Yes	Yes	No	6 3/8 x 1 x 5	
SANSUI	SM-X700	500.00	A			100	90		0.03	Sel.	No	No	Yes	12 5/8 x 3 1/8 x 11	Bridgeable.
	SM-X500	280.00	A			90	50		0.03	Sel.	No	No	Yes	7 7/8 x 2 1/2 x 9	
	SM-X300	200.00	A			85	35		0.05	Sel.	No	No	Yes	7 1/8 x 1 x 6	
	SM-X70	100.00	A			91	15		0.05	Sel.	No	No	Yes	4 3/4 x 3 1/2 x 1 1/8	
	SG-X1000	290.00	E	7		80			0.05		Yes	Yes	Yes	7 1/8 x 1 x 5 3/4	
	SG-7B	130.00	E	7		85			0.05		Yes	Yes	Yes	4 1/4 x 1 1/8 x 3 1/2	
SANYO	PA7020	99.95	A			100	20	20-20	0.05	Var.	No	No	Yes		
	PA6050	96.00	A			70	25	20-40	0.05	Sel.	No	No	Yes		
	PA7050	159.95	A			100	50	20-40	0.05	Sel.	No	No	Yes		
	EQZ6210	79.95	E	7	12	70				Sel.	Yes	No	Yes	6 1/2 x 2 x 4 3/4	
	EQZ10	96.00	E	7	12	70				Sel.	Yes	No	Yes	5 5/8 x 2 x 6 7/8	
SENTREK	SAQ 1407	44.95	A/E	7	12	82	12	30-10	5	S	Yes	No	No	5 1/2 x 1 x 4 1/4	Surround sound circuit. As above; four EQ memories; includes spectrum analyzer. For underdash. Bridgeable.
	SAQ 1507	54.95	A/E	5	12	85	12	20-12	1	Sel.	Yes	No	Yes	4 x 1 1/4 x 5 1/2	
	SAQ 1707	64.95	A/E	7	12	85	12	20-12	1	Sel.	Yes	No	Yes	5 x 1 1/4 x 5 1/2	
	SAQ 2007	79.95	A/E	10	12	85	12	20-12	1	Sel.	Yes	No	Yes	7 x 1 1/4 x 5 1/2	
	SAQ 2207	109.95	A/E	10	12	85	12	20-12	1	Sel.	Yes	No	Yes	7 x 1 1/4 x 5 1/2	
	SAQ 8000	109.95	A/E	10	12	85	12	20-12	1	Var.	Yes	No	Yes	5 7/8 x 1 3/8 x 6	
	SAQ 3800	149.95	A/E	7	12	85	15	30-10	1	Sel.	Yes	No	Yes	7 3/8 x 2 x 7	
	SAQ 7200	169.95	A/E	7	12	85	15 x 4	30-10	1	Sel.	Yes	No	Yes	6 3/8 x 2 x 6 5/8	
	SEQ 700	69.95	E	7	12					Sel.	Yes	No	Yes	4 1/2 x 1 1/4 x 5 1/4	
	SPA 065	32.95	A			85	12	30-10	2	S	No	No	Yes	4 3/4 x 4 7/8 x 1 3/8	
	SPA 070	39.95	A			85	12	100-15	2	Sel.	No	No	Yes	4 1/8 x 1 x 5 1/2	
	SPA 130	79.95	A			85	15	30-10	1	Var.	No	No	Yes	8 3/8 x 2 3/8 x 3	
	SPA 180	119.95	A			87	25	45-12	5	Var.	No	No	Yes	8 3/8 x 2 1/2 x 5 1/8	
	SPA 330	189.95	A			82	65	20-20	0.5	Var.	No	Yes	Yes	8 3/8 x 2 1/2 x 7 7/8	
SHERWOOD	SCA240	79.95	A			85	13	30-20	0.5	P	No	No	Yes	1 1/4 x 6 x 6 1/4	External processor loop.
	EQA280	99.95	A/E	7	10	85	12 x 2, 3.5 x 4	50-20	0.5	P	Yes	No	Yes	1 x 7 x 6	
	SCA2250	179.95	A			85	40	10-45	0.5	P	No	No	Yes	2 1/2 x 7 5/8 x 9 1/8	Bridgeable. As above; includes subsonic filter.
	SCA2100	199.95	A			80	70	10-30	0.5	P	No	No	Yes	3 3/4 x 8 x 9 5/8	
SONY	XME-50	159.95	A/E	5	12	75	12	40-20	1.0	Var.	Yes	No	Yes	7 x 1 x 5 1/4	Bridgeable.
	XME-71	219.95	A/E	7	12	75	14	20-20	0.8	Var.	Yes	No	Yes	7 x 1 1/4 x 6	
	XE-110	179.95	E	11	12	92				Var.	Yes	Yes	Yes	7 x 1 x 5 1/4	
	XM-301	89.95	A			85	14	40-20	0.5	Var.	No	No	Yes	7 x 1 x 6 1/2	
	XM-601	129.95	A			85	14 x 4	20-20	0.8	Var.	No	No	Yes	9 x 1 1/2 x 6 1/2	
	XM-641	199.95	A			105	22	20-20	0.5	Var.	No	No	Yes	7 x 1 3/4 x 5 1/8	
	XM-701	269.95	A			105	45	20-20	0.5	Var.	No	No	Yes	7 x 2 3/8 x 8	
SOUND BARRIER	Galaxy 707	219.95	A				100 x 2, 20 x 2	20-35	0.1	Sel.	No	Yes	Yes	9 7/8 x 7 x 2 1/8	
	Galaxy 505	149.95	A			100		20-35	0.1	Sel.	No	No	Yes	8 3/8 x 7 x 2 1/8	
	Galaxy 303	119.95	A			75		20-35	0.1	Sel.	No	No	Yes	8 x 7 x 2 1/8	
	Galaxy 101	89.95	A			50		20-35	0.1	Sel.	No	No	Yes	7 x 7 x 2 1/8	
	Alfa 300		A				100 x 4	15-40	0.08	Sel.	No	No	Yes	10 x 10 x 2 3/4	

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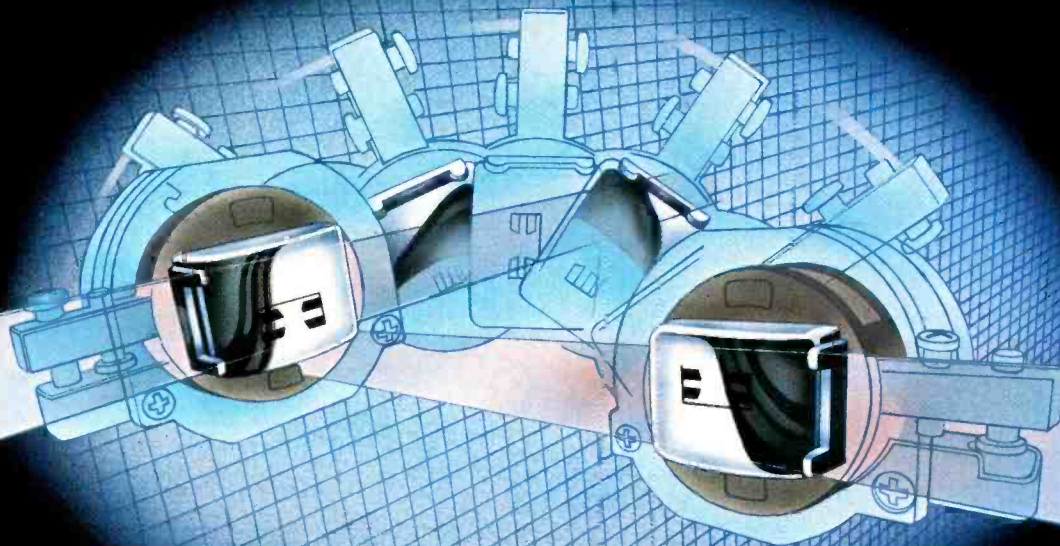
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AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$		Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts/Channel into 4 Ohms, per IEC RS-430	Full-Power Bandwidth, Hz to kHz	THD at Rated Output, % per IEC RS-430	Input Level, Program (P), Speaker (S), Selectable (Sel.), Continuously Variable (Vc.)	Fader Control?	Includes Active Crossover?	RCA Input Jacks?	Dimensions, inches	Notes
SOUNDSTREAM	MC500	975.00	A		100	†		15-75	0.1	Sel.	No	No	Yes	19¼ x 10¾ x 3¾	†Two-channel mode, 250 watts x 2; three-channel, 125 watts x 2 and 250 watts x 1; four-channel, 125 watts x 4. Variable-frequency bass boost; includes subsonic filter.	
	D200	449.00	A		100	100		15-75	0.1	Sel.	No	No	Yes	2¼ x 7 x 11½	Dual mono; bridgeable.	
	Class A50	350.00	A		100	25		15-75	0.1	Sel.	No	No	Yes	2¼ x 7 x 6½	Class A; bridges to 90 watts.	
	D100	295.00	A		100	50		15-75	0.1	Sel.	No	No	Yes	2¼ x 7 x 6½	Bridges to 120 watts.	
	SF90	320.00	A		100	†		15-75	0.1	Sel.	No	No	Yes	2¼ x 7 x 6½	†Three-channel mode, 15 watts x 2 and 80 watts x 1; four-channel, 15 watts x 2 and 30 watts x 2.	
	D60	198.00	A		100	30		15-75	0.1	Sel.	No	No	Yes	2¼ x 7 x 4½	Bridges to 85 watts.	
	D30	119.00	A		85	15		20-20	0.25	Sel.	No	No	Yes	5½ x 1½ x 5¾	Operates into 2 ohms.	
D10	69.00	A		100	5		20-20	0.1	P	No	No	Yes	1¼ x 2¼ x 1¾			
SPARKMATIC	SBE-7	49.95	A/E	7	12	55	20	20-20	5		Yes		No	1¾ x 5½ x 4¾	Night illumination.	
	GE-50	34.95	A/E	5	12	55	20	20-20	5		Yes		No	4¾ x 1¾ x 4¾		
	LC-52	17.95	A			55	20	20-20	5		No		No	4¼ x 1¼ x 4		
SPECO	HPA-200	229.95	A		70	100		20-20	0.05	Sel.	No	No	Yes	2¾ x 7½ x 7¾	Bridgeable. As above. Common or floating ground. As above.	
	HPA-300	349.95	A		70	150		20-20	0.05	Sel.	No	No	Yes	2¾ x 10½ x 7¾		
	EPB-100	94.95	A/E	7	12	45		20-20	1.0	P	Yes	No	No	1¼ x 5½ x 5¾		
	EPB-150	124.95	A/E	10	12	30		20-20	1.0	P	Yes	No	No	1¼ x 6½ x 5¾		
SUNKYOWG	SQ-100	99.95	P/A/E	7	12	60	25 x 4	20-20	1	Sel.	Yes		Yes	2 x 6¾ x 6		
	SQ-200	149.95	P/E	7	12	60				P	Yes		Yes	1½ x 6¾ x 5½		
	SQ-300	169.95	P/A/E	7	12	60	25 x 4	20-20	1	Sel.	Yes		Yes	1½ x 6¾ x 5½		
	SA-240P	289.95	A		90	120		20-20	0.05	Var.			Yes	2½ x 6¾ x 13¼		
	SA-150P	189.95	A		90	75		20-20	0.05	Var.			Yes	2½ x 6¾ x 9½		
	SA-100P	169.95	A		90	50		20-20	0.05	Var.			Yes	2½ x 6¾ x 8¾		
	SA-200	259.95	A		90	100		20-20	0.05	Var.			Yes	3 x 6½ x 11¼		
	SA-130	169.95	A		90	65		20-20	0.05	Var.			Yes	3 x 6½ x 9		
	SA-80	139.95	A		90	40		20-20	0.05	Var.			Yes	3 x 6½ x 7¾		
	SA-244P	280.95	A		90	60 x 4		20-20	0.05	Var.			Yes	2½ x 6¾ x 13¼		
	TECHNICS	CY-M125EU	110.00	A		90	12.5		10-80	0.8	P	No	No	No		7 x 5½ x 1
CY-M160EU		250.00	A		100	30		5-140	0.05	P	No	No	No	7 x 7½ x 2		
CY-M280EU		380.00	A		100	50		5-140	0.05	P	No	No	No	8½ x 7¼ x 2¾		
CY-EQ9EU		160.00	E	9	12	95			0.005	P	Yes	No	No	7 x 5½ x 1		
CY-EQ14EU		250.00	E	14	12	100			0.005	P	Yes	No	No	7 x 5½ x 1		
CY-EQ77EU		250.00	E	14	12	100			0.005	P	Yes	No	No	7 x 5½ x 1		
ULTIMATE SOUND	PA1004	249.95	A		85	25 x 4		10-40	0.2	Sel.	No	No	Yes	2¾ x 12¼ x 7¾	Two-, three-, or four-channel operation; bridgeable. As above.	
	PA2004	349.95	A		85	50 x 4		10-40	0.2	Sel.	No	No	Yes	2¾ x 15 x 7¾		
YAMAHA	YGE-600	229.00	P/E	5	12	95			0.02	Var.	Yes	No	Yes	2 x 6¼ x 4¾	Bridges to two channels. As above. Bridges to 150 watts. 0.1% THD at 13 watts.	
	YGE-400	169.00	P/E	7	12	100			0.02	Var.	Yes	Yes	Yes	1½ x 6½ x 6½		
	YPA-800	379.00	A		95	40 x 4			1	Var.	Yes	Yes	Yes	6¼ x 1¾ x 9¾		
	YPA-700	349.00	A		105	35 x 4			0.005	Var.	No	Yes	Yes	11¾ x 2 x 8¾		
	YPA-600	279.00	A		90	50			0.01	Var.	Yes	Yes	Yes	8¾ x 3 x 9¾		
	YPA-200	119.00	A		90	20			1	Var.	No	Yes	Yes	8¼ x 1½ x 6¾		
	YPA-100	79.00	A		100	18			8	Var.	No	Yes	Yes	7½ x 1¼ x 3¾		
ZAPCO	S-80	275.00	A		105	40		20-20	0.03	Var.	No	No	Yes	8.4 x 6.3 x 2	†Amp, 5.2 x 5.8 x 3.2; power supply, 7 x 3.3 x 2.1. Bridgeable. ††Dimensions of amp and power supply as above; includes Model ESM (Energy Storage Module), 5.5 x 3.1 x 1.5.	
	M-80 +	235.00	A		108	80 x 1		20-500 Hz	0.03	Var.	No	Yes	Yes	8.4 x 6.3 x 2		
	M-80	205.00	A		108	80 x 1		20-100 Hz	0.03	P	No	Yes	Yes	7.5 x 6.3 x 2		
	Sys 150	465.00	A		110	78		20-20	0.03	P	No	No	Yes	†		
	Sys 150A	612.00	A		110	78		20-20	0.02	P	No	No	Yes	††		
	Sys 200	535.00	A		110	100 x 2, 225 x 1		20-20	0.03	P	No	No	Yes	†		
	Sys 200A	678.00	A		110	100 x 2, 225 x 1		20-20	0.02	P	No	No	Yes	††		
	PX	480.00	P/E	4	18	115			0.004	Var.	No	Yes	Yes	†††		
	PEQ	345.00	P/E	9	18	92			0.05	Var.	No	No	No	8.8 x 4.3 x 1.2		
	AGM-V	46.50	P		95				0.005	Var.	No	No	Yes	5.5 x 3 x 1.5		
Z220	590.00	A		110	110 x 2, 250 x 1		20-20	0.01	Var.	No	No	Yes	12.3 x 8.5 x 3			

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CD PLAYERS

MANUFACTURER	Model	Price, \$	Frequency Response, Hz @ kHz, ± dB	Dynamic Range, dB	THD, %, at 1 kHz	Filtering: Analog Only (A), Digital (B)	Loading: Single Disc (A), Single Disc Magazine (B), Multi-Disc (C)	AUX Input?	Controls: Volume (V), Balance (B), Fader (F), Tone (T)	Audible Fast Search?	Auto Scan: Disc (D), Tuner (T)	TUNER				
												FM Sensitivity, dBf (for 30-dB Quieting)	Alternate-Channel Selectivity, dB	FM Mono S/N Ratio, dB	Built-in Amp Power, Watts (if Applicable)	RCA In/Out Jacks?
ALPINE	5950 (Optional 1341 tuner, \$220.00)	1500.00	5-20 ± 1.0	90	0.005	A	C	Yes	V/B/F/T	Yes	D	16.3	80	60		No
	7902	850.00	5-20 ± 1.0	90	0.004	D	A	Yes	V/B/F/T	Yes	D/T	16.3	80	60		No
	7901	650.00	5-20 ± 1.0	90	0.007	A	A	No	V/B/F/T	No		16.3	80	60		No
	5902	600.00	5-20 ± 1.0	90	0.004	D	A	Yes	V/B/F/T	Yes	D					No
BLAUPUNKT	CDP 05	549.95	20-20 ± 1	90	0.1		A	No	V/B/T	Yes	D					No
CLARION	CDC005	789.95	20-20	90	0.05	D	B		V/B/T	Yes	D					Yes
DEWON	DCC-8900	850.00	5-20 ± 1.0	90	0.005	A	A	No	V/B/F/T	Yes	T	20.3@ 50 dB	70	60		Yes
FUJITSU TEN	SD-1110	595.00	5-20 ± 1		0.01		A				D					
HI-EMP	HCD-100	699.95	5-20 ± 3	92	0.05	D	B	No	V/B/F/T	Yes	D/T	11	75	70		No
JVC	XL-C30	699.95	5-20 ± 0.5	90	0.0015	D	B	Yes	V/B/F/T	No	D/T	16.3	65	60		Yes
KENWOOD	KDC-9R	849.00	5-20 ± 1	90	0.005	D	A	No	V/B/F/T	Yes	D/T	12.0	80	73		No
MITSUBISHI	CD-100 System I (With CV-232 amp)	699.95	5-20 + 1.0, -1.5	90	0.01	A	A	No	V/B/F/T	No	D				25	No
	CD-100 System II (With CZ-741 radio and CV-251 amp)	899.95	5-20 + 1.0, -1.5	90	0.01	A	A	No	V/B/F/T	No	D	14	65	60	25 x 4	No
	CD-100 System III (With CZ-741 radio and CL-150 adaptor)	869.95	5-20 + 1.0, -1.5	90	0.01	A	A	No	V/B/F/T	No	D	14	65	60		No
	CD-100 System IV (With JX-3 radio)	899.95	5-20 + 1.0, -1.5	90	0.01	A	A	No	V/B/F/T	No	D	14	65	60	25 x 4	No
	CD-100 System V (With JX-2 radio)	869.95	5-20 + 1.0, -1.5	90	0.01	A	A	No	V/B/F/T	No	D	14	65	60	30	No
PANASONIC	CQ-E800EU	799.95	5-20 ± 1	90	0.005	A	A	No	V/B/F/T	Yes	D/T	15.2@ 50 dB	75	70		Yes
PHILIPS	DC 085	599.95	20-20 ± 0.5	90	0.01	D	A	Yes	V/B/F/T	Yes	D					No
PIONEER	DEX-77	850.00	5-20 ± 1.0	90	0.005	A	A	Yes	V/B/T	No	D/T	17	70	70		No
SANSUI	CD-X500	600.00	5-20	90	0.005	D	A	No	V/B	Yes	D					Yes
SANYO	FTEC1	579.95	5-20	90	0.005	A	A	Yes	V/B/F/T	Yes	D/T	19.2	65	60		Yes
	FTEC2	649.95	5-20	90	0.005	A	A	Yes	V/B/F/T	Yes	D/T	19.2	65	60		Yes
SONY	CDX-R88 (Optional XK-8 deck, \$269.95)	749.95	5-20 ± 0.5	90	0.005	D	A	Yes	V/B/F/T	Yes	D/T	14@ 50 dB	75	70	25	Yes
	CDX-A10 DiscJockey (Optional XT-10 tuner pack, \$159.95)	999.95	5-20 ± 0.5	90	0.005	A	C	Yes	V/B/F/T	Yes	D/T	15.3@ 50 dB	75	70		Yes
TECHNICS	CQ-DP5EU	840.00	5-20 ± 1	90	0.005	A	A	No	V/B/F/T	Yes	D/T	15.2@ 50 dB	75	70		No
YAMAHA	YCD-1000	499.00	20-20 + 0, -3	92	0.05	D	B	No	V/B/T	Yes	D					Yes



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ALPINE

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	AMPLIFIER											TUNER							TAPE					
			Average Watt's Channel, per EIA RS-490		THD at Rated Output, % per EIA RS-490	Outputs: Preamp (P), Speaker Level (S), Both (Both)	Number of Tone or EQ Controls	FM Sensitivity, dB (For 30-dB Quieting)	Alternate Channel Selectivity, dB	FM Mono S/N Ratio, dB	Total Number of Station Presets	Tuning: Seek (A), Scan (B), Both (C)	Local Distant Control: Manual (M), Automatic (A)	AM Stereo Capable? See Code	Frequency Response, Hz to kHz, ±dB	Noise-Reduction Circuit? See Code	Tape S/N Ratio, dB (With NR if Applicable)	Auto Reverse?	Program Search?	Tape EQ Switch?	In-Dash (I), DIN (D), Dash (D), Under-Dash (U), Convertible (C)	RCA In-Out Jacks?				
			4.4	0.8																			Both	2	14.2	70
AIWA	CT-X5001I	600.00	4.4	0.8	Both	2	14.2	70	65	12	A	M	No	40-16 ±3	B/C	71	Yes	Yes	Yes	D/E	Yes					
	CT-X4001I	500.00	4.4	0.8	Both	2	14.2	70	65	12	A	M	No	40-16 ±3	B/C	64	Yes	Yes	Yes	D/E	Yes					
	CT-X3001I	400.00	4.4	0.8	Both	2	14.2	70	65	12	A	M	No	40-16 ±3	B/C	64	Yes	No	Yes	D/E	Yes					
ALPINE	7385	550.00			P	2	16.3	80	60	18	A	M/A	No	20-22 ±3	B/C	72	Yes	Yes	Auto	D/E	No					
	7284	500.00	16	8.0	Both	2	16.3	80	60	18	A	M/A	No	30-20 ±3	B	64	Yes	Yes	Auto	D/E	No					
	7283	400.00	16	8.0	Both	2	16.3	80	60	18	A	M/A	No	40-18 ±3	B	64	Yes	Yes	Auto	D/E	No					
	7368	550.00			P	2	16.3	80	60	18	A	M/A	No	20-22 ±3	B/C	72	Yes	Yes	Auto	D	No					
	7267	480.00	16 x 4	8.0	Both	2	16.3	80	60	12	A	M/A	No	30-20 ±3	B	64	Yes	Yes	Auto	D	No					
	7263	300.00	16	8.0	Both	2	16.3	80	60	12	A	M/A	No	40-16 ±3	B	62	Yes	Yes	Auto	D	No					
	7375	1500.00			P	2	16.3	80	60	18	A	M/A	No	20-22 ±3	A/B/C	86	Yes	Yes	Auto	D	No					
	7287	620.00	16 x 4	8.0	Both	2	16.3	80	60	18	A	M/A	No	20-22 ±3	B	64	Yes	Yes	Auto	D	No					
	7296	620.00	16 x 4	8.0	Both	2	16.3	80	60	18	A	M/A	No	20-22 ±3	B	64	Yes	Yes	Auto	D	No					
	7274	600.00	16	8.0	Both	2	16.3	80	60	12	A	M/A	No	30-18 ±3	B	64	Yes	Yes	Auto	D	No					
	7282	340.00	16	8.0	Both	2	16.3	80	60	18	A	M/A	No	40-18 ±3	B	64	Yes	Yes	Auto	D	No					
	7181	290.00	6	8.0	Both	2	16.3	80	60	18	A	M/A	No	40-18 ±3	B	64	Yes	Yes	Auto	D	No					
	7166	330.00	6	8.0	Both	2	16.3	80	60	12	A	M/A	No	40-16 ±3	B	64	Yes	Yes	Auto	D	No					
	7163	250.00	6	8.0	Both	2	16.3	80	60	12	A	M/A	No	40-16 ±3	B	64	Yes	Yes	Auto	D	No					
	7159	420.00	6	8.0	Both	2	16.3	80	60	12	A	M/A	No	30-20 ±3	B	64	Yes	Yes	Auto	D	No					
7158	370.00	6	8.0	Both	2	16.3	80	60	12	A	M/A	No	40-16 ±3	B	64	Yes	Yes	Auto	D	No						
7141	220.00	6	8.0	Both	2	16.3	80	60	12	A	M/A	No	40-16 ±3	B	64	Yes	Yes	Auto	D	No						
AUDIA	2000E	789.95			P	4	12	70		18	C	A	M	30-18 ±3	B/C	71	Yes	Yes	Yes	D	Yes					
	200E	579.95			P	4	12	70		18	C	A	M	30-18 ±3	B/C	71	Yes	Yes	Yes	D	Yes					
	200	569.95			P	4	12	70		18	C	A	M	30-18 ±3	B/C	71	Yes	Yes	Yes	D	Yes					
	20	459.95			P	4	12	70		18	C	A	No	30-18 ±3	B/C	71	Yes	Yes	Yes	I	Yes					
AUDIVOX	AV-210	375.00	15	10	S	5	13	70	65	12	C	M	No	50-10	D	59	Yes	No	Yes	D						
	AV-210BR	480.00	15	10	S	5	13	70	65	12	C	M	No	50-10	D	59	Yes	No	Yes	D						
	AV-200	295.00	5	10	S	1	15	60	60	12	C	M	No	50-10	D	50	Yes	No	No	D						
	AV-205	235.00	3	10	S	1	13	65	65	12	C	M	No	50-10	D	50	No	No	No	D						
	AV-989	345.00	15	10	S	5	13	65	65	12	C	M	No	50-10	D	50	No	No	No	D						
	AV-987	256.00	15	10	S	5	13	65	65	12	C	M	No	50-10	D	50	No	No	No	D						
	AV-960	375.00	20	10	S	2	13	70	65	12	A	M	No	40-12.5	B	59	Yes	Yes	Yes	I						
	AV-938	320.00	5	10	S	1	15	65	65	12	C	M	No	50-10	D	50	Yes	Yes	No	I						
	AV-935	256.00	5	10	S	1	15	60	60	12	C	M	No	50-10	D	50	Yes	No	No	I						
	AV-934	200.00	5	10	S	1	16	60	60	12	A	M	No	50-10	D	50	No	No	No	I						
	AV-932	175.00	3	10	S	1	16	60	60	12	A	M	No	50-10	D	50	No	No	No	I						
	AV-929	165.00	5	10	S	1	16	60	60	12	A	M	No	50-10	D	50	No	No	No	I						
	AV-686	165.00	15	10	S	5	16	60	65	0	A	M	No	50-10	D	50	No	No	No	I						
	AV-3050	140.00	5	10	S	1	16	60	60	0	M	No	No	50-10	D	50	No	No	No	I						
	AV-3000	90.00	5	10	S	1	16	60	60	0	M	No	No	50-10	D	50	No	No	No	I						
AUTOTEK	SR-90	199.95	3.5	0.5	S	2	26	65	66	12	C	M	No	30-15 ±0.3	No	52	Yes	No	Yes	I	No					
	SR-200	269.95	3.5	0.5	Both	2	24	65	66	12	C	M	No	30-17 ±0.3	B	62	Yes	Yes	Yes	I	Yes					
	SR-500	319.95	14 x 2, 4 x 4	0.5	Both	2	24	65	66	12	C	M	No	30-17 ±0.3	B/C	71	Yes	Yes	Yes	I	Yes					
	SR-300D	319.95	16	0.5	S	2	23	65	68	12	C	M	No	30-17 ±0.3	D	65	Yes	No	No	E	No					
	SR-5670A	349.95	4	0.5	Both	2	26	66	65	12	C	M	No	50-14	B/D	65	Yes	Yes	Yes	D	Yes					
SR-5770A	379.95	2.5	0.5	Both	2	22	66	64	12	A	M	No	50-15	B/D	65	Yes	Yes	Yes	D	Yes						
BLAUPUNKT	Berlin TQR 07	1499.95			P		13	78	65	96	C	A	M	35-18 ±3	B/C	73	Yes	Yes	Yes	D/C	No					
	Washington SQR 47	489.95	8 x 4	0.1	Both		15	78	65	10	A	A	No	35-18 ±3	B/C/D	73	Yes	Yes	Yes	D/C	No					
	Seattle SQR 47	219.95	7.5		S		13	65	65	12	A	A	No	35-18 ±3	D	53	Yes	No	Yes	D/C	No					
	Houston SQR 06	749.95		0.03	P		13	80	70	24	C	A	No	30-20 ±3	A/B/C/D	83	Yes	Yes	Yes	D/C	No					
	Tucson SQR 06	619.95		0.03	P		13	80	70	24	C	A	M	30-20 ±3	B/C/D	73	Yes	Yes	Yes	D/C	No					
	Lexington SQR 46	489.95	16	0.1	Both		13	78	65	12	C	A	No	35-18 ±3	B/D	63	Yes	Yes	Yes	D/C	No					
	Portland SQR 26	329.95	7.5	1	Both		13	75	70	12	A	A	No	30-16 ±3	D	63	Yes	No	Yes	D/C	No					
Denver SQR 26	269.95	7.5		S		13	65	65	12	A	M	No	30-14 ±3	D	63	Yes	No	No	D/C	No						
Frankfurt SQM 36	249.95	7.5 x 4	1	Both		13	75	65	24	C	A	No	30-14 ±3	D	63	Yes	No	No	D/C	No						
Frankfurt	169.95	7.5	1	Both		13	65	63	10	C	A	M	30-14 ±3	D	63	Yes	No	No	D/C	No						
CARVER	TX-Nine	775.00					13	68	74	30	C	A	No	20-20 ±3	B/C	65	Yes	Yes	Yes	D	Yes					
	TX-Seven	650.00					15	60	68	30	C	A	No	25-18 ±3	B	60	Yes	No	Yes	D	Yes					
CLARION	9425RT	589.95	11	1	Both	3	12	70		18	C	A	M	30-16 ±3	B/C	71	Yes	Yes	Yes	D	Yes					
	9200RT	419.95	12	1	Both	3	12	70		18	C	A	No	30-16 ±3	B/C	71	Yes	Yes	Yes	I	Yes					
	9100RT	319.95	12	1	Both	3	12	70		18	C	A	No	30-14 ±3	B/C	53	Yes	Yes	Yes	I	Yes					
	8925RT	429.95	3.2	5	Both	2	12	70		18	C	A	M	30-14 ±3	B/C	63	Yes	Yes	Yes	D	Yes					
	8900RT	399.95	3.2	5	Both	2	12	70		18	C	A	M	30-14 ±3	B/C	71	Yes	Yes	Yes	I	Yes					
	8825RT	399.95	12	1	Both	3	12	70		18	C	A	No	30-14 ±3	B	63	Yes	Yes	Yes	E	Yes					
	8800RT	339.95	3.2	5	Both	2	12	70		18	C	A	No	30-14 ±3	B	63	Yes	Yes	Yes	E	Yes					
	8725RT	319.95	3.2	5	Both	2	12	70		10	A	A	No	30-14 ±3	B	63	Yes	Yes	Yes	D	Yes					
	8670R	359.95	3.2	5	S	2	12	70		18	C	A	No	30-14 ±3	B	53	Yes	Yes	Yes	E	Yes					
	8625RT	319.95	3.2	5	Both	2	12	70		18	C	A	No	30-14 ±3	No	53	Yes	Yes	Yes	D	Yes					
	8600RT	289.95	3.2	5	Both	2	12	70		18	C	A	No	30-14 ±3	No	53	Yes	Yes	Yes	D	Yes					
	8401RT	249.95	3.2	5	Both	2	12	70		18	C	A	No	30-14 ±3	No	53	Yes	Yes								

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	AMPLIFIER										TUNER					TAPE																		
			Average Watts Channel, per EIA RS-499		THD at Rated Output, % per EIA RS-499		Outputs, Preamp (P), Speaker Level (S), Both (Both)		Number of Tone or EQ Controls		FM Sensitivity (dB) (For 30-dB Quieting)		Alternate-Channel Selectivity, dB		FM Mono S/N Ratio, dB		Total Number of Station Presets		Tuning: Seek (A), Scan (B), Both (C)		Local/Distant Control: Manual (M), Automatic (A)		AM Stereo Capable? See Code		Frequency Response, Hz to kHz, ±dB		Noise-Reduction Circuit? See Code		Tape S/N Ratio, dB (With NR if Applicable)		Auto Reverse?		Program Search?		Tape EQ Switch?	
			12 x 2, 5 x 4	0.8	Both	2	11.2	70	12	B	A	No	30-17 ±3	B/C	70	Yes	Yes	Yes	I	Yes																
CONCORD (Continued)	HPL-540	449.95	12	0.8	Both	2	11.2	70	12	B <td>A <td>No <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B/C</td> <td>70</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td></td></td>	A <td>No <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B/C</td> <td>70</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td></td>	No <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B/C</td> <td>70</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td>	M	No	30-17 ±3	B/C	70	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	HPL-550	549.95	12 x 2, 5 x 4	0.8	Both	2	11.2	70	12	B <td>A <td>M</td> <td>No</td> <td>M</td> <td>20-20 ±2</td> <td>A/B/C</td> <td>80</td> <td>Yes <td>No</td> <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td></td>	A <td>M</td> <td>No</td> <td>M</td> <td>20-20 ±2</td> <td>A/B/C</td> <td>80</td> <td>Yes <td>No</td> <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td>	M	No	M	20-20 ±2	A/B/C	80	Yes <td>No</td> <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	No	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes													
COUSTIC	RX-512	309.95	25	0.9	Both	2	13.2	55	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-18 ±3</td> <td>B/C</td> <td>70</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td>	M	No	M	No	40-18 ±3	B/C	70	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-506	259.95	8	0.9	Both	2	13.2	55	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-16 ±3</td> <td>B</td> <td>60</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td>	M	No	M	No	40-16 ±3	B	60	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-505	219.95	25	0.9	Both	2	13.2	55	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>50-15 ±3</td> <td>B</td> <td>65</td> <td>Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td></td>	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-504	179.95	25	0.9	Both	2	14.7	50	12	M	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-503	139.95	8	0.9	Both	2	14.7	50	12	M	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-906	149.95	8	0.9	S	1	14.7	50	12	M	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-903	119.95	8	0.9	S	1	14.7	50	12	M	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
	RX-902	69.95	8	0.9	S	1	14.7	50	12	M	M	No	M	No	50-15 ±3	B	65	Yes <td>Yes <td>Yes <td>I</td> <td>Yes</td> </td></td>	Yes <td>Yes <td>I</td> <td>Yes</td> </td>	Yes <td>I</td> <td>Yes</td>	I	Yes														
CRAIG	T507	49.95	4.0	5.0	S	1	20.8	60	60			M	No	M	No	63-10 ±6	No	50	No	No	No	I														
	T508	74.95	4.0	5.0	S	1	20.8	60	60			M	No	M	No	63-10 ±6	No	50	No	No	No	I														
	T508A	79.95	4.0	5.0	S	1	20.8	60	60			M	No	M	No	63-10 ±6	No	50	No	No	No	I														
	T509	84.95	4.0	5.0	Both	1	20.8	60	60			M	No	M	No	63-10 ±6	No	50	Yes	No	No	No	I													
	T520	99.95	4.0	5.0	S	1	20.8	60	60	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±6</td> <td>No</td> <td>50</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	63-10 ±6	No	50	No	No	No	No	I													
	T521	129.95	4.0	5.0	S	1	20.8	60	60	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±6</td> <td>No</td> <td>50</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	63-10 ±6	No	50	Yes	No	No	No	I													
	T726	129.95	4.5	5.0	S	2	17.3	60	60	12	B <td>A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td> </td>	A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	No	M	No	63-10 ±3	No	54	No	No	No	No	I													
	T727	169.95	4.5	5.0	Both	2	17.3	60	60	12	B <td>A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td> </td>	A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	No	M	No	63-10 ±3	No	54	Yes	No	No	No	I													
	T728	199.95	16	5.0	Both	2	17.3	60	60	10	B <td>A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>D</td> <td>59</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td></td> </td>	A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>D</td> <td>59</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td></td>	No	M	No	63-10 ±3	D	59	Yes	Yes	Yes	I														
	T563	169.95	4.5	5.0	Both	2	17.3	60	60	12	B <td>A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>Yes</td> <td>No</td> <td>No</td> <td>C</td> <td></td> <td></td> </td>	A <td>No</td> <td>M</td> <td>No</td> <td>63-10 ±3</td> <td>No</td> <td>54</td> <td>Yes</td> <td>No</td> <td>No</td> <td>C</td> <td></td> <td></td>	No	M	No	63-10 ±3	No	54	Yes	No	No	C														
	CYBERNET	CMS 3000	549.00	18	10	Both	2	14.8	60	60	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-12.5 ±3</td> <td>B <td>59</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>U</td> <td>No</td> </td>	M	No	M	No	40-12.5 ±3	B <td>59</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>U</td> <td>No</td>	59	Yes	No	Yes	U	No												
CMS 4000		699.00	20	10	Both	2	14.8	60	60	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-12.5 ±3</td> <td>A/B</td> <td>68</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>U</td> <td>No</td>	M	No	M	No	40-12.5 ±3	A/B	68	Yes	Yes	Yes	U	No													
DENON	DCR-5320	375.00	10 x 2, 4.5 x 4	0.8	Both	2	20.3 ^(a) 50 dB	70	60	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-16 ±3</td> <td>B/C</td> <td>70</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>D/E</td> <td>Yes</td>	M	No	M	No	40-16 ±3	B/C	70	Yes	No	Yes	D/E	Yes													
	DCR-5420A	450.00	10 x 2, 4.5 x 4	0.8	Both	2	20.3 ^(a) 50 dB	70	60	24	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>30-18 ±3</td> <td>B/C</td> <td>72</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>D/E</td> <td>Yes</td>	M	No	M	No	30-18 ±3	B/C	72	Yes	Yes	Yes	D/E	Yes													
	DCR-5520	600.00	10	0.8	(2)P, S	2	20.3 ^(a) 50 dB	70	60	24	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>30-18 ±3</td> <td>B/C</td> <td>72</td> <td>Yes</td> <td>Yes</td> <td>Auto</td> <td>D/E</td> <td>Yes</td>	M	No	M	No	30-18 ±3	B/C	72	Yes	Yes	Auto	D/E	Yes													
	DCR-5500	500.00	5	0.8	(2)P, S	2	20.3 ^(a) 50 dB	70	60	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>30-18 ±3</td> <td>B/C</td> <td>72</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	M	No	M	No	30-18 ±3	B/C	72	Yes	Yes	Yes	D	Yes													
	DCR-7600	600.00	600.00	5	0.8	(2)P	2	20.3 ^(a) 50 dB	70	60	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>30-18 ±3</td> <td>B/C</td> <td>72</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	M	No	M	No	30-18 ±3	B/C	72	Yes	Yes	Yes	D	Yes												
DIGITRON	10	52.95	3.5	2	S	1	25	40	40			No	M	No	60-10 ±6	No	40	No	No	No	No	I														
	12		3.5	2	S	1	25	40	40			No	M	No	60-10 ±6	No	40	No	No	No	No	I														
	20		3.5	2	S	1	25	60	55	10	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-10 ±6</td> <td>No</td> <td>45</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	60-10 ±6	No	45	No	No	No	I														
	22	159.95	3.5	2	Both	2	25	60	55	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-10 ±6</td> <td>No</td> <td>50</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	60-10 ±6	No	50	No	No	No	I														
	30	154.95	3.5	2	Both	1	25	60	55	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-10 ±6</td> <td>No</td> <td>45</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	60-10 ±6	No	45	Yes	No	No	No	I													
	50	189.95	12.5	2	Both	2	14	60	45	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-10 ±6</td> <td>D</td> <td>52</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td></td>	M	No	M	No	60-10 ±6	D	52	Yes	No	No	No	I													
	SEP45	295.95	3.5 x 4	1.5	S	2	20	65	45	10	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>47-12 ±0.3</td> <td>D</td> <td>55</td> <td>Yes</td> <td>No</td> <td>No</td> <td>D</td> <td>Yes</td>	M	No	M	No	47-12 ±0.3	D	55	Yes	No	No	D	Yes													
EPI	LSR-20	219.95	8	0.8	S	2	14.7	60	55	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>50-13 ±3</td> <td>D</td> <td>55</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td>Yes</td>	M	No	M	No	50-13 ±3	D	55	Yes	No	Yes	I	Yes													
	LSR-24	269.95	8	0.8	Both	2	14.7	60	55	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>50-13 ±3</td> <td>B</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	M	No	M	No	50-13 ±3	B	60	Yes	Yes	Yes	I	Yes													
	LSR-34	369.95	12	0.8	Both	2	11.2	60	60	12	B <td>A <td>No</td> <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td> </td>	A <td>No</td> <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	No	M	No	30-17 ±3	B	60	Yes	Yes	Yes	I	Yes													
	LSR-42	429.95	12	0.8	Both	2	10.3	60	60	12	B <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>30-17 ±3</td> <td>B/C</td> <td>72</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	M	No	M	No	30-17 ±3	B/C	72	Yes	Yes	Yes	I	Yes													
FUJITSU TEN	L-1	279.95	5	5		2	22 ^(a) 50 dB	60		10	A <td>M</td> <td></td> <td>M</td> <td>No</td> <td>40-15 ±3</td> <td>No</td> <td>53</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td></td>	M		M	No	40-15 ±3	No	53	Yes	No	Yes	I														
	L-2	329.95	15	3	Both	2	20 ^(a) 50 dB	60		10	A <td>M</td> <td></td> <td>M</td> <td>No</td> <td>40-15 ±3</td> <td>D</td> <td>60</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td></td>	M		M	No	40-15 ±3	D	60	Yes	No	Yes	I														
	L-3	369.95	8.5	3	S	2	20 ^(a) 50 dB	60		10	A <td>M</td> <td></td> <td>M</td> <td>No</td> <td>40-15 ±3</td> <td>B</td> <td>60</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td></td>	M		M	No	40-15 ±3	B	60	Yes	No	Yes	I														
	M-1	299.95	3	5		1	18 ^(a) 50 dB	75		12	A <td></td> <td></td> <td>M</td> <td>No</td> <td>35-18 ±3</td> <td>B</td> <td>55</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td></td>			M	No	35-18 ±3	B	55	Yes	No	Yes	I														
	M-2	349.95	3	5		2	16 ^(a) 50 dB	75		12	A <td></td> <td></td> <td>M</td> <td>No</td> <td>35-18 ±3</td> <td>B</td> <td>69</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>I</td> <td></td>			M	No	35-18 ±3	B	69	Yes	No	Yes	I														
	M-3	399.95	11	5		2	16 ^(a) 50 dB	75		12	C <td>M</td> <td></td> <td>M</td> <td>No</td> <td>35-18 ±3</td> <td>B</td> <td>69</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td></td>	M		M	No	35-18 ±3	B	69	Yes	Yes	Yes	I														
	FULTRON	16-7700	249.95	10	3	Both	2				12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td></td> <td>D</td> <td></td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>No</td>	M	No	M	No		D		Yes	Yes	Yes	D	No												
16-7400		219.95	10	3	Both	2				12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td></td> <td>D</td> <td></td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>C</td> <td>No</td>	M	No	M	No		D		Yes	Yes	Yes	C	No													
16-7300		199.95	3	3	Both	2				12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td></td> <td>D</td> <td></td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>C</td> <td>No</td>	M	No	M	No		D		Yes	Yes	Yes	C	No													
16-6700		169.95	3	3	S	1				12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td></td> <td>D</td> <td></td> <td>Yes</td> <td>No</td> <td>No</td> <td>C</td> <td>No</td>	M	No	M	No		D		Yes	No	No	C	No													
16-5700		139.95	10	3	Both	2				0	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td></td> <td>D</td> <td></td> <td>Yes</td> <td>Yes</td> <td>No</td> <td>C</td> <td>No</td>	M	No	M	No		D		Yes	Yes	No	C	No													
16-5300		119.95	3	3	Both	1				0		M	No	M	No		D		Yes	Yes	No	C	No													
16-5900		89.95	3	3	S	1				0		M	No	M	No		D		Yes	Yes	No	C	No													
16-5800		59.95	3	3	S	1				0		M	No	M	No		D		Yes	Yes	No	C	No													
HARMAN/KARDON		CH140				P	2	14.8	70	70	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>20-20 ±3</td> <td>B <td>64</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td> </td>	M	No	M	No	20-20 ±3	B <td>64</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	64	No	Yes	Yes	I	Yes												
	CH160				P	2	14.8	70	70	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>20-20 ±3</td> <td>B/C</td> <td>64</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	M	No	M	No	20-20 ±3	B/C	64	No	Yes	Yes	D	Yes													
	CH141				P	2	14.8	70	70	12	B <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>20-20 ±3</td> <td>B <td>64</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td> </td>	M	No	M	No	20-20 ±3	B <td>64</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	64	No	Yes	Yes	D	Yes													
	CH161				P	2	14.8	70	72	12	B <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>20-20 ±3</td> <td>B/C</td> <td>72</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	M	No	M	No	20-20 ±3	B/C	72	No	Yes	Yes	D	Yes													
HI-COMP	HCC-1035	140.00	3	1	S	1	16	60	65	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-12.5 ±3</td> <td>D</td> <td>50</td> <td>No</td> <td>No</td> <td>No</td> <td>I</td> <td>Yes</td>	M	No	M	No	60-12.5 ±3	D	50	No	No	No	I	Yes													
	HCC-1040	180.00	3	1	S	1	16	65	65	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-12.5 ±3</td> <td>D</td> <td>50</td> <td>Yes</td> <td>No</td> <td>No</td> <td>I</td> <td>Yes</td>	M	No	M	No	60-12.5 ±3	D	50	Yes	No	No	I	Yes													
	HCC-1060	200.00	3	1	Both	2	12	70	65	12	A <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>60-12.5 ±3</td> <td>D</td> <td>57</td> <td>Yes</td> <td>No</td> <td>No</td> <td>I</td> <td>Yes</td>	M	No	M	No	60-12.5 ±3	D	57	Yes	No	No	I	Yes													
	HCC-1160	270.00	13	1	Both	2	11	74	70	18	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-12.5 ±3</td> <td>D</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	M	No	M	No	40-12.5 ±3	D	60	Yes	Yes	Yes	I	Yes													
	HCC-1260	340.00	13	1	Both	2	11	74	70	18	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-14 ±3</td> <td>B</td> <td>63</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>I</td> <td>Yes</td>	M	No	M	No	40-14 ±3	B	63	Yes	Yes	Yes	I	Yes													
	HCC-2100	340.00	13	1	Both	2	11	74	70	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-12.5 ±3</td> <td>D</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>D</td> <td>Yes</td>	M	No	M	No	40-12.5 ±3	D	60	Yes	Yes	Yes	D	Yes													
	HCC-2100BR	390.00	13	1	Both	2	11	74	70	12	C <td>M</td> <td>No</td> <td>M</td> <td>No</td> <td>40-12.5 ±3</td> <td>D</td> <td>60</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>E</td> <td>No</td>	M	No	M	No	40-12.5 ±3	D	60	Yes	Yes	Yes	E	No													

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	AMPLIFIER										TUNER							TAPE					
			Average Watts Channel, per EIA RS-499		THD at Rated Output, % per EIA RS-499	Outputs: Preamp (P), Speaker Level (S), Both (Both)	Number of Tone or EQ Controls	FM Sensitivity (dB) (For 30-dB Overriding)	Alternate Channel Selectivity, dB	FM Mono S/N Ratio, dB	Total Number of Stations Presets	Tuning: Seek (A), Scan (B), Both (C)	Local/Station Control: Manual (M), Automatic (A)	AM Stereo Capable? See Code	Frequency Response, Hz to kHz, -dB	Noise Reduction Circuit? See Code	Tape S/N Ratio, dB (With NR If Applicable)	Auto Reverse?	Program Search?	Tape EQ Switch?	In-bass (I), DM In-bass (D), Under-Bass (U), Compatible (C)	RCA In-Out Jacks?			
			12	0.2																			Both	5	16.3
HITACHI	CSK-451A	399.95	12	0.2	Both	5	16.3	80	60	18	B	A	No	40-16 ± 3	B/C	68	Yes	Yes	Yes	D	Yes				
	CSK-351A	349.95	12	0.2	Both	5	16.3	80	60	12	B	A	No	40-16 ± 3	B	62	Yes	No	Yes	D	Yes				
	CSK-350A	349.95	12	0.2	Both	5	16.3	80	60	12	B	A	No	40-16 ± 3	B	62	Yes	No	Yes	D	Yes				
	CSK-321A	299.95	12	0.2	Both	2	16.3	78	60	12	B	A	No	40-16 ± 3	B	62	Yes	No	Yes	D	Yes				
	CSK-310A	299.95	12	0.2	Both	2	16.3	80	60	12	B	A	No	40-16 ± 3	B	53	Yes	No	Yes	D	Yes				
	CSK-281A	249.95	12 x 4	0.2	Both	2	16.3	78	60	12	B	A	No	40-16 ± 3	B	52	Yes	No	Yes	D	Yes				
	CSK-270A	249.95	12	0.2	S	1	16.3	80	60	12	B	A	No	40-16 ± 3	B	53	Yes	No	Yes	D	No				
	CSK-251A	199.95	12 x 4	0.2	S	2	16.3	78	60	12	B	A	No	40-16 ± 3	B	52	Yes	No	Yes	D	No				
	CSK-250A	184.95	12	0.2	S	2	16.3	80	60	12	B	A	No	40-16 ± 3	B	53	No	No	Yes	D	No				
IMPACT INDUSTRIES	DR-7010	274.95					15.0	60	50	12	C	M	No	40-14	D	50	Yes	Yes	Yes	D	Yes				
	DR-7020	319.95					15.0	60	50	12	C	M	No	40-14	D	50	Yes	Yes	Yes	D	Yes				
JENSEN	JXL-55	399.95	4	1.0	Both	2	18.5	58	60	12	B	A	No	50-13.5 ± 3	B	62	Yes	No	Yes	I	Yes				
	JXL-45	329.95	4	1.0	Both	2	18.5	58	60	12	B	A	No	50-13.5 ± 3	B	54	Yes	No	Yes	I	Yes				
	JXL-35	274.95	4	1.0	S	1	18.5	58	60	8	A	M	No	50-13.5 ± 3	B	54	Yes	No	Yes	I	Yes				
	JXL-25	239.95	4	1.0	S	1	18.5	58	60	8	A	M	No	50-13.5 ± 3	B	54	No	No	Yes	I	Yes				
	JS6400	289.95	15	2.5	S	2	28.2	57	58	12	B	M	No	80-10 ± 3	B	60	No	No	Yes	I	Yes				
	JS6200	249.95	3.5	2.5	S	2	28.2	57	58	12	C	M	No	80-10 ± 3	B	50	No	No	No	I	No				
	JS6100	169.95	3.5	2.5	S	1	28.2	57	58	12	C	M	No	80-10 ± 3	B	50	No	No	No	I	No				
	CS-4000	199.95	3	2.5	S	1	28.2	57	58	8	A	A	No	80-10 ± 3	B	50	No	No	No	I	No				
	CS-2000	169.95	3	2.5	S	1	28.2	57	58	8	A	A	No	80-10 ± 3	B	50	No	No	No	I	No				
	JSE	9742	169.95	10	0.001	Both	25	25	55	10	B	M	No	30-12	D	45	Yes	Yes	Yes	I	Yes				
9762		229.95	10	0.001	Both	25	25	55	12	B	M	No	30-12	D	65	Yes	Yes	Yes	I	Yes					
9772		269.95	25	0.001	Both	25	25	55	12	B	M	No	30-12	B/C	65	Yes	Yes	Yes	I	Yes					
9680		349.95	10	0.001	Both	25	25	57	12	B	M	No	30-12	D	50	Yes	Yes	Yes	I	Yes					
9517		119.95	10	0.001	Both	25	25	58	8	M	M	No	30-12	D	45	No	No	No	I	Yes					
9527		149.95	10	0.001	Both	25	25	58	8	M	M	No	30-12	D	45	No	No	No	I	Yes					
JVC	KSR17	199.95	3	0.8	S	2	17.2	65	60	15	B	A	No	50-13 ± 0.3	B	52	Yes	No	Yes	I	Yes				
	KSRX111	299.95	8	0.8	Both	2	16.3	65	60	20	B	A	No	50-15 ± 0.3	B	52	Yes	Yes	Yes	I	Yes				
	KSRX222	379.95	8 x 2, 3 x 2	0.8	Both	2	16.3	65	60	20	B	M	No	50-15 ± 0.3	B	60	Yes	Yes	Yes	I	Yes				
	KSRX333	449.95	8 x 2, 3 x 2	0.8	Both	2	16.3	65	60	20	B	A	No	40-15 ± 0.3	B/C	68	Yes	Yes	Yes	I	Yes				
	KSR33	229.95	3	0.8	Both	2	17.2	65	60	15	B	A	No	50-13 ± 0.3	B	52	Yes	No	No	D	Yes				
	KSRX710	499.95	12	0.8	Both	5	16.3	65	60	20	B	A	No	40-15 ± 0.3	B	60	Yes	Yes	Yes	E	Yes				
	KSRX715	599.95	8 x 2, 3 x 2	0.8	Both	5	16.3	65	60	20	C	M	No	40-15 ± 0.3	B/C	68	Yes	Yes	Yes	E	Yes				
	KSRX605	499.95	8	0.8	Both	5	16.3	65	60	20	C	M	No	50-15 ± 0.3	B	60	Yes	Yes	Yes	E	Yes				
	KSRX515	449.95	8 x 2, 3 x 2	0.8	Both	2	16.3	65	60	20	C	A	No	50-15 ± 0.3	B	60	Yes	Yes	Yes	E	Yes				
KSRX415	379.95	8	0.8	Both	2	16.3	65	60	20	B	A	No	50-15 ± 0.3	B	60	Yes	No	Yes	E	Yes					
KENWOOD	KRC-2000A	279.00	4	1.0	Both	2	15.3	65	66	12	A	M	No	40-16 ± 3	O	53	Yes	Yes	Yes	D	No				
	KRC-2001	329.00	10	1.0	Both	2	15.3	65	66	12	A	M	No	40-16 ± 3	O	59	Yes	No	Yes	D	No				
	KRC-5001	459.00	10 x 4	1.0	Both	2	15.3	65	70	12	A	M	No	40-16 ± 3	B	64	Yes	Yes	Yes	O	No				
	KRC-8001	629.00	10	1.0	Both	2	14.8	65	70	24	A	A	M	30-18 ± 3	B/C	73	Yes	Yes	Yes	O	No				
	KRC-512	399.00	4	1.0	Both	2	15.3	65	68	10	A	A	M	40-14 ± 3	B	60	Yes	No	Yes	D	No				
	KRC-333	399.00	4	1.0	Both	2	15.3	65	70	12	A	M	No	40-16 ± 3	B	61	Yes	No	Yes	D	No				
	KRC-434	499.00	4	1.0	Both	2	15.3	65	70	12	A	M	No	40-16 ± 3	O	64	Yes	No	Yes	D	No				
	KRC-636	579.00	4	1.0	Both	2	15.3	65	70	24	A	M	No	30-18 ± 3	B/C	61	Yes	Yes	Yes	D/E	No				
	KRC-838	659.00	10	1.0	Both	2	14.8	65	70	24	A	M	No	30-18 ± 3	B/C	72	Yes	Yes	Yes	D/E	No				
	KRC-939	999.00	10	1.0	P	2	12.0	90	73	24	A	M	U	20-22.5 ± 3	B/C	73	Yes	Yes	Yes	D/E	No				
	KRC-999	1649.00	10	1.0	P	7	12.0	80	73	20	A	M	No	20-22.5 ± 3	A/B/C	86	Yes	Yes	Yes	D/D	No				
	KRACO	KF-1190	399.95	32	0.009	Both	5	16.1	40	65	10	C	M	No	47-13 ± 3	B	85	Yes	Yes	Yes	I	Yes			
		ETR-1090	399.95	29	0.01	Both	2	16.1	40	65	12	C	A	M	47-13 ± 3	B	85	Yes	Yes	Yes	I	Yes			
ETR-1084		329.95	33	0.09	S	2	16.1	53	60	12	C	A	No	49-12 ± 3	D	60	Yes	Yes	Yes	I	No				
KF-1186		289.95	10	0.01	Both	2	18.3	40	60	10	C	M	No	50-10 ± 3	D	80	Yes	Yes	No	I	No				
ETR-1086		289.95	10	0.01	S	1	18.3	53	60	10	C	M	No	50-10 ± 3	D	60	Yes	No	No	I	No				
ETR-808		289.95	33	0.01	S	5	17.2	52	55	10	C	M	No	50-10 ± 3	D	60	Yes	No	No	I	No				
KF-1107		259.95	32	0.01	Both	5	17.2	45	60	0	C	M	No	50-10 ± 3	No	60	Yes	No	No	I	No				
KGE-807		259.95	33	0.01	S	5	17.2	52	55	0	C	M	No	50-10 ± 3	No	50	Yes	No	No	I	No				
ETR-1082		199.95	10	0.01	S	1	18.8	55	50	0	C	M	No	50-10 ± 3	No	59	Yes	Yes	No	I	No				
ETR-1081		179.95	9	0.01	S	2	18.3	40	60	10	C	M	No	50-10 ± 3	No	55	No	No	No	I	No				
KGE-801		179.95	29	0.01	S	2	16.8	40	50	70	0	C	M	No	40-10 ± 3	No	45	No	No	No	I	No			
MAJESTIC		MCR5900HP	299.55	25	10	Both	1	10		12	C	M	No		B	50	Yes	Yes	Auto	E	Yes				
	MCR3700	169.95	7	10	Both	1	10		10	C	M	No	100-8 + 0, -6	B	50	Yes	No	Auto	I	Yes					
	MCR4650HP	199.95	25	10	Both	5	20		55	12	A	M	No	100-8 + 0, -6	B	50	Yes	No	Auto	I	Yes				
	MCR3900	159.95	7	10	Both	1	20		50	12	C	M	No	40-10	B	50	Yes	No	Auto	I	Yes				
	MCR4100	179.95	7	10	Both	1	15		50	12	C	M	No	50-10	B	50	Yes	No	Auto	I	Yes				
MCR4800	199.95	25	10	Both	1	10		12	C	M	No	+ 0, -6 40-14	B	60	Yes	No	Auto	I	Yes						

Until now, car stereo systems let you equalize sound through two speakers, at best. Which is hardly best, if you have four speakers. The highs and lows you control in only two speakers are virtually cancelled out by the levels you can't control in the other speakers.

But listen to Sherwood. Listen to the CRD-350 stereo cassette receiver combined with the EQA-280 equalizer/amplifier. Listen to full equalizer control of all *four* speakers at 20 watts per channel. A total of 80 watts.

The experts did at this past summer's Consumer Electronics Show. And they voted the CRD-350/EQA-280 combo "Among the most innovative consumer electronics products of the year." The EQA-280's line output loops through the CRD-350's preamp sending fully equalized sound to the four corners of your car.

And the EQA-280 gives you seven EQ bands. Five LEDs to indicate power levels. A selectable EQ defeat switch. A high/low gain switch. An automatic remote on/off.

What about the CRD-350? What about everything you ever wanted in car stereo. You get FM stereo, of course. But also C-QUAM* AM stereo. Dolby** B/C noise reduction for its full logic, auto-reverse cassette deck.

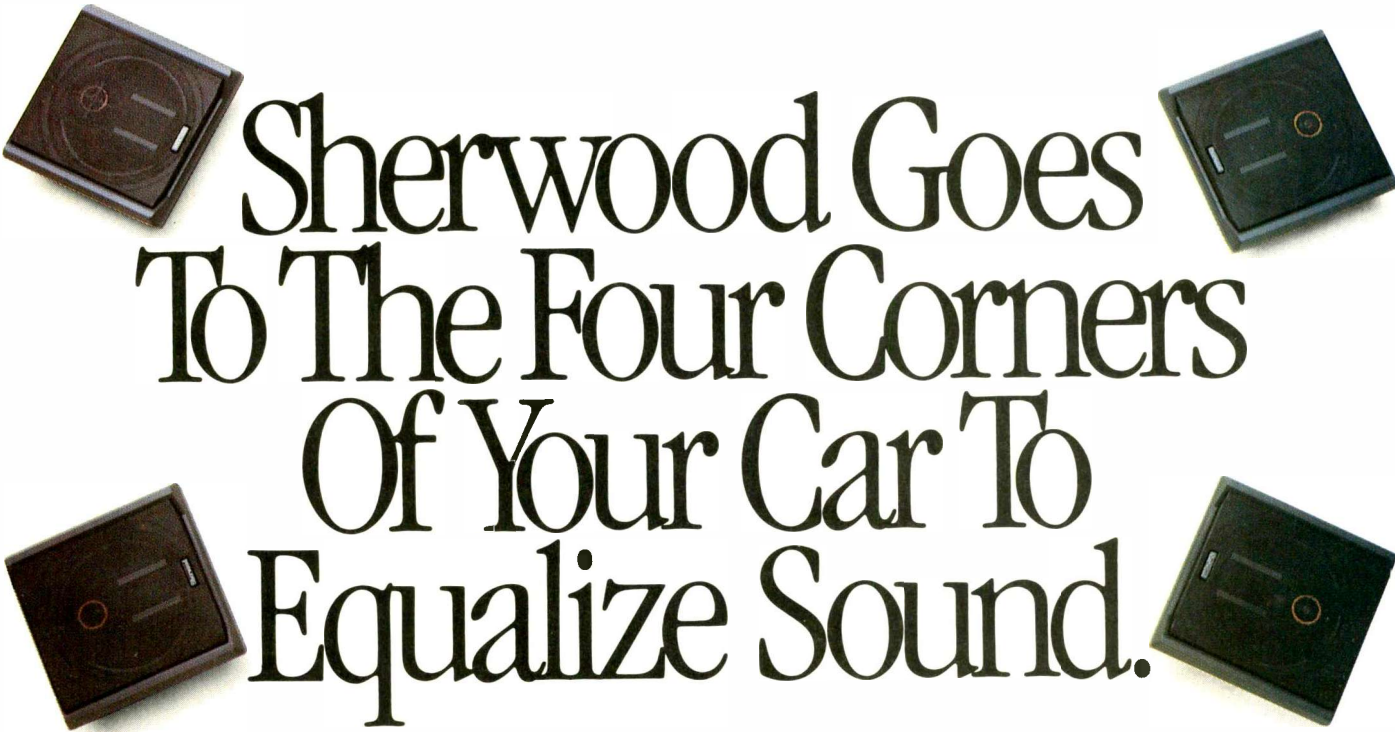
Plus, a computer controlled PLL synthesizer tuner. Automatic seek tuning. Local/distance switch. Twelve station presets. Preset scan. A compact disc player input. Fader control. Auto tape scan system. Auto tape music search and music repeat system. Super HI- β permalloy playback head. Even two illumination colors you can select with one touch.

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Sherwood Goes
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Of Your Car To
Equalize Sound.

Enter No. 31 on Reader Service Card

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price \$	AMPLIFIER										TUNER						TAPE					
			Average Watt Channel, per EIA RS-490		THD at Rated Output, % per EIA RS-490	Outputs: Preamp (P), Speaker Level (S)	Number of Tone or EQ Controls	FM Sensitivity, dB (For 30-dB Banding)	Alternate Channel Selectivity	FM Mono S/N Ratio, dB	Total Number of Station Presets	Tuning: Seek (A), Scan (B), Both (C)	Local Display Control: Manual (M), Automatic (A)	AM Stereo Capable? See Code	Frequency Response, Hz to KHz, ±dB	Noise-Reduction Circuit? See Code	Tape S/N Ratio, dB (With NR if Applicable)	Auto Reverse?	Program Search?	Tape EQ Switch?	In-Deck (D), Out-Deck (O), Expandable (E)	RCA In-Out Jacks?		
			THD	Outputs																			THD	Outputs
ME	CX118M	69.95	2.5	0.8	S	1	22	70	59			M	No	80-9.5 ±3		50	No	No	Auto					
	CX119M	79.95	2.8	0.8	S	1	19	70	60		A	No	40-12 ±3		46	No	No	Auto						
	CX117M	89.95	2.8	0.8	S	1	19	70	60		A	No	40-12 ±3		46	No	No	Auto						
	CX127M	119.95	2.8	0.8	S	1	22.5	61	58			M	No	80-10 ±3		53	Yes	Yes	Yes					
	CX136M	179.95	12.5	0.8	S	5	21.5	50	58			M	No	50-15.5 ±3		50	Yes	Yes	Yes					
	CX154E	219.95	12.5	0.8	S	5	21	50	54	10		M	No	40-12.5 ±3		54	Yes	Yes	Yes					
	CX135E	139.95	2.5	0.8	S	1	23	50	44		A	No	40-12 ±3		40	No	No	Auto						
	CX152E	159.95	2.5	0.8	S	1	23	50	44		A	No	40-12 ±3		40	No	No	Auto						
	CX143E	174.95	2.8	0.8	S	1	20	50	44		A	No	40-12 ±3		40	No	No	Auto						
	CX148E	199.95	2.8	0.8	Both	2	20	50	44		A	No	60-12.5 ±3		55	Yes	Yes	Yes						
	CX167E	259.95	12.5	0.8	Both	2	22	52	62		A	No	40-15 ±3	B	50	Yes	Yes	Yes				Yes		
	CX177E	399.95	12.5	0.8	Both	2	19	52	62		A	No	40-15 ±3	B/C	60	Yes	Yes	Yes				Yes		
	CXR158E	269.95	3	0.8	Both	2	21	52	60		A	No	30-18.5 ±3	B/C	70	Yes	Yes	Yes				Yes		
	CXR168E	309.95	12.5	0.8	Both	5	22	52	62		A	No	40-15 ±3	B/C	60	Yes	Yes	Yes				Yes		
METRO SOUND	CS1100	399.95	7	0.10	Both	2		12			C	M	No		D		Yes	Yes	Yes	E		Yes		
	CS1050	349.95	7	0.10	Both	2		12			C	M	No		D		Yes	Yes	Yes	E		Yes		
	CS811	249.95	7	0.10	Both	2		12			C	M	No		D		Yes	Yes	Yes	E		Yes		
	CS805	249.95	7	0.10	Both	2		12			C	M	No		D		Yes	Yes	Yes	E		Yes		
	CS760	149.95	7	0.10	S	1		12			C	M	No		D		Yes	No	No	E		Yes		
	CS635	139.95	5	0.10	S	1		12			C	M	No		D		Yes	No	No	E		Yes		
	CS630	99.95	5	0.10	S	1		12			C	M	No		D		Yes	No	No	E		Yes		
	MITSUBISHI	JX-3	419.95	13 x 4	1	S	6	14	65	60		C	M	M	50-14 ±3	B	62	Yes	Yes	Yes	I		No	
JX-2		329.95	17	1	S	2	14	65	60	18	C	M	No	50-14 ±3	B	62	Yes	Yes	Yes	I		No		
MX-4		389.95	13	1	Both	2	14	65	60	15	A	M	M	50-14 ±3	B/C	70	Yes	Yes	Yes	I		Yes		
MX-3		289.95	3.5	1	Both	2	14	65	60	15	A	M	No	50-14 ±3	B	62	Yes	Yes	Yes	I		Yes		
MX-35		289.95	3.5	1	Both	2	14	65	60	15	A	M	No	50-14 ±3	B	62	Yes	Yes	Yes	I		Yes		
MX-2		229.95	3.5	1	Both	2	14	65	60	15	A	M	No	50-12 ±3	B	52	Yes	No	No	I		Yes		
DX-4		449.95	13	1	Both	2	14	65	60	15	A	M	M	50-14 ±3	B/C	70	Yes	Yes	Yes	D		Yes		
DX-3		399.95	11	1	Both	2	14	65	60	12	A	M	No	50-12 ±3	B	62	Yes	Yes	Yes	D		Yes		
RX-740		279.95	3.5	1	Both	3	14	65	60	10	C	A	No	50-12.5 ±3	B	61	Yes	Yes	Yes	D		Yes		
RX-734		199.95	3.5	1	Both	3	14	65	60	10	A	M	No	50-10 ±3	No	50	Yes	No	No	D		Yes		
RX-731		179.95	3.5	1	S	2	16	65	60	10	A	M	No	50-10 ±3	No	50	No	No	No	D		No		
RX-722		89.95	3.5	1	S	1	20	80	60	60	A	M	No	50-10 ±3	No	50	No	No	No	D		No		
CZ-741 (only with CD player)						S	3	14	65	60	10	C	A	No	50-14 ±3	B	62	Yes	Yes	Yes	I		No	
NAKAMICHI	TD-1200II	1395.00			P	3	20	65	65	10	A	M	No	20-22 ±3	B/C	70	Yes	No	Yes	I		Yes		
	TD-700	895.00			P	3	18	65	65	12	B	M	No	20-21 ±3	B/C	70	No	Yes	Yes	D		Yes		
	TD-500	750.00			P	3	18	65	65	10	B	M	No	20-21 ±3	B/C	70	No	Yes	Yes	D		Yes		
	TD-400	495.00			P	2	20	65	65	12	A	M	No	25-20 ±3	B/C	70	No	Yes	Yes	D		Yes		
	TD-300	395.00			P	2	20	65	65	10	A	M	No	30-18 ±3	B/C	68	No	Yes	Yes	D		Yes		
PANASONIC	CQ-E650EU	579.95	7 x 2, 11 x 2	0.8	Both	3	15.2@ 50 dB	75	70	12	C	A	No	30-17 ±3	A/B/C	88	Yes	Yes	Auto	D		Yes		
	CQ-E452EU	389.95	14	3	Both	3	17.2@ 50 dB	75	70	12	C	A	No	35-16 ±3	B	62	Yes	Yes	Yes	D		Yes		
	CQ-E402EU	329.95	14	3	Both	2	17.2@ 50 dB	75	70	10	C	A	No	35-16 ±3	B	62	Yes	Yes	Yes	I		Yes		
	CQ-E380EU	299.95	6	3	Both	2	17@ 50 dB	75	70	15	A	A	No	35-16 ±3	B	62	Yes	Yes	Yes	I		Yes		
	CQ-E352EU	289.95	3	3	Both	3	17.2@ 50 dB	75	70	12	C	A	No	35-16 ±3	B	62	Yes	No	Yes	D		Yes		
	CQ-E34DEU	249.95	6	3	Both	2	17@ 50 dB	75	70	10	C	A	No	35-16 ±3	B	52	Yes	No	Yes	I		Yes		
	CQ-E320EU	199.95	3	3	S	2	17@ 50 dB	75	65	10	A	A	No	35-16 ±3	B	52	Yes	No	Yes	I		Yes		
	CQ-E302EU	249.95	3	3	Both	1	17.2@ 50 dB	75	70	12	A	A	No	35-16 ±3	B	52	Yes	No	No	D		Yes		
	CQ-E300EU	179.95	3	3	S	1	17@ 50 dB	75	65	10	A	A	No	35-12.5 ±3	B	52	No	No	No	I		Yes		
	CQ-S550EU	329.95	14	3	S	2	17@ 50 dB	75	70	10	C	A	No	35-16 ±3	B	62	Yes	Yes	Yes	I		Yes		
CQ-S535EU	269.95	14	3	S	2	17@ 50 dB	75	70	10	A	A	No	35-16 ±3	B	52	Yes	No	Yes	I		Yes			
CQ-S505EU	109.95	2	3	S	1	19@ 50 dB	55	0	0	A	M	No	80-10 ±3	B	50	Yes	No	No	I		Yes			
PHILIPS	DC 864	529.95		10	P	Both			20	20	A	A	No	40-18	B	50	Yes	Yes	Yes	D		Yes		
	DC 854	499.95	20 x 2, 7 x 4	10	Both				20	20	A	A	No	40-18	B	50	Yes	Yes	Yes	D		Yes		
	DC 846	439.95	20 x 2, 7 x 4	10	Both				20	20	A	A	No	40-16	B	50	Yes	Yes	Yes	D		Yes		
	DC 789	279.95	20	10	Both				20	20	A	A	No	40-16	B	30	Yes	No	Yes	D		Yes		

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	AMPLIFIER										TUNER				TAPE					
			Average Wkts/Channel, per EIA RS-430	THD at Rated Output, % per EIA RS-430	Output, Preamp (P) Speaker Level (S)	Number of Tube or EQ Controls	FM Sensitivity, dbf (For 40-dB Quieting)	Alternate Channel Selectivity, dB	FM Momp S/N Ratio, dB	Total Number of Stations Presets	Tuning: Seek (A), Scan (B), Both (C)	Local/Remote Control: Manual (M), Automatic (A)	AM Stereo Capable? See Code	Frequency Response, Hz to KHz, ±dB	Noise-Reduction Circuit? See Code	Tape S/N Ratio, dB (With NR if Applicable)	Auto Reverse?	Program Search?	Tape EQ Switch?	In-play (U), DIN In-play (D), Under-play (U), Convertible (C)	RCA In Out Jacks?	
PIONEER	KEX-960	750.00			P	7	17	70	76	24	A	A	No	30-20 ± 0.3	B/C	70	Yes	Yes	Auto	D	No	
	KEX-500	580.00			P	2	17	70	70	24	A	A	No	30-19 ± 0.3	B	63	Yes	Yes	Auto	D	No	
	KEH-9020	550.00	11	5	Both	2	17	70	70	24	A	A	No	50-19 ± 0.3	B/C	67	Yes	Yes	Auto	D	No	
	KEH-8020	480.00	11	5	Both	2	17	70	73	24	A	A	No	50-19 ± 0.3	B	60	Yes	Yes	Auto	D	No	
	FEX-55	400.00			P	2	17	70	70	18	B	A	No	30-20 ± 0.3	B	63	Yes	Yes	Auto	D	No	
	KEH-9292	400.00	11	5	Both	2	17	70	70	24	A	A	No	50-17 ± 0.3	B/C	67	Yes	Yes	Auto	I	Yes	
	KEH-7272	350.00	11	5	Both	2	17	70	70	24	A	A	No	50-17 ± 0.3	B	60	Yes	Yes	Auto	I	Yes	
	KEH-6020	340.00	10	5	Both	2	17	70	70	24	A	M	No	50-14 ± 0.3	B	52	Yes	Yes	Auto	I	No	
	KEH-5252	300.00	11	5	Both	2	17	70	70	24	A	A	No	50-14 ± 0.3	B	52	Yes	Yes	Auto	I	No	
	KEH-4020	270.00	10	5	S	2	17	70	70	24	A	A	No	50-13 ± 0.3	B	52	No	Yes	Auto	I	No	
	KE-3050QR	320.00	3.2	5	S	2	17	70	70	24	A	M	No	50-14 ± 0.3	B	52	Yes	Yes	Auto	I	No	
	KE-4242	260.00	3.2	5	Both	2	17	70	70	24	A	A	No	50-14 ± 0.3	O	52	Yes	No	Yes	I	Yes	
	KE-3232	245.00	3.2	5	Both	2	17	70	70	24	A	A	No	50-17 ± 0.3	B	52	Yes	No	Yes	I	No	
	KE-2222	225.00	3.2	5	S	1	17	70	70	24	A	A	No	50-14 ± 0.3	B	52	No	No	No	I	No	
	KE-1212	210.00	3.2	5	S	1	17	70	70	24	A	A	No	50-12 ± 0.3	B	52	No	No	No	I	No	
KP-5550	170.00	3.2	5	S	2	23.2	50	65	24	A	A	No	50-14 ± 0.3	B	52	Yes	No	No	I	No		
KP-4440	155.00	3.2	5	S	1	23.2	50	65	24	A	A	No	50-14 ± 0.3	B	52	Yes	No	No	I	No		
PROTON	201	149.00	4		Both	2	12.8			C		M	No	30-15 ± 3	B/C	65	Yes	Yes	Yes	I		
	203CD	319.00	4		Both	3	12.8			16	C	M	No	35-16 ± 3	B/C	76	Yes	Yes	Yes	D		
	214CD	349.00	11		Both	3	12.8			16	C	M	No	35-16 ± 3	B/C	76	Yes	Yes	Yes	D		
	203T (With TV band)	379.00	4	0.5	Both	3	12.8	60		24	C	M	No	35-16 ± 3	B	67	Yes	Yes	Yes	D		
	205	269.00	18	0.5	Both	3					12	M	No	35-16 ± 3	B		Yes	Yes	Yes	D		
215	299.00			Both	3					12	M	No	35-16 ± 3	B		Yes	Yes	Yes	D			
REALISTIC	12-1912	159.95	12		S	3				12	C	A	No				Yes			I		
	12-1930	149.95	12		S	5				12	A	A	No				Yes			I		
	12-1926	129.95	12		S	2				12	B	A	No				No			I		
	12-1924	99.95	4		S	3				12	A	A	No				No			I		
ROADSTAR	10	52.95	3.5	2	S	1	25	40	40			No	60-10 ± 6	No	40	No	No	No	No	I		
	12		3.5	2	S	1	25	40	40			No	60-10 ± 6	No	40	No	No	No	No	I		
	16	87.95	3.5	2	S	1	25	60	30			No	60-10 ± 6	No	40	No	No	No	No	I		
	20		3.5	2	S	1	25	60	55	16	A	M	No	60-10 ± 6	No	45	No	No	No	No	I	
	22	159.95	3.5	2	Both	2	25	60	55	12	C	A	No	60-10 ± 6	No	50	No	No	No	No	I	
	30	154.95	3.5	2	Both	1	25	60	55	12	A	M	No	60-10 ± 6	No	45	Yes	No	No	No	I	
	40	169.95	12.5	2	S	6	20	60	45	10	C	M	No	60-10 ± 6	No	45	Yes	No	Yes	No	I	
	50	189.95	12.5	2	Both	2	14	60	45	12	C	B	No	60-10 ± 6	D	52	Yes	No	No	No	I	
	80	295.95	3.5 x 4	1.5	S	2	20	65	45	10	B	M	No	47-12 ± 0.3		55	Yes	No	No	No	D	Yes
ROYAL SOUND	RS-1500	80.00	10	0.25	S		11	60	60			M	No	40-12 ± 0.3		60	No	No	No	C	No	
	RS-1600	100.00	10	0.25	S		11	60	60			M	No	40-12 ± 0.3		60	No	No	No	C	No	
	RS-1800	125.00	10	0.25	S		11	60	60			M	No	40-12 ± 0.3		60	Yes	No	No	C	No	
	RS-2100		10	0.25	S		11	60	60	12	A	A	No	20-12 ± 0.3		80	No	No	No	C	No	
	RS-2520	225.00	10	0.25	S		11	65	60	12	A	A	No	20-12 ± 0.3		80	Yes	No	No	C	No	
	RS-3310	200.00	20	0.25	S	5	11	75	60	12	A	A	No	20-12 ± 0.3		80	Yes	No	No	C	No	
SANSUI	GTX-7000	700.00			P	3	16.2	70	24	C	M	No	30-18 ± 3	B/C	78	Yes	Yes	Auto	D	Yes		
	RX-7100	550.00	16	0.05	Both	3	16.2	70	18	C	M	No	30-16 ± 3	B	65	Yes	Yes	Yes	D	Yes		
	RX-5100	450.00	16	0.05	Both	3	16.2	70	18	C	M	No	30-16 ± 3	O	60	Yes	Yes	Yes	D	Yes		
	RX-550	400.00	16	0.05	Both	3	18.4	70	24	C	M	No	30-16 ± 3	B	65	Yes	Yes	Yes	I	Yes		
	RX-350	280.00	10	0.05	S	3	18.4	70	24	C	M	No	30-16 ± 3	O	60	Yes	Yes	Yes	I	Yes		
SANYO	FTU58	60.00	3.0	10	S	1	24.2	40	50	0		M	No	80-10	No	50	No	No	No	I	No	
	FTU50	68.00	3.0	10	S	1	24.2	40	60	0		M	No	80-10	No	50	Yes	No	No	I	No	
	FTU80	79.95	9.5	1	S	1	24.2	40	60	0		M	No	80-12.5	No	50	Yes	No	No	I	No	
	FTU100	89.95	9.5	1	S	1	24.2	50	60	0		M	No	80-12.5	No	50	Yes	No	Yes	I	No	
	FTU150	99.95	9.5	1	S	1	20.3	50	60	0		M	No	63-12.5	B	60	Yes	No	Yes	I	No	
	FTU42	116.00	9.5	1	Both	3	20.8	60	64	0		M	No	63-14	B	60	Yes	Yes	Yes	I	Yes	
	FTU52	124.00	10.0	1	Both	6	19.2	60	60	0		M	No	63-14	B/C	66	Yes	Yes	Yes	I	Yes	
	FT325	79.95	3.0	1	S	1	20.8	60	60	12	A	A	No	80-10	No	50	No	No	No	I	No	
	FT528	99.95	3.0	1	S	1	20.8	60	60	12	A	M	No	80-10	No	50	No	No	No	I	No	
	FT635	139.95	6.0	1	S	3	19.2	60	60	12	A	A	No	63-12.5	No	50	No	No	Yes	I	No	
	FT911	179.95	6.0	1	S	3	15.2	60	60	12	A	M	No	63-14	B	60	Yes	No	Yes	I	No	
	FT928	199.95	9.5	1	Both	3	15.2	60	60	12	A	M	No	63-14	B	60	Yes	No	Yes	I	Yes	
	FTE40	190.00	9.5	1	Both	3	19.2	60	50	12	A	C	M	No	63-14	B	60	Yes	Yes	Yes	I	Yes
	FTE50	214.00	9.5	1	Both	3	19.2	60	50	12	C	B	M	No	63-14	B/C	66	Yes	No	Yes	I	Yes
	FTE04	142.00	9.5	1	Both	1	19.2	60	60	12	C	M	No	63-14	No	50	Yes	No	Yes	D	Yes	
SENTREK	SCR 090	59.95	3.5	1	S	1	25	55	65	0		M	No	80-8 ± 3		45	No	No	No	I		
	SCR 100	69.95	3.5	1	S	1	25	55	65	0		M	No	80-8 ± 3		45	No	No	No	I		
	SCR 120	89.95	12	1	S	1	22	55	65	0		M	No	80-8 ± 3		45	No	No	No	I		
	SCR 140	89.95	3.5	1	S	1	22	45	65	0		M	No	80-8 ± 3		50	Yes	No	No	I		
	SCR 160	129.95	3.5	1	Both	2	20	55	65	0		M	No	60-8 ± 3		50	Yes	No	No	I		
	SCR 560	129.95	3.5	1	S	1	17	60	58	12	C	M	No	60-10 ± 3		50	No	Yes	No	I	Yes	
	SCR 650	169.95	3.5	1	Both	1	17	60	58	12	C	M	No	60-10 ± 3		50	No	No	Yes	I	Yes	
	SCR 760	179.95	3.5	1</																		

RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	AMPLIFIER				TUNER						TAPE								
			Average Watts/Channel, per EIA RS-480	THD at Rated Output, % per EIA RS-480	Outputs: Phono (P), Speaker Level (S), Both (Both)	Number of Taps or EQ Controls	FM Sensitivity, dB (For 30-dB Quieting)	Alternate Channel Selectivity, dB	FM Mono S/N Ratio, dB	Total Number of Station Presets	Tuning Seek (A), Scan (B), Both (C)	Local/Remote Control: Manual (M), Automatic (A)	AM Stereo Capable? See Code	Frequency Response, Hz to KHz, ±dB	Noise-Reduction Circuit? See Code	Tape S/N Ratio, dB (With NR if Applicable)	Auto Reverse?	Program Search?	Tape EQ Switch?	In-Deck (D), Out-Deck (O), Under-Deck (U), Convertible (C)	RCA In/Out Jacks?
SHARP	RG-8608(BK)	129.95	8	3	S	0	20	65	60	6	A	M	No	50-20	No	56	No	No	No	I	No
	RG-8920(BK)	159.95	8	3	S	0	20	65	60	6	A	M	No	50-20	B	56	Yes	No	I	No	
	RG-8926(BK)	199.95	25	1	Both	0	20	70	60	6	A	M	No	50-20	B	56	Yes	No	I	No	
	RG-F882(BK)	449.95	25	1	Both	7	20	70	60	6	A	M	No	50-20	B	65	Yes	Yes	D	No	
SHERWOOD	CRD 165	189.95	3.5	0.5	S	2	20.7	65	12	C	M	No	30-15 ±3	D	52	Yes	No	Yes	I	Yes	
	CRD 175	249.95	3.5	0.5	Both	2	20.7	65	12	C	M	No	30-17 ±3	B	62	Yes	Yes	Yes	I	Yes	
	CRD 210	279.95	12 x 2, 3.5 x 4	0.5	Both	2	20.7	65	12	C	M	M	30-17 ±3	B/C	71	Yes	Yes	Yes	I	Yes	
	CRD 230	279.95	12 x 2, 3.5 x 4	0.5	Both	2	20.7	65	12	C	M	M	30-17 ±3	B/C	71	Yes	Yes	Yes	D	Yes	
	CRD 350	329.95	12 x 2, 3.5 x 4	0.5	Both	2	20.7	65	12	C	M	M	30-17 ±3	B/C	71	Yes	Yes	Yes	D	Yes	
SONY	XR-17	159.95	4	1.5	S	1	15	65	63				40-14 ±3		53	Yes	No	No	I		
	XR-6100	219.95	4	1.5	S	2	15	65	65				40-14 ±3		58	Yes	No	Yes	I	Yes	
	XR-37R	259.95	11	1.0	Both	2	15	65	65	18	A	M	40-14 ±3		58	Yes	No	Yes	I	Yes	
	XR-6300	329.95	11	1.0	Both	2	15	65	65	18	A	M	40-14 ±3		66	Yes	Yes	Yes	I	Yes	
	XR-66	399.95	11	1.0	Both	2	15	65	65	18	A	M	30-18 ±3	B	66	Yes	Yes	Yes	I	Yes	
	XR-510R	259.95	4	1.5	Both	2	15	70	65	18	C	M/A	40-14 ±3		58	Yes	Yes	Yes	D	Yes	
	XR-530R	309.95	14	0.8	Both	5	15	70	65	18	C	M/A	40-14 ±3		58	Yes	Yes	Yes	D	Yes	
	XR-550R	359.95	14	0.8	Both	5	15	70	65	18	C	M/A	40-14 ±3	B	66	Yes	Yes	Yes	D	Yes	
	XR-7000	329.95	11	1.0	Both	2	15	70	65	18	A	M	40-14 ±3		58	Yes	Yes	Yes	D	Yes	
	XR-7100	499.95	13 x 4	1.0	Both	2	14	70	65	18	A	M	30-18 ±3	B	66	Yes	Yes	Yes	D	Yes	
	XK-8	269.95											40-15 ±3	B	60	Yes	Yes	Auto	I	Yes	
SOUND BARRIER	AF-321	199.95	25	12	Both	2	18.3		59	12	C	A	No	20-20 ±3	D	50	Yes		D	Yes	
SOUNDSTREAM	TC-308	639.00			(4)P	3	20	65	67	12	B	M	No	30-18 ±3	B/C	68	Yes	Yes	Yes	D/E	Yes
	TC-305	499.00			(4)P	3	20	65	67	12	B	M	No	30-17 ±3	B/C	68	Yes	No	Yes	D/E	Yes
	Powered 305	549.00	5	0.1	Both	3	20	65	67	12	B	M	No	30-17 ±3	B/C	68	Yes	No	Yes	D/E	Yes
SPARKOMATIC	SR-315	329.95	20	1	S	5	17.2	65	60	10	C	A	No	20-20 ±3	B/C/D	76	Yes	Yes	Yes	I	
	SR-430	259.95	20	1	S	5	20	65	60	10	C	M	No	20-20 ±3	D	65	Yes	Yes	Yes	I	
	SR-317	199.95	20	1	S	5	20	65	60	10	C	M	No	20-20 ±3	D	65	Yes	No	Yes	I	
	SR-360	159.95	5	1	S	2	20	65	60	15	C	M	No	60-20 ±3	D	65	Yes	No	No	I	
	SR-350	129.95	5	1	S	2	20	65	60	15	C	M	No	60-20 ±3	D	65	Yes	No	No	I	
	SR-308	179.95	20	1	S	2	20	55	60	10	C	A	No	20-20 ±3	D	65	Yes	No	Yes	I	
	SR-425	169.95	20	1	S	1	20	65	60	10	C	A	No	20-20 ±3	D	65	Yes	No	Yes	I	
	SR-420	149.95	5	1	S	1	23.3	65	60	10	C	M	No	70-12 ±3		60	No	No	Yes	I	
	SR-314	119.95	5	1	S	1	20	65	60	10	C	A	No	70-12 ±3		55	No	No	No	I	
	SR-338	99.95	5	1	S	1	20	50	60	10	C	A	No	70-12 ±3		55	No	No	No	I	
	SR-307	129.95	20	1	S	5	20	65	60				20-20 ±3	D	60	Yes	No	Yes	I		
	SR-305	99.95	20	1	S	5	20	65	60				20-20 ±3		60	No	No		I		
	SR-334	99.95	5	1	S	1	26	65	60			No	75-10 ±3		35	Yes	No		I		
	SR-31	79.95	5	1	S	1	26	40	60			No	75-10 ±3		35	No	No		I		
	SR-36	74.95	5	1	S	1	29.9	45	60			No	75-10 ±3		35	Yes	No		I		
	SR-300	49.95	5	1	S	1	29.3	45	60			No	75-10 ±3		35	No	No		I		
SR-35	44.95	5	1	S	1	32	40	50			No	100-9 ±3		35	No	No		I			
SUNKYONG	SIR-8100	269.95	50	0.005	Both	2	20	50	55	12	C	M	M	20-20	D	55	Yes	Yes	Yes	I	Yes
	SIR-7100	219.95	14	0.005	Both	2	20	50	55	12	C	M	M	20-20	D	55	Yes	Yes	Yes	I	Yes
	SIR-7900	229.95	14	0.005	Both	2	20	50	55	12	C	M	M	20-20	D	55	Yes	Yes	Yes	I	Yes
	SIR-6200	188.00	14	0.005	Both	2	20	50	55	12	C	M	M	20-20	D	50	Yes	No	Yes	I	Yes
	SIR-5200	139.95	14	0.005	Both	2	20	50	55	12	C	M	M	20-20		50	No	No	Yes	I	Yes
	SIR-6500	199.95	14	0.005	Both	2	20	50	55	10	C	M	M	20-20		50	No	No	Yes	I	Yes
	SIR-3100	103.75	14	0.005	S	1	20	50	55			M	M	20-20		50	No	No	No	I	No
	SIR-2000	85.65	14	0.005	S	1	20	50	55			M	M	20-20		50	No	No	No	I	No
	SIR-1000	60.95	14	0.005	S	1	20	50	55			M	M	20-20		50	No	No	No	I	No
TECHNICS	CQ-R9500EU	570.00	11 x 4	0.8	Both	3	15.2@50 dB	75	70	18	C	A	No	30-17 ±3	A/B/C	88	Yes	Yes	Yes	D	No
	CQ-R9400EU	500.00	11	0.8	Both	3	15.2@50 dB	75	70	18	C	A	No	30-17 ±3	B/C	70	Yes	Yes	Yes	D	No
	CQ-R9300EU	380.00	11	0.8	Both	3	15.2@50 dB	75	70	18	C	A	No	30-17 ±3	B	62	Yes	Yes	Yes	D	No
	CQ-H7500EU	700.00		0.01	P	7	15.2@50 dB	75	70	12	C	A	No	30-18 ±3	B/C	74	Yes	Yes	Yes	D	No
	CQ-R920EU	330.00	11	0.8	Both	2	17.2@50 dB	75	70	10	C	A	No	35-17 ±3	B	62	Yes	Yes	Yes	I	No
	CQ-R910EU	300.00	2.5	0.8	Both	2	17.2@50 dB	75	70	10	C	A	No	35-17 ±3	B	62	Yes	Yes	Yes	I	No
	CQ-R220EU	360.00	11	0.8	Both	2	17.2@50 dB	75	70	15	C	A	No	35-17 ±3	B	62	Yes	Yes	Yes	I	No
	CQ-R210EU	310.00	2.5	0.8	Both	2	17.2@50 dB	75	70	15	C	A	No	35-17 ±3	B	62	Yes	No	Yes	I	No
YAMAHA	YCR-950	600.00	18	8	Both	3	17.3	80	65	12	B	M	No	30-16 ±3	B/C	75	Yes	Yes	Yes	I	Yes
	YCR-350	300.00	18	8	Both	3	17.3	70	65	12	A	M	No	30-16 ±3	B	65	Yes	No	Yes	I	Yes
	YCR-150	250.00	5	8	Both	3	17.3	70	65	12	A	M	No	30-16 ±3	B	65	Yes	No	Yes	I	Yes
	YCR-50	400.00	18	8	Both	3	16.3	75	70	24	B	M	No	40-18 ±3	B/C	75	Yes	No	Auto	D	Yes
	YCR-50 (Extractable)	450.00																		D/E	
	YCR-30	339.00	5.5	8	Both	3	16.3	75	70	12	A	A	No	40-16 ±3	B	67	Yes	No	Auto	D	Yes
	YCR-10	289.00	5.5	8	Both	2	16.3	75	70	12	A	A	No	40-16 ±3	B	58	Yes	No	Auto	D	Yes
	YCT-850	650.00			P	3	17.3	80	65	12	B	M	No	30-18 ±3	A/B/C	85	Yes	Yes	Yes	I	Yes
	YCT-40	350.00			P	3	16.3	75	75	24	B	M	No	40-18 ±3	B/C	75	Yes	No	Auto	D	Yes
	YCT-40 (Extractable)	400.00																		D/E	

SPEAKERS

MANUFACTURER	Model	DRIVERS													Notes		
		Price, \$		Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Subwoofer Only (S) / Woofer Only (W) / Midrange Only (M) / Tweeter Only (T)	Woofer Size, Inches	Woofer (W) / 2-Way (2) / 3-Way (3) / 4-Way (4)	Angle of Tweeter = A	Separately Mounted Drivers?	Flush Mount (F) / Surface Mount (S) / Convertible (C) / Plate (P)	Maximum Required Mounting Depth, Inches		Weatherproofed?	
		(If Sold Individually)	(If Sold in Pairs)														
ADS	320i	430.00	100	91	4	58-20 ± 3		5 1/4	2		P	Yes	F	1 1/2	Yes	Crossover has tweeter level control. Flush-mount kit optional.	
	300i	290.00	100	90	4	50-20 ± 3		5 1/4	2		No	P	S	1 1/2	Yes		
	300CC	370.00	75	90	4	68-20 ± 3		5 1/4	2		No	S	S				
	200CC	280.00	50	88	4	85-20 ± 3		4	2		No	S	S				
	CS700	270.00	120	91	4	30-85 Hz ± 3	S	7 1/2					F	2 3/4	Yes		Includes crossover.
	S10		150	90	4	20-85 Hz ± 3	S	10					F	4	No		
	SB7	400.00	160	90	4	30-85 Hz ± 3	S	(2)7 1/2					S				Enclosed system.
SB10	650.00	300	90	4	30-85 Hz ± 3	S	(2)10					S			As above.		
AFS KRIKET	DSII693P		105	93	4	40-22		6 x 9	3			No	F	4 1/8	Yes		
	DSII692		105	93	4	40-19		6 x 9	2			No	F	4 1/8	Yes		
	DSII693E		70	93	4	50-20		6 x 9	3			No	F	3 1/2	Yes		
	DSII542		50	91	4	60-18		5 1/4	2			No	F	2 1/2	Yes		
	DSII402		30	90	4	80-18		4	2			No	F	1 1/2	Yes		
	DSII462		30	90	4	80-18		4 x 6	2			No	F	1 3/4	Yes		
	DSII572		50	91	4	50-18		5 x 7	2			No	F	2 1/2	Yes		
DSII4102		70	91	4	50-18		4 x 10	2			No	F	3 1/8	Yes			
ALPHASONIK	D6200	87.50	50	4	4	70-25 ± 3		4 1/2	2			No	P	1 1/2	No		
	D6300	135.00	60	4	4	70-25 ± 3		4 1/2	2			No	S		Yes		
	D7200	117.50	65	4	4	45-25 ± 3		5 1/4	2			Yes	C	2 1/2	No		
	MDT-1	37.50	120	4	4	1.4k-30k ± 3	T						C		No		
	SW6025G	65.00	60	4	4	40-2.5 ± 3	W	6					F	2 1/2	Yes		Optional grille.
SW8030	65.00	75	4	4	40-2 ± 3	W	8					F	3 1/2	Yes			
ALPINE	6265		80	88	4	45-21 ± 3		6 1/2	2				F	2 9/8			
	6102		200				S	10					F				
	6255		100	87	4	50-23 ± 3		5 1/4	2		Yes		F	2			
	6133		20	90	4	60-20 ± 3		3 1/2	W				F	1 9/8			
	6149		20	90	4	60-20 ± 3		4	W		No		F	1 9/8			
	6244		40	88	4	60-21 ± 3		4	2				F	1 3/4			
	6204		40	90	4	75-20 ± 3		4 x 6	2				F	1 3/4			
	6266		40	90	4	60-20 ± 3		6 1/2	2				F	2			
	6258		40	90	4	63-20 ± 3		5 1/4	2				F	1 1/2			
	6190	130.00	150	92	4	30-6	S	6 x 9	3				F	3 1/2			
	6399	350.00	100	94	4	35-25		6 x 9	3			No	F	3 3/4			
	6392	150.00	60	94	4	50-21		6 x 9	3			No	F	3 3/4			
	6394		100	91	4	50-21 ± 3		6 x 9	3			No	F	3 1/8			
	6294		100	91	4	50-21 ± 3		6 x 9	3			No	F	3 1/8			
ALTEC LANSING	ALS-525	270.00	100	89	4	60-22 ± 3		5 1/4	2		Yes		C	2 1/8	Yes	Biamp capable. Includes 4 x 6-inch adaptor plate.	
	ALS-500	250.00	100	89	4	60-22 ± 3		5 1/4	W				S	1 1/2	Yes		
	ALS-35	70.00	30	88	4	90-22 ± 3		3 1/2	W				C	2 1/8	Yes		
	ALS-8	200.00	150	90	4	45-3 ± 3	S	8					C	2 1/8	Yes		
	ALS-693	250.00	120	93	4	50-22 ± 3		6 x 9	3		No		C	3 1/2	Yes		
	ALS-692	200.00	120	93	4	50-20 ± 3		6 x 9	2		No		C	3 1/2	Yes		
	ALS-62	150.00	100	91	4	60-22 ± 3		6 1/2	2	A	No		S		Yes		
	ALS-62	150.00	100	91	4	60-22 ± 3		6 1/2	2	A	No		S		Yes		
	ALS-40	110.00	50	90	4	100-20 ± 3		4	W		No		S		Yes		
AR	GCS100	295.00	100	93	4	33-30		6 x 9	3		Yes		F, S	3 3/4	Yes		
	GCS200	220.00	100	88	4	38-32		5 1/4	2				P	2 1/8	Yes		
	GCS300	200.00	100	93	4	30-30		6 x 9	3	A			F	3 9/8	Yes		
	GCS400	160.00	90	92	4	58-30		6 1/2	2				F	2	Yes		
	GCS500	138.00	60	92	4	42-30		5 1/4	2				F	2 1/8	Yes		
	GCS600	78.00	35	92	4	75-25		4	W				F	1 3/4	Yes		
	GCS1200	52.50	35	91	4	63-20		4 x 6	W				F	2	Yes		
	GCS1400	42.00	20	88	4	120-12		3 1/2	W				F	1 3/4	Yes		
AUDIOMOBILE	SW6x9	135.00	100	89.4	2	30-2 ± 3	S	6 x 9				Yes	F	3 1/2	Yes	Satellite. As above; for GM cars.	
	RS4.5	220.00	40	86.5	4	100-20 ± 3			2				S		No		
	FS4x6	140.00	40	86.5	4	100-20 ± 3			2			Yes	P	1 1/2	No		
AUDIO PRO	B2-07	499.95		30 Inc.	105	40-250 Hz Adj.	S	(2)4						8	No	Selectable preamp/speaker input level.	
	C-101	79.95		10	90	50-20 ± 3		4	2	P			F	1 3/4	Yes		
	C-132	99.95		50	92	45-20 ± 3		5 1/4	2	P			F	1 3/4	Yes		
AUDIOSOURCE	LS-ONE	179.95	50	88	4	80-20		4	2	P	No		S		Yes		
AUDIOVOX	TRY-100	100.00	100		4/8	40-20		6 x 9	3			No	F		No		
	TRY-25	70.00	40		4/8	70-18		5 1/4	3			No	F		No		
	TRY-20	70.00	40		4/8	60-18		6 x 9	3			No	F		No		
	TRY-15	45.00	30		4/8	80-18		5 1/4	3			No	F		No		
	TRY-9	65.00	30		4/8	70-18		6 x 9	3			No	F		No		
	CX-120	70.00	100		4/8	70-18		6 x 9	2			No	F		Yes		
	CX-105	50.00	30		4/8	80-18		6 x 9	2			No	F		No		
	CX-46	50.00	20		4/8	100-18		4 x 6	2			No	F		No		
	CX-41	70.00	30		4/8	80-18		4 x 10	2			No	F		Yes		
	CX-20	58.00	100		4/8	90-18		5 1/4	2			No	F		Yes		
	CX-10	50.00	30		4/8	100-18		5 1/4	2			No	F		No		
	CX-6	50.00	30		4/8	100-20		5	2			No	F		No		
	CX-4	45.00	30		4/8	120-17		4	2			No	F		No		
	CX-3	45.00	20		4/8	120-16		5	2			No	F		No		
	CX-2	40.00	25		4/8	110-17		5	2			No	F		No		
	SC-10	40.00	20		4/8	90-15		5 1/4	W			No	F		No		
	SC-4	40.00	20		4/8	120-16		4	W			No	F		No		
SC-3	35.00	20		4/8	120-15		3 1/2	W			No	F		No			
SC-1	30.00	15		4/8	120-15		5	W			No	F		No			

Yamaha's new FFT speakers do the same for your ears.



Before you listen to a pair of FFT Series™ speakers, close your eyes. Yamaha's about to take your favorite music into a whole new dimension.

A sonic dimension of greater acoustic imaging, creating a soundstage purely and precisely articulated. Where instruments and voices are clearly defined in their own space, yet always in proper balance.

You hear the music the way it was meant to be heard: Horns stage left. Percussion stage rear. The singer's voice center stage and up front. And each distinguishable from the other.

You also hear more of each instrument's true range: Violins are rich and full. A flute riff ascends

the scale. The acoustic bass thumps its lowest possible note.

The imaging becomes so dimensional, you'll swear you can "see" the performers on stage. While the emotions the music contains become even more powerful.

A truer picture of what you're hearing emerges, because we had a truer picture of the FFT Series in its design stage. A computer program called the Fast Fourier Transform (FFT) made this expanded soundstage and greater musicality possible. And helped our U.S. engineers create speakers using the most sophisticated drivers, crossover networks and cabinet design. All integrated for optimum performance.

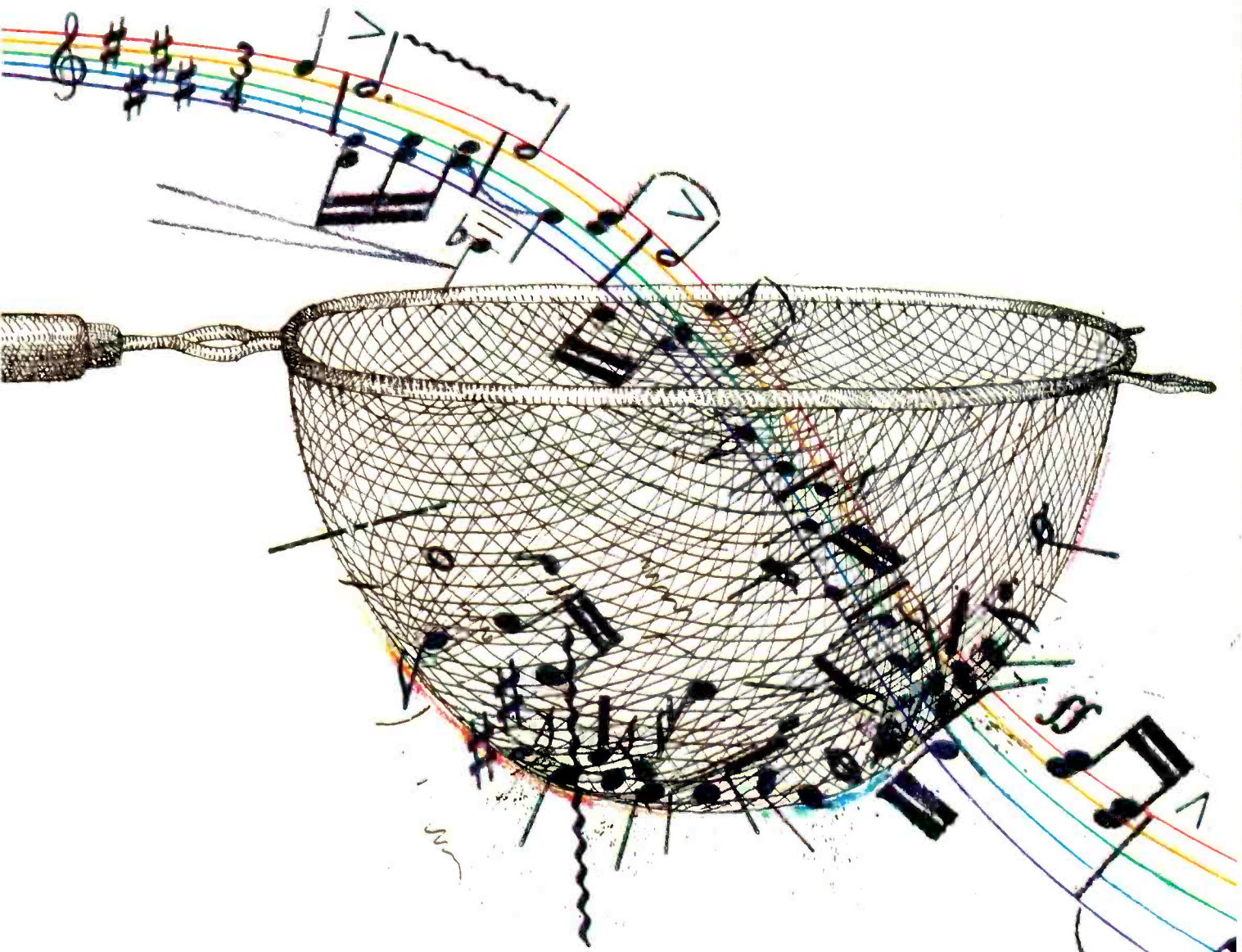
What's more, each model has the power handling capacity to meet the expanded dynamic range of today's digital audio sources.

So listen to the new Yamaha FFT Series at any authorized Yamaha FFT dealer today. Discover how our world-renowned expertise in the creation and re-creation of fine music has been applied to the FFT Series. Then close your eyes, and watch your music come alive.

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YAMAHA 1887-1987



EVEN THE FINEST LOUDSPEAKERS
SIFT OUT SOME OF
THE MID-RANGE DETAIL.WHY?

Many of today's more expensive loudspeakers have impressive specifications that may look great on paper, but do not necessarily sound great in your home. For instance, they boast frequency ranges that extend well beyond the limits of human hearing. But while these loudspeakers may be sensitive to the musical extremes of the spectrum they are often insensitive to the subtle details in between. Details that create the finer musical nuances within the mid-range.

At Altec Lansing®, on the other hand, we've designed our new line of loudspeakers to recreate every subtlety of recorded music. To give not only the highs and lows but everything in between.

The secret of Altec Lansing's extraordinary timbre, texture and detail? A polyimide mid-range that produces an expansive stereo image to give you pure uncolored sound. In fact, Altec Lansing loudspeakers are so uncompromising, so revealing, they prompted J. Gordon Holt of *Stereophile* magazine to write, "I have been hearing more going on in (the mid-range of) old, familiar recordings than I have ever heard before...instrumental sections are suddenly resolved into many individual instruments rather than a mass of instruments," and they compelled him to add that Altec Lansing's speakers have "high end sweetness and openness... with astounding inner detail."



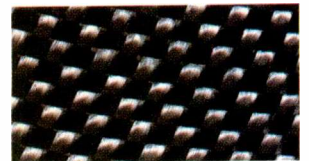
Polyimide/Titanium
Mid-range

What's more, our woofers provide unparalleled low frequency definition that beautifully complements the flawless performance of our mid and high frequency drivers. How? With woven carbon fiber cones that are rigid yet lighter than paper or

polypropylene to virtually eliminate breakup, flexing and distortion.

The unique features like these, that make our home loudspeakers so impressive, also extend into our automotive loudspeakers. In addition, our automotive loudspeakers have features like Thermoisolate™ construction and high temperature resistant materials to assure lasting performance even in the extremes of a demanding auto environment. As a result, you'll capture the same details in your car as you do at home.

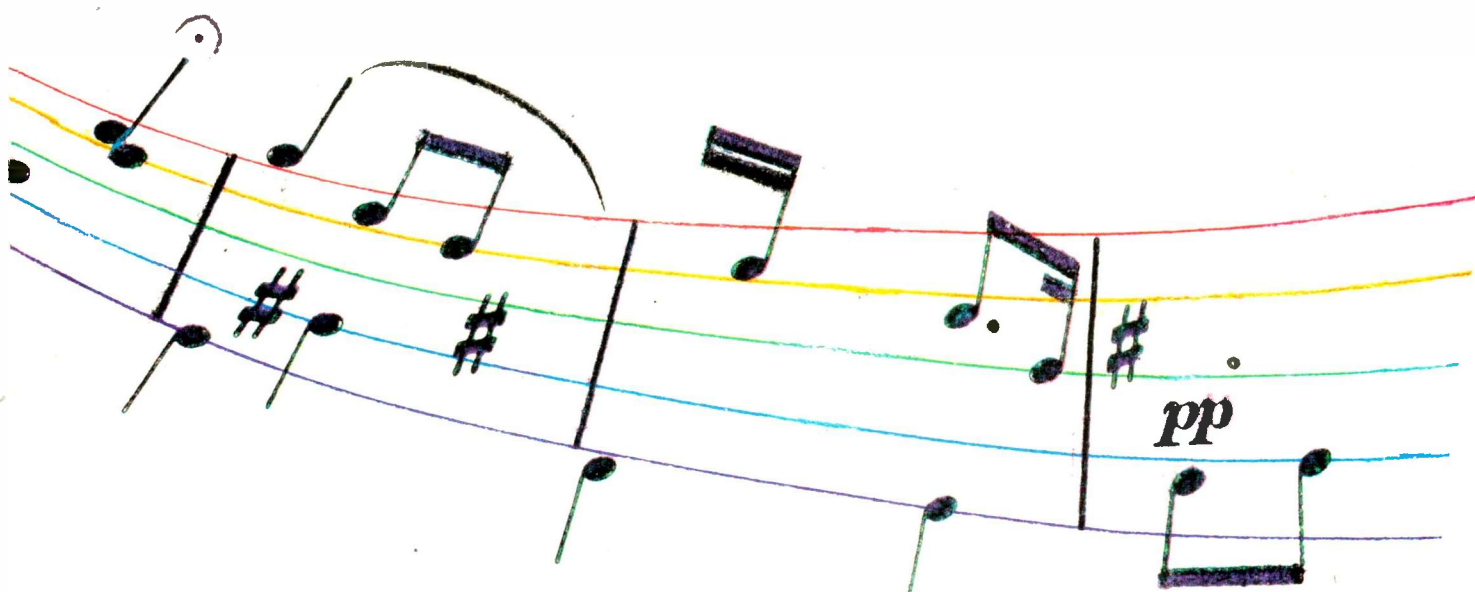
Listen to Altec Lansing loudspeakers for yourself and hear how much detail you've been missing. Call 1-800-ALTEC88 for information and the Altec dealer nearest you (in Pennsylvania 717-296-HIFI). In Canada call 416-496-0587 or write 265 Hood Road, Markham, Ontario L3R 4N3, Canada.



Carbon Fibers in Woofer Cone



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LOUDSPEAKERS FOR
THE WELL-TRAINED EAR.**



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SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS											Notes
								Subwoofer Only (S), Woofer Only (W), Midrange Only (M), Tweeter Only (T)	Woofer Size, Inches	Woofer (W) 2-Way (2), 3-Way (3), 4-Way (4)	Applied Tweeter(s) = A, Passive (Passive) = P	Separately Mounted Drivers?	Flush Mount (F), Surface Mount (S), Conceivable (C), Pole (P)	Maximum Requires Mounting Depth, Inches	Weatherproofed?				
CLARION	SE990	159.95	120	93	4	30-23 ±3	6 x 9	4	A	No	F	2 7/8	Yes						
	SE980	129.95	80	94	4	50-21 ±3	6 x 9	3		No	F	3	Yes						
	SE972	99.95	120	93	4	50-22 ±3	6 x 9	2		No	F	3	Yes						
	SE971	89.95	50	95	4	60-21 ±3	6 x 9	2		No	F	1 7/8	Yes						
	SE970	89.95	60	95	4	50-20 ±3	6 x 9	2		No	F	3	Yes						
	SE830	169.95	100	91	4	55-23 ±3	8	3	A	No	C	3 3/8	Yes						
	SE632	79.95	60	91	4	65-22 ±3	6 1/2	3		No	F	2 3/4	Yes						
	SE631	99.95	60	90	4	40-22 ±3	6 1/2	3	A	No	F	2 1/4	Yes						
	SE627	89.95	80	93	4	70-22 ±3	6 1/2	3		No	F	2	Yes						
	SE625	79.95	40	90	4	50-21 ±3	6 1/2	2	A	No	F	1 5/8	Yes						
	SE621	79.95	40	92	4	70-20 ±3	6 1/2	2		No	F	1 1/2	Yes						
	SE620-H	79.95	40	91	4	70-20 ±3	6 1/2	2		No	F	1 7/8	Yes						
	SE610	59.95	40	92	4	70-19 ±3	6 1/2	W		No	F	2	Yes						
	SE628	129.95	80	91	4	50-22 ±3	6	2	P	No	F	2 1/4	Yes						
	SE531	99.95	40	90	4	70-22 ±3	5 1/4	3		No	F	1 3/4	Yes						
	SE525	89.95	80	93	4	70-22 ±3	5 1/4	2		No	F	2 1/4	Yes						
	SE521	49.95	30	90	4	60-20 ±3	5	2	A	No	F	1 1/2	Yes						
	SE520	69.95	30	90	4	80-18 ±3	5	2		No	F	1 3/4	Yes						
	SE513	39.95	30	91	4	60-18 ±3	5	W		No	F	1 5/8	Yes						
	SE431	69.95	30	90	4	60-20 ±3	4	3	A	No	F	1 5/8	Yes						
	SE423	69.95	30	91	4	90-20 ±3	4	2		No	F	1 1/2	Yes						
	SE413	54.95	40	91	4	60-20 ±3	4	W		No	F	1 7/8	Yes						
	SE411	49.95	20	90	4	100-20 ±3	4	W		No	F	1 1/8	Yes						
	SE602	99.95	80	90	4	40-6 ±3	6		S	F	F	2 1/4	Yes						
	SE601	79.95	80	90	4	40-6 ±3	6 1/2		S	F	F	2 7/8	Yes						
	SE430	139.95	30	90	4	90-20 ±3	4			Yes	S		Yes						
	SE320	99.95	30	89	4	70-20 ±3	4			Yes	S		Yes						
	SE260	79.95	80	90	†	3k-21k ±3	T				S		Yes						
	SE250	39.95	80	93	4	3k-22k ±3	T				F	7/8	Yes						
	SE153	99.95	40	92	4	50-22 ±3	T				F	2 1/2	Yes						
	SE675	49.95	30	90	4	90-20 ±3	4 x 10	2	A	No	F	1 7/8	Yes						
SE671	39.95	20	90	4	90-17 ±3	4 x 6	2		No	F	1 3/4	Yes							
SE326	39.95	30	88	4	150-20 ±3	4 x 5	W		No	F	1 3/8	Yes							
SE310	29.95	20	88	4	100-20 ±3	3 1/2	2		No	F	1 3/8	Yes							
CONCORD	CS141	69.95	40	91	4	70-20	4	2		No	F	1 1/4							
	CS153	79.95	40	98	4	60-20	5 1/4	2		No	F	1 5/8							
	CS261	89.95	50	95	4	40-20	6 1/2	2		No	F	2							
	CS264	119.95	90	96.5	4	40-18	6 x 9	2		No	F	3 1/4							
	CS300	199.95	100	88	8	70-20 ±3	6	2		No	P	2 1/4							
	CS400	249.95	100	88	4	80-20 ±3	5 1/4	2		Yes	S, P	1 3/4							
COUSTIC	HT-620	129.95	60	89	4	70-19 ±4	5 1/4	2		No	P	1 3/4							
	HT-621	169.95	60	89	4	70-19 ±4	5 1/4	2		No	S								
	HT-640	50.00	100	91	4	32-600 Hz ±3	S	3		Yes	C	4							
	HT-650	75.00	150	92	4	24-600 Hz ±3	S	10			C	5							
	HS-893	99.95	80	94	4	48-20 ±5	6 x 9	3	A			3							
	HS-892	79.95	80	93	4	50-19 ±5	6 x 9	2	A			3							
	HS-890	54.95	80	92	4	58-18 ±5	6 x 9	W				3							
	HS-872	79.95	80	93	4	68-18 ±5	4 x 10	2	A			3							
	HS-863	74.95	60	91	4	75-19 ±5	6 1/2	3	A			2							
	HS-862	59.95	60	90	4	68-18 ±5	6 1/2	2	A			2							
	HS-860	42.95	60	90	4	87-15 ±5	6 1/2	W				2							
	HS-846	46.95	40	89	4	95-18 ±5	4 x 6	2	A			1 3/4							
	HS-842	39.95	40	88	4	106-18 ±5	4	2	A			1 3/4							
HS-840	31.95	40	88	4	106-18 ±5	4	W				1 1/2								
HS-830	16.95	25	86	4	180-15 ±5	3 1/2					1 1/4								
CYBERNET	CSP 123	138.00	60	85	8	60-22 ±6	4	3	P	No	C	4 3/8	Yes						
	CSP 402	138.00	35	87	8	80-22 ±6	4	2	P	No	F	1	Yes						
	CSP 602	169.00	80	89	4	50-20 ±6	6	2	P	No	F	2 1/2	Yes						
	CSP 603	199.00	100	90	4	60-22 ±6	6	3	P	No	F	3 1/8	Yes						
	DELTASNIK	MP5GX	26.10	60	4	1k-6k ±3	M					F	2						
DTX-1		25.00	100	4	4k-25k ±3	T					S								
WP820		54.00	60	4	40-3 ±4	W	8				F	4							
WP1030		57.50	160	4	30-2 ±4	W	10				F	5							
WP1230		62.50	160	4	20-2 ±4	W	12				F	5 1/2							
WP6920G		54.00	60	4	40-2.5 ±4	W	6 x 9				F	4							
DENON	DCS-691	180.00	100	91	4	40-21 ±3	6 x 9	3		No	S		Yes						
	DCS-401	75.00	35	91	4	80-20 ±3	4	W		No	S		Yes						
	DCS-351	43.00	20	89	4	90-20 ±3	3 1/2	W		No	S		Yes						
DESIGN ACDUSTICS	DA-602		120	89	4	55-20 ±2	6	2		Yes	C	2 3/4	Yes						
	DA-692		150	90	4	40-19 ±2	6 x 9	2		Yes	C	4	Yes						
	DA-693		150	90	4	40-20 ±2	6 x 9	3		Yes	C	4	Yes						
DIGITRON	6700702	49.95	45	93	4	100-20 ±10	6	2		No	F	2	Yes						
	6700703	54.95	45	93	4	100-20 ±10	3	3		No	F	2	Yes						
	6700704	59.95	60	96	4	100-20 ±10	6 x 9	2		No	F	3	Yes						
	6700705	69.95	60	96	4	100-20 ±10	6 x 9	3		No	F	3	Yes						
	6700706	59.95	60	93	4	100-20 ±10	4 x 10	3		No	F	2 1/2	Yes						
	6700698	19.95	20	88	4	100-18	3 1/2	W		No	F	1 5/8	Yes						
	6700696	24.95	25	92	4	100-20	4	W		No	F	1 5/8	Yes						
	6700697	29.95	25	90	4	100-20	4	2		No	F	1 5/8	Yes						
	6700700	34.95	25	90	4	100-20	4 x 6	2		No	F	1 3/4	Yes						
	6700701	39.95	20	90	4	100-20	5 1/4	2		No	F	1 3/8	Yes						

†Add-on tweeter includes 30-ohm matching transformer with crossover. Includes crossover.

Optional grille.

SPEAKERS

MANUFACTURER	Model	Price, \$		Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 W/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS										Notes				
		(If Sold Individually)	(If Sold in Pairs)					Subwoofer Only (S)	Woofer Only (W)	Midrange Only (M)	Tweeter Only (T)	Woofer Size, inches	Woofer (W)	2-Way (2)	3-Way (3)	4-Way (4)	Angled Tweeters = A		Separately Mounted Drivers?	Flush Mount (F)	Surface Mount (S)	Convertible (C)
HI-COMP (Continued)	HS-41	60.00	30	95	4/8	90-20		4	2			No	F	1 3/4	No							
	HS-51	70.00	40	95	4/8	70-20		5 1/4	2			No	F	2	No							
	HS-56	40.00	30	92	4/8	100-18		5	W			No	F	1 1/2	No							
	HS-70	90.00	100	95	4/8	40-20		6 x 9	2			No	F	3 1/4	No							
	HS-75	70.00	40	95	4/8	60-20		4 x 10	2			No	F	2 1/2	No							
	HS-80	120.00	100	96	4/8	40-20		6 x 9	3			No	F	3 3/4	No							
HITACHI	SF-123	37.95	25	89	4	80-18 ±3		5	2			No	F	1 1/8	No							
	SF-124	59.95	25	89	4	80-20 ±3		5	2			No	F	1 1/8	No							
	SF-165	99.95	30	92	4	70-20 ±3		6 1/2	3			No	F	1 3/4	No							
	SF-4060	69.95	50	90	4	50-22 ±3		4 x 6	2			No	F	1 7/8	No							
	SF-6092	135.95	120	92	4	50-22 ±3		6 x 9	3			No	F	2 3/8	No							
	SX-103	129.95	30	88	4	70-20 ±3		4	2			No	S		No							
IMPACT INDUSTRIES	ID-8770	39.60	79.20	60	88	4	52-3.5	W	6				F	2	No							
	ID-8771	43.20	86.40	80	89	4	32-3.5	W	8				F	2 1/2	No							
	ID-8804	67.10	134.20	100	90	4	27-3	W	10				F	2 1/2	No							
	ID-8835	72.00	144.00	100	90	4	20-3	W	12				F	3	No							
	ID-8845	96.00	192.00	150	90	4	20-3	W	15				F	3 1/2	No							
	SD-6	298.00	100	4	4	40-45		6					S		No							
	TD-8	298.00	100	4	4	36-45		8					S		No							
	D-8	278.00	100	4	4	38-45		8					S		No							
	SD-10	329.00	100	4	4	34-35		10					S		No							
	SD-6-B	329.00	100	4	4	40-3.5		6					S		No						Box enclosure.	
	SD-10-B	495.00	200	4	4	30-4.5		10					S		No							
	SI-46	329.00	150	4	4	36-3.5		6					S		No							
	Twin Pack	185.00	40	4	4	40-35		6					S		No							
	Mini Pack	185.00	40	4	4	40-35		6					S		No							
	Hatchback	185.00	40	4	4	40-35		6					S		No							
	INFINITY	RSA 5211	124.95	35	88	4	63-22		5 1/4	2			No	C	1 3/4	Yes						
		RSA 4211	89.95	30	87	4	98-16		4	W			No	C	1 5/8	Yes						
RSA 46211		54.95	25	86	4	98-16		4 x 6	W			No	F	1 3/4	Yes						Drop-in replacement.	
RSA 3211		44.95	18	86	4	112-16		3 1/2	W			No	F	1 1/2	Yes						As above.	
EMIT II		99.95	110	87	4	4K-32k	T	6 x 9	3			Yes	S, C	3	Yes						Biamp or triamp capable; EMIT tweeters.	
CS-111		359.95	110	87	4	34-32		6 x 9	3			Yes	S, C	3	Yes						EMIT tweeter.	
RSA 69311		229.95	75	90	4	38-32		6 x 9	3			No	C	3	Yes							
RSA 69211		169.95	75	90	4	38-22		6 x 9	2			No	C	3	Yes							
RSA 6311	179.95	55	88	4	58-32		6 1/2	3			No	C	2	Yes						As above.		
RSA 6211	129.95	55	88	4	58-22		6 1/2	2			No	C	2	Yes								
JAMO	Jamocar 30R	59.95	50	87	4	70-14		4					F		Yes							
	Jamocar 40	74.95	60	88	4	70-20		4	2				F		Yes							
	Jamocar 50R	84.95	70	89	4	60-20		5	2				F		Yes							
	Jamocar 45	99.95	75	88	4	70-20		4	2				F		Yes							
	Jamocar 70	109.95	95	91	4	50-20		6 1/2	2				S		Yes							
	Jamocar 60	179.95	85	89	4	70-20		4	3		A		S		Yes							
	Jamocar 90	189.95	130	94	4	40-20		6 x 9	3				S		Yes							
	Jamocar 305 Electronic	249.95	10, 20 Inc.	10k		50-20		5	2				F		Yes							Biamped.
	JBL	TL500	40	88	4	80-20 ±3		5	2				No	S								
TL600	60	90	4	4	60-20 ±3		6 1/2	2				No	S									
TL900	100	93	4	4	50-20 ±3		6 x 9	3				No	C	3 3/8								
T55	75	88	4	4	85-20 ±3		5	2				No	S									
T65	100	91	4	4	65-27		6 1/2	2				No	S									
T95	125	93	4	4	65-27		6 x 9	3				No	S	3 3/8								
T05 TNS	50	92	4	4	2.5k-27k							No	C								Includes crossover.	
T50	75	88	4	4	80-8 ±3	T	5						S									
T60	100	91	4	4	65-6 ±3	W	6 1/2						S									
T90	125	93	4	4	65-6 ±3	W	6 x 9						S	3 3/8								
T80	100	88	4	4	40-5 ±3	S	8						C	3 3/8								
T100	150	91	8	8	35-4 ±3	S	10						C	4 5/8								
JENSEN	JTX-300	149.95	150	92	4	40-25		6 x 9	3			No	F	4								
	JCX-200	109.95	150	91	4	40-22		6 x 9	2			No	F	4								
	JTX-365	119.95	120	91	4	58-20		6 1/2	3			No	F	1 7/8								
	JCX-265	89.95	90	90	4	60-20		6 1/2	2			No	F	1 3/4								
	JCX-245	89.95	70	89	4	65-20		4 1/2	2			No	C	1 5/8								
	JFX-140	56.95	60	88	4	70-20		4	W		A		F	4								
	JXL-693	159.95	175	93	4	40-26		6 x 9	3			No	F	4 1/8								
	JXL-653	129.95	135	91	4	58-23		6 1/2	3			No	F	1 3/4								
	JXL-452	89.95	80	90	4	65-23		4 1/2	2			No	F	1 3/4								
	JXL-401	59.95	65	88	4	70-21		4	W			No	F	1 5/8								
	JXL-461	49.95	50	91	4	65-21		4 x 6	W			No	F	1 1/2								
	JXL-351	39.95	50	86	4	70-20		3 1/2	W			No	F	1 1/8								
	P/EQ-1	149.95	↑	93	4	55-20		4 1/2					No	F	2							†100 watts maximum; includes 20-watt amp. Switchable EQ curves. All as above.
	P/EQ-2	179.95	↑	94	4	45-20		6 1/2					F	2								
	J1445	44.95	25	88	4	70-17		4 1/2	W		A	No	C	1 5/8								
	J1401	149.95	45	92	4	40-20		4 x 10	3			No	F	2 5/8								
	J1405	99.95	45	92	4	45-18		4 x 10	2			No	F	2 5/8								
	J1350	39.95	25	83	4	80-15		3 1/2	W			No	F	1 3/8								
	J1435	49.95	25	90	4	65-18		4 x 6	W			No	F	1 3/4								
	JTE-802	299.95	150	94	4	60-25		8	2		A	No	S									For pickup trucks.
	J1500	79.95	50	99	4	68-20		6 1/2	2			No	F	1 7/8	Yes							
J1510	89.95	50	99	4	68-20		6 1/2	2		A	No</											

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS										Notes
								Subwoofer Only (S) Midrange Only (M) Tweeter Only (T)	Woofer Size, Inches	Whizzer (W) 3-Way (3) 4-Way (4)	Ampl. Tweeter(s) = A, Passive Tweeter(s) = P	Separately Mounted Drivers?	Flush Mount (F), Convertible (C), Plate (P)	Maximum Required Mounting Depth, Inches	Weatherproofed?			
JSE	988	149.95	100	4	50-20		6 x 9	4				S	Yes					
	986	129.95	100	4	50-20		6 x 9	4			F	Yes						
	976	89.95	100	4	60-20		6 x 9	2			F	Yes						
	4040	99.95	120	4	60-600 Hz	W	8				F	Yes						
	4010	39.95	60	4		T					F	Yes						
JVC	CS304	34.95	30	87	4	80-15 ± 2		3 1/2	W		No	F	1 1/2	Yes	Dash mount. For narrow rear decks of GM cars.			
	CS4124	129.95	60	90	4	40-20 ± 2		4 x 10	2		No	F	3	Yes				
	CS5724	119.95	60	91	4	40-20 ± 2		5 x 7	2		No	F	2 5/8	Yes				
	CS614	59.95	60	90	4	40-17 ± 2		6 1/2	W		No	F	1 3/4	Yes				
	CS624	74.95	100	90	4	40-20 ± 2		6 1/2	2		No	F	1 1/8	Yes				
	CS514	44.95	30	90	4	60-17 ± 2		5 1/4	W		No	F	1 3/4	Yes				
	CS414	44.95	45	87	4	50-20 ± 2		4	W		No	F	1 3/4	Yes				
	CS424	54.95	45	86	4	50-20 ± 2		4	2		No	F	1 3/4	Yes				
	CS6914	69.95	75	92	4	30-15 ± 2		6 x 9	W		No	F	2 5/8	Yes				
	CS6924	84.95	75	92	4	30-20 ± 2		6 x 9	2		No	F	2 5/8	Yes				
	CS6934	124.95	150	91	4	30-20 ± 2		6 x 9	3		No	F	2 5/8	Yes				
	CS6943	209.95	150	93	4	30-20 ± 2		6 x 9	4		No	F	4 1/4	Yes				
	CS6933	149.95	135	93	4	30-20 ± 2		6 x 9	3		No	F	4 1/4	Yes				
	CS633	129.95	105	90	4	40-22 ± 2		6 1/2	3		No	F	2 1/4	Yes				
	CS433	79.95	45	89	4	50-23 ± 2		4	3	A	No	F	1 7/8	Yes				
	CS6931A	119.95	75	92	4	40-20 ± 2		6 x 9	3		No	F	1 7/8	Yes				
	CS80K	169.95	150	87	4	30-20 ± 2		5 1/4	2	A	No	F	1 7/8	Yes				
KEF	GT-100	250.00	50	90	4	50-20 ± 3		4 1/2	2		No	P	1 1/2	Yes	Satellites and enclosed subwoofers.			
	GT-200	575.00	100	90	4	50-20 ± 3		8	3		Yes	P	1 1/2	Yes				
	KAR-33A			90	4		T					S		Yes				
	KAR-33F			90	4		W			A/P		F	1 1/4	Yes				
	KAR-110			90	4		M					F	2 1/8	Yes				
	KAR-200SW			90	4		S					F		Yes	Enclosed subwoofer.			
KENWOOD	KFC-830G	49.00	30	89	4	96-20 ± 3		3 1/2	W		No	F	1 7/8	No	Drop-in dash replacement for American cars. Drop-in dash replacement for Toyota pickups, Mercedes, and Audis. Drop-in replacement for VWs, Porsches, and BMWs. Drop-in dash replacement for GM cars. Drop-in replacement for GM 4 x 10 speakers. Can mount from front or rear of panel. As above. As above. As above. Biamp capable. Includes crossover.			
	KFC-104B	99.00	30	90	4	60-20 ± 3		4	2		No	F	1 5/8	No				
	KFC-103D	99.00	45	90	4	60-20 ± 3		4	W		No	F	1 3/4	Yes				
	KFC-1071	109.00	45	90	4	60-21 ± 3		4	2		No	F	1 3/4	Yes				
	KFC-463V	99.00	45	89	4	70-20 ± 3		4 x 6	2		No	F	1 5/8	Yes				
	KFC-4670	119.00	35	91	4	60-20 ± 3		4 x 6	2		No	F	1 3/4	No				
	KFC-410G	119.00	30	93	4	50-20 ± 3		4 x 10	2		No	F	2 3/8	No				
	KFC-1261	59.00	45	90	4	60-20 ± 3		5	W		No	F	1 3/4	Yes				
	KFC-1271	119.00	45	90	4	50-20 ± 3		5	2		No	F	1 3/4	Yes				
	KFC-1281	129.00	50	90	4	50-21 ± 3		5	3		No	F	1 3/4	Yes				
	KFC-1661	99.00	60	90	4	55-20 ± 3		6 1/2	W		No	F	1 3/4	Yes				
	KFC-1671	119.00	90	90	4	55-20 ± 3		6 1/2	2		No	F	1 5/8	Yes				
	KFC-1681	149.00	110	90	4	45-21 ± 3		6 1/2	3		No	F	2 1/8	Yes				
	KFC-1691	189.00	150	88	4	35-22 ± 3		6 1/2	2		No	F	2 3/8	Yes				
	KFC-6966	99.00	30	90	4	45-20 ± 3		6 x 9	W		No	F	2 3/4	Yes				
	KFC-6977	139.00	100	92	4	45-20 ± 3		6 x 9	2		No	F	3 3/8	Yes				
	KFC-6988	199.00	150	92	4	40-21 ± 3		6 x 9	3		No	F	3 1/2	Yes				
	KFC-6999	249.00	200	92	4	40-21 ± 3		6 x 9	4		No	F	3 1/2	Yes				
	KSC-5100	179.00	60	85	4	35-21 ± 3		4	2		No	S		No				
KSC-1000	269.00	100	89	4	60-20 ± 3		5	2		No	S, C	1 5/8	Yes					
KFC-1010	119.00	60	85	4	60-25 ± 3		5	2		Yes	S, C	2 1/8	Yes					
KFC-5050	149.00	100	85	4	55-8 ± 3						C		Yes					
	KFC-2020	199.00	100	88	4	20-3 ± 3	T	8	W			F	3 1/4	Yes				
	KFC-6060	125.00	100	88	4	20-3 ± 3	W	6 1/2				F	2 7/8	Yes				
KRAGO	TPS-694	129.95	100	92	4	20-20 ± 10		6 x 9	4	P	No	F	3 7/8	Yes				
	TPS-693	119.95	100	92	4	40-20 ± 10		6 x 9	3	A	No	F	3 7/8	Yes				
	TPS-552	79.95	60	92	4	50-20 ± 10		5 1/2	2	P	No	F	1 3/4	Yes				
MAGMAT	CAR 5	219.95	100	90	4	50-22 ± 3		5 1/4	2		No	P	1 1/2	Yes	†Optional adaptor for angled mounting, Model GT-1.			
	MCC 22M	229.95	100	91	4	40-34 ± 3		5 1/4	2		Yes	F	2 1/2	Yes				
	MCC 25M	239.95	100	91	4	40-34 ± 2.5		6	2		Yes	F	2 5/8	Yes				
	MCC 11E	249.95	80	90.5	4	45-20 ± 3		(2)4	2		Yes	F	2 1/4	Yes				
	MCC 32	289.95	80	91	4	40-20 ± 2.5		5 1/4	3		Yes	F	2 1/2	Yes				
	DC 10	74.95	50	93	4	65-20 ± 3		4	W		No	F	1 1/4	Yes				
	CAR 2	119.95	80	91	4	45-20 ± 2.5		5 1/4	2	A	No	F	2 1/2	Yes				
	CAR 3	129.95	80	91.5	4	40-20 ± 2.5		6	2		No	F	2 5/8	Yes				
	MCC 11	159.95	80	89	4	60-20 ± 3		4	2		Yes	F	2 1/4	Yes				
	MCC 12	169.95	80	90	4	40-20 ± 3		5 1/4	2		Yes	F	2 1/2	Yes				
	MCC 35M	339.95	100	91.5	4	40-34 ± 2		6	3		Yes	F	2 5/8	Yes				
	HT-1	39.95	80	90	8	5k-20k	T						F	3/8		Yes		
	MAGNUM	4112D	169.95	50	87	4	60-20		4 x 10					2 3/4			For pickups, vans, and hatchbacks. As above.	
4512D		129.95	40	85	4	85-20		4 1/2					1 1/8					
5312D		149.95	50	85	4	65-20		5 1/4					2 1/4					
6912D		169.95	60	89	4	45-20		6 x 9										
6944XP		229.95	200	98	4	30-22		6 x 9					3 1/8					
MB12		359.00	150	97	4/8			12	3			S						
MB10		409.00	150	97	4/8			10	3			S						
MB8	309.00	100	94	4/8			8	2			S							

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt, 1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS										Notes
								Speaker Only (S), Woofer Only (W), Midrange Only (M), Tweeter Only (T)	Woofer Size, Inches	Wizzer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Applied Tweeter(s) = A, Foldable Tweeter(s) = P	Separately Mounted Drivers?	Flush Mount (F), Surface Mount (S), Corner/Ceiling (C), Plate (P)	Maximum Required Mounting Depth, Inches	Weatherproofed?			
MAGTONE	P-900	89.95	50	4	4	50-20 ±3		6 x 9	3	P	No			2 7/8				
	P-600	79.95	50	4	4	70-20 ±3		6 1/2	3	P	No			2 1/8				
	P-410	84.95	30	4	4	70-20 ±3		4 x 10	3	P	No							
	P-500	69.95	40	4	4	70-20 ±3		5 1/4	2	P	No			2 1/4				
	P-460	59.95	25	92 ±2	4	90-20 ±3		4 x 6	2	P	No	S						
	P-400	55.95	20	93 ±2	4	90-20 ±3		4	2	P	No	S						
	P-300	34.95	20	94 ±2	4	100-18 ±3		3 1/2	2	P	No	S						
	CSP-6930P	149.95	120	93 ±2	4	40-20 ±3		6 x 9	3	P	No	S						
	CSP-6530P	139.95	120	92 ±2	4	50-20 ±3		6 1/2	3	P	No	S						
	CSP-522P	79.95	40	93 ±2	4	60-20 ±3		5 1/4	2	P	No	S						
	CSP-402P	69.95	40	92 ±2	4	80-20 ±3		4	2	P	No	S						
	CSP-521PP	89.95	40	94	4	45-20 ±3		5	2	A	No	S						
MAJESTIC	MPS42SL	59.95	60	4	4	60-20		5 1/4	2		No	F		1 3/4	Yes			
	MPS52SL	59.95	60	4	4	60-20		6 x 9	3		No	F		2	Yes			
	MPS69	89.95	150	4	4	40-22	W	8	3		No	F		4 1/2	Yes			
	MCS8	79.95	150	4	4	50-5		8	3		No	F		3 1/4	Yes			
	MSS400BR	99.95	200	4	4	60-20		4	3		No	S						
MEI	SK325F	34.95	40	88	4	80-16 ±3		3 1/2	W		No	F		1 1/2	No	For GM and VW cars. For GM and European cars.		
	SK426F	54.95	20	90	4	65-20 ±3		4 x 6	2		No	F		1 3/4	No			
	SK401F	29.95	20	90	4	50-18 ±3		4	W		No	F		1 1/2	Yes			
	SK405F	44.95	20	91.5	4	50-18 ±3		4	W		No	F		1 1/2	Yes			
	SK525F	59.95	20	90	4	50-18 ±3		5 1/2	2		No	F		2	Yes			
	SK601F	18.95		88	4	60-12 ±3		6 1/2			No	F		1 3/4				
	SK605F	34.95		90	4	50-16 ±3		6 1/2	W		No	F		2 1/8				
	SK620F	39.95		91	4	55-18 ±3		6 1/2	2		No	F		2 1/8				
	SK655F	79.95	50	91	4	70-20 ±3		6 1/2	2		No	F		1 1/2				
	SK655F	94.95	60	92	4	70-21 ±3		6 1/2	3		No	F		1 1/2				
	SK665F	49.95	30	92	4	60-20 ±3		4 x 10	2		No	F		1 3/4				
	SK412F	44.95	30	90	4	50-16 ±3		6 x 9	W		No	F		3 1/2				
	SK691F	59.95	30	90	4	40-16 ±3		6 x 9	3		No	F		3 1/2				
	SK693F	99.95	100	91	4	40-20 ±3		6 x 9	3		No	F		4 3/8				
	SK696F	99.95	100	91	4	40-20 ±3		6 x 9	3		No	F		1 7/8				
	SK697F	129.95	100	98	4	30-5 ±3	S	8	3		No	F		1 7/8				
	SK698F	199.95	100	92	4	30-22 ±3		8	3		No	F		1 7/8				
	SK333S	129.95	40	87.5	4	60-20 ±3	T	3	2		No	S		1				
	SK350T	59.95	75	91	4	4.5K-22K ±3	T	3	2		No	S		1				
	DS4002	84.95	60	91	4	90-20 ±3		4	2	A	No	F		1 7/8				
DS6003	119.95	120	90	4	60-21 ±3		6 1/2	3	A	No	F		2 1/2					
DS6902	139.95	150	92	4	50-20 ±3		6 x 9	2	A	No	F		3 7/8					
DS6903	159.95	150	92	4	50-21 ±3		6 x 9	3	A	No	F		3 7/8					
METROSOUND	SSP69S	89.95	100	93	4	40-20		6 x 9	3		No	F		No				
	SKP69S	69.95	80	91	4	50-30		6 x 9	3		No	F		No				
	SKP62S	59.95	60	91	4	60-20		6 x 9	2		No	F		No				
	SKP52S	39.95	60	91	4	65-18		5 1/4	2		No	F		No				
	SKP42S	39.95	50	89	4	80-18		4	2		No	F		No				
	SKP51S	29.95	40	88	4	70-14		5 1/4	W		No	F		No				
MITSUBISHI	SG-69TM	99.95	100	88	4	50-20 ±3		6 x 9	3		No	S		Yes				
	SG-16CM	79.95	30	89	4	100-18 ±3		6 1/2	2		No	S		Yes				
	SG-12CM	69.95	30	86	4	130-18 ±3		5	2		No	S		Yes				
	SG-10CB	69.95	60	80	4	100-20 ±3		4	2		No	P	1 3/8	Yes				
	SG-46CB	39.95	25	86	4	90-18 ±3		4 x 6	2		No	S		Yes				
	SG-10CM	49.95	25	87	4	150-15 ±3		4	2		No	S		Yes				
	SG-10WM	39.95	25	87	4	150-14 ±3		4	W		No	S		Yes				
	M&M ELECTRONICS	620-15R-4	74.95	200	93	4	38-4 ±3	W	6 1/2			C	6 1/2		Yes	8-ohm version, Model 620-15R-8. 8-ohm version, Model 620-15PR-8. 8-ohm version, Model 6920-15R-8. 8-ohm version, Model 6920-15PR-8. 8-ohm version, Model 820-15R-8. 8-ohm version, Model 820-15PR-8. 8-ohm version, Model 1030-2R-8. 8-ohm version, Model 1030-2PR-8. 8-ohm version, Model 1230-2R-8. 8-ohm version, Model 1230-2PR-8. 8-ohm version, Model 1560-2R-8. 8-ohm version, Model 1560-2PR-8. has maximum mounting depth of 6 1/8 inches. 8-ohm version, Model 1570-25PR-8. 8-ohm version, Model 1870-25A-8. With crossover, Model 505-1A, \$23.95. With crossover, Model PR-45A, \$20.95.		
620-15PR-4		82.95	200	93	4	38-4 ±3	W	6 1/2			C	6 1/2		Yes				
6920-15R-4		80.95	200	95	4	35-5 ±3	W	6 x 9			C	4 1/8		Yes				
6920-15PR-4		86.95	200	95	4	35-5 ±3	W	6 x 9			C	4		Yes				
820-15R-4		82.95	200	96	4	30-3 ±3	W	8			C	4 1/8		Yes				
820-15PR-4		91.95	200	96	4	38-3 ±3	W	8			C	4 1/8		Yes				
1030-2R-4		107.95	200	96	4	30-3 ±3	S	10			C	4 5/8		Yes				
1030-2PR-4		112.95	200	96	4	30-3 ±3	S	10			C	4 5/8		Yes				
1230-2R-4		125.95	200	97	4	30-3 ±3	S	12			C	5 1/4		Yes				
1230-2PR-4		132.95	200	97	4	30-3 ±3	S	12			C	5 1/4		Yes				
1560-2PR-4		189.95	300	97.5	4	22-2 ±3	S	15			C	5 1/4		Yes				
1570-25PR-4		264.95	400	98	4	19-2 ±3	S	15			C	6 1/8		Yes				
1870-25A-4		384.95	400	98	4	18-2 ±3	S	18			C	6 1/8		Yes				
505-1		22.95	50	8	8		M				C	1 1/4						
PR-45	19.95	50	8	8		T				C	1 1/4							
MONOLITHIC SOUND	W-700	59.00	125	91	8	40-2	S	7			S	2 1/2	Yes	Box enclosure.				
	M-350	59.00	50	93	4	50-20	S	3 1/2			S	2 1/2						
	WA-100	199.00	50	98	4	30-200 Hz	S	7			S	2 1/2						

SPEAKERS

MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS						Weatherproofed?	Notes
								Subwoofer Only (W)	Midrange Only (M)	Tweeter Only (T)	Woofer Size, Inches	Woofer (W) / 2-Way (2) / 3-Way (3) / 4-Way (4)	Amplifier Tweeter(s) = A, / Compatible Tweeter(s) = P		
MOREL ACOUSTICS	Integra 1 MKII	189.00	100	91	4	45-25 ±3	6		2	P	No	F	2 1/4		
	Integra 2 MKII	219.00	120	92	4	35-25 ±3	6		2	P	No	F	2 1/4		
	Coax-162	149.00	80	93	4	45-20 ±3	6		2	P	No	F	2 1/4		
	CR-3	439.00	200	90	4	500-25 ±3	6		2	P	Yes	S			
	CR-7	399.00	125	90	4		6		2	P	Yes	S			
	CR-8	439.00	150	90	4	70-25 ±3	6		2	P	Yes	S			
	MDT-80	59.00	40	93		4k-20k ±3		T					5/8		
	MDT-101	99.00	200	91	6.4	1.2k-25k ±3		T					1 1/2		
	CDM-75	189.00	100	91	6.4	400-5 ±3		M					2 1/4		
	MCW-162	139.00	150	90	4	40-50 ±3		W					2 1/4		
	MCW-164	159.00	150	91	4	40-50 ±3		6			No	F	2 1/4		
	MCW-220	149.00	150	90	4	30-30 ±3		8			No	F	2 1/4		
	MCW-224	179.00	150	92	4	25-30 ±3		8			No	F	2 1/4		
	PPC-8	129.00	150	94	4	23-500 Hz		S			No	F	2 1/4	Dual voice-coils.	
	MTX	RFL18	359.95	1.2k	96	4	18-1.5	W	18					7 1/2	Yes
PL5G		69.95	100	97	8	800-8	M						1 7/8	Yes	
RFL840		109.95	250	93	8	34-2	W							Yes	
RFL1240		129.95	250	95	8	32-2	W							Yes	
RFL8		109.95	250	93	4	34-2	W	8					3 1/2	Yes	
RFL10		119.95	300	93	4	32-2	W	10					4 1/8	Yes	
RFL12		209.95	800	93	4	25-2	W	12					5 1/4	Yes	
RFL15		259.95	1k	95	4	20-2	W	15					6 1/8	Yes	
Minisubs			75	91.5	4/8	65-3	W					S			
RFL1040		119.95	250	94	8	33-2	W							Yes	
RFL-T1		119.95	250	107	8	5k-20k	W						2 1/8	Yes	
RFL69		99.95	200	93	4	35-2	W	6 x 9				S	3 3/8	Yes	
BX1010		329.95	200	96	4	30-2	W	10				S			
45SB			409.00	150	97	4/8	55-22			3			S		
35SB			309.00	100	94	4/8	60-22			2			S		
25SB			199.95	45	90	4/8	80-22						S		
10NU590		49.95	200	4				10						4 3/8	
12NU596		59.95	200	4				12						5	
15MU682		79.95	200	4				15						6 1/2	
55HB			359.00	150	97	4/8	40-22						S		
52KU494		24.95	80	4				5 1/4						2 1/2	
69MU496		39.95	150	4				6 x 9						3 1/4	
6JU497		39.95	120	4				6 1/2						3 3/8	
8NU588		44.95	200	4				8						3 3/8	
35FU6210		19.95		4				8						1 3/4	
4-721		12.95		8										2	
45FU545		23.95		4										1 3/4	
5FU599		24.95		8										2 1/4	
1CU578		11.95		4										1/2	
1HU577		24.95		8										1 1/8	
1HU459		22.95		4										1 1/4	
372684		11.95		4										2 1/8	
B7.5		79.95	200	4		30-22		6 x 9						3 1/8	
46P		49.00	60	4		400-20		4 x 6						1 3/4	
B88		109.95	50	91	4	34-2		8				F			
BB12		139.95	75	94	4	22-21		12				F			
B4.5		34.95	60	4		90-20		4 1/2						1 3/4	
B5.3		39.95	60	4		75-20		5 1/4		2				2 1/8	
B6.5		44.95	60	4		60-20		6 1/2						2 1/2	
B6.9		49.95	60	4		55-20		6 x 9						3	
RFL410	49.95	100	100	8	800-16								8	Yes	
QT-1	79.95	60	91	4	3.5k-20k				P			S			
B3.5	24.95	60	4		130-20		3 1/2					S	1 5/8		
B4.0	29.95	60	4		150-20							S			
8JU403	36.95	120	8				8						3 5/8		
10JU750	44.95	150	4				10						4 3/8		
10JU703	49.95	150	8				12						5		
12NU751	59.95	200	4				12						5		
8NU699	59.95	100	4				8						3 3/8		
10NU728	64.95	130	4				10						4 3/4		
12NU713	69.95	150	4				12						5 1/4		
8KU753	33.95	80	4				8						3 1/4		
NAKAMICHI	SP-300	379.00	80	86	4	50-22		5 1/8	2	A/P	No	P	1 3/8	Yes	
	SP-200	239.00	80	86	4	50-20		5 1/8	2		No	P	1 3/8	Yes	
	SP-80	229.00	160	92	4	30-1	S	7 1/8				P	3/8	Yes	
	SP-50	145.00	80	87	4	50-6	W	5 1/4				F	1 1/2	Yes	
	SP-40	120.00	40	88	4	75-20		4		W		F	1 1/8	Yes	
	SP-10	190.00	40	86	4	2.5k-22k	T					C		Yes	
ORA ELECTRONICS	Auto Spec	69.95	100	97	4	38-10	W	8				C	2 3/8	No	
	ASPO-8W0														
	ASPO-69W0	49.95	100	97	4	38-10	W	6 x 9				F	3	No	
	ASPO-6903	59.95	100	94	4	35-20		6 x 9		3	No	F	2 3/4	No	
	ASPO-69S3	47.95	70	94	4	38-22		6 x 9		3	No	F	1 3/4	No	
	ASPO-55S3	39.95	60	94	4	65-18		6 1/2		3	No	F	1 5/8	No	
	ASPO-553	27.95	50	92	4	60-20		5		3	No	F	1 3/4	No	
	ASPO-42W	23.95	40	91	4	50-20		4		2	No	F	1 1/2	No	
ASPO-DT	21.95	80	96	4	4k-22k	T					C		No		



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SPEAKERS

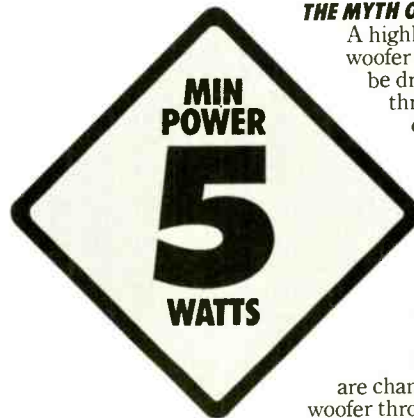
MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 W/1m, 1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ± dB	DRIVERS										Notes
								Subwoofer Only (W)	Midrange Only (M)	Tweeter Only (T)	Woofer Size, Inches	Woofer (W) 2-Way (3) 2-Way (4) 3-Way (5)	Angular Tweeter(s) = A, Polyaxial Tweeter(s) = P	Separately Mounted Drivers?	Flush Mount (F), Surface Mount (S), Convertible (C), Plate (P)	Maximum Required Mounting Depth, Inches	Weatherproof?	
PANASONIC	EAB-S411	39.95	40	91	4	50-22		4	W			No	F	1 3/4	Yes			
	EAB-S451	69.95	40	92	4	50-22		4	W		No	F	1 3/4	Yes				
	EAB-S611	49.95	50	92	4	40-20		6 1/2	W	A	No	F	1 7/8	Yes				
	EAB-S651	59.95	50	92	4	40-22		6 1/2	2	A	No	F	1 7/8	Yes				
	EAB-S691	74.95	80	92	4	40-22		6 x 9	2	A	No	F	3/4	Yes				
	EAB-T501	49.95	40	89	4	50-16		5	W		No	F	3/8	Yes				
	EAB-466	54.95	50	90	4	60-22		4 x 6	2		No	F	1 7/8	Yes				
	EAB-0432	49.95	40	92	4	50-20		4	W		No	F	1 3/4	Yes				
	EAB-0652	84.95	80	92	4	40-22		6 1/2	2		No	F	1 7/8	Yes				
	EAB-6951	89.95	80	94.5	4	30-22		6 x 9	2	A	No	F	4	Yes				
	EAB-6971	119.95	100	94.5	4	30-25		6 x 9	3	A	No	F	4	Yes				
	EAB-4152	84.95	60	92	4	45-22		4 x 10	2	A	No	F	3/8	Yes				
	EAB-T601	59.95	50	92	4	40-20		6 1/2	2	W	No	F	1 1/2	Yes				
	EAB-T651	84.95	50	92	4	40-22		6 1/2	2		No	F	1 1/2	Yes				
	EAB-D450	89.95	100	92.5	4	40-22		4	2	A	No	F	2	Yes				
	EAB-D650	109.95	120	93	4	30-22		6 1/2	2		No	F	2	Yes				
	EAB-D970	149.95	150	94	4	28-25		6 x 9	3	A	No	F	4 1/8	Yes				
	EAB-030	29.95	20	90	4	100-20		3 1/2	W		No	F	1 3/8	Yes				
	EAB-0551	59.95	50	91	4	40-22		5 1/4	2	A	No	F	2 1/8	Yes				
	EAB-062	74.95	25	92	4	45-25		6 1/2	2		No	F	2	Yes				
EAB-911	39.95	20	93	4	50-15		5	2		No	F	1 3/4	Yes					
PHASE LINEAR	PL 1352	50.00	70	88	4	110-22		3 1/2	W		No	F	1 1/2					
	PL 1400	65.00	75	88	4	65-22		4	W		No	F	1 3/4					
	PL 2450	85.00	100	89	4	60-27		4 1/2	2		No	F	1 3/4					
	PL 2460	90	91	4	65-22		4	2		No	P	1 3/4						
	PL 2650	130.00	160	90	4	55-27		6 1/2	2		No	F	1 7/8					
	PL 3690	200.00	250	92	4	36-27		6 x 9	3		No	F	4 1/8					
	PHILIPS	S10	269.95	200	90	4	20-20		8	3		Yes	C					
S20		299.95	200	90	4	20-20		6 x 9	3		Yes	C						
EN 8895		399.95	200	90	4	20-20		(2)5	3		Yes	C						
Pro 8869		199.95	200	90	4	20-20		6 x 9	3		Yes	C						
Pro 8769		149.95	150	90	4	20-20		6 x 9	2		Yes	C						
Pro 8749		129.95	100	90	4	20-20		6 x 9	2		No	C		Yes				
EN 8810		139.95	100	90	4	20-20		4 x 10	2		No	C		Yes				
Pro 8890		99.95	80	91	4	40-20		4	2		No	C		Yes				
EN 8846		89.95	60	91	4	100-20		3 1/2	2		Yes	C		Yes				
EN 8346		49.95	100	91	4	2.7k-20k	T					C		Yes				
EN 8340		49.95	100	91	4	2.7k-20k	T					C		Yes				
EN 8335		49.95	100	91	4	2.7k-20k	T					C		Yes				
Pro 100		69.95	80	91	4	6k-20k	T					C		Yes				
Pro 200		59.95	80	91	4	2k-20k	T					C		Yes				
Pro 635		109.95	110	90	4	25-20		6 1/2	3		Yes	C		Yes				
Pro 620		129.95	110	93	4	30-20		6 1/2	2	W	No	S		Yes				
Pro 610		99.95	60	95	4	30-20		6 1/2	2		No	S		Yes				
SFL 621		79.95	30	92	4	35-20		6 1/2	2		No	C		Yes				
Pro 535		139.95	80	92	4	35-20		5 1/4	3		No	C		Yes				
Pro 520		119.95	80	92	4	35-20		5 1/4	2		No	C		Yes				
Pro 510		89.95	60	93	4	35-20		5 1/4	2	W	No	C		Yes				
Pro 420		99.95	80	91	4	40-20		4	2		No	C		Yes				
Pro 410		69.95	80	91	4	45-20		4	2	W	No	C		Yes				
Pro 800	149.95	100	94	4	43-3	W	8			No	C		Yes					
PIONEER	TS-1001	40.00	40	90	4	50-16		4	W		No	F	1 5/8	No				
	TS-1050	53.00	40	90	4	50-21		4	2		No	F	1 1/2	No				
	TS-1002	60.00	40	91	4	50-20		4	2		No	F	1 5/8	No				
	TS-1080	83.00	30	91	4	50-21		4	2		No	F	1 3/4	No				
	TS-V10	160.00	60	90	4	48-25		4	2		No	F	1 7/8	Yes				
	TS-139	85.00	100	90	4	45-20		5 1/4	2		No	F	2 1/8	Yes				
	TS-1601	46.00	60	92	4	40-20		6 1/2	W		No	F	1 5/8	No				
	TS-1602	65.00	60	92	4	40-20		6 1/2	2		No	F	1 5/8	No				
	TS-1625	85.00	100	92	4	30-20		6 1/2	2		No	F	1 5/8	Yes				
	TS-1655	95.00	60	92	4	60-20		6 1/2	3		No	F	1 7/8	No				
	TS-1675	125.00	100	90	4	30-20		6 1/2	3		No	F	2 1/8	Yes				
	TS-1685	155.00	150	90	4	30-20		6 1/2	3		No	F	2 1/2	Yes				
	TS-V16	240.00	150	91	4	30-25		6 1/2	3		No	F	2 3/8	Yes				
	TS-F202	130.00	60	89	4	48-20		5 x 5	3		No	F	1 1/2	Yes				
	TS-F606	90.00	120	91	4	38-23		6 1/2 x	2		No	F	1 1/2	Yes				
	TS-6920	65.00	60	93	4	40-20		6 1/2			No	F	2 3/4	No				
	TS-6930	90.00	60	93	4	35-22		6 x 9	W		No	F	2 3/4	No				
	TS-6940	120.00	100	94	4	35-22		6 x 9	2		No	F	3 1/2	No				
	TS-6950	150.00	120	94	4	30-22		6 x 9	3		No	F	3 1/2	No				
	TS-6960	200.00	120	94	4	30-23		6 x 9	4		No	F	3 1/2	Yes				
	TS-6970	220.00	150	93	4	48-25		6 x 9	4		No	F	3 1/2	Yes				
	TS-6985	240.00	200	94	4	28-28		6 x 9	4		No	F	3 1/2	No				
	TS-6995	270.00	200	94	4	29-32		6 x 9	3		No	F	3 3/8	Yes				
	TS-V69	320.00	150	95	4	28-32		6 x 9	3		No	F	3 3/8	Yes				
	TS-44	35.00	40	88	4	180-20		4	W		No	S		No				
	TS-56	95.00	40	90	4	180-18		5 1/8	W		No	S		No				
	TS-X4	95.00	60	89	4	90-20		4	W		No	S		No				
	TS-X20	120.00	60	88	4	70-20		4 x 4	2		No	S		No				
	TS-TRX3	150.00	100	90	4	75-22		5	2		No	S		No				
	TS-X30	200.00	100	88	4	50-22		4x4 1/4	3	A	No	S		No				
	TS-TRX5	270.00	150	92	4	65-22		6 1/2	2	A	No	S		No				
	TS-X40	320.00	100	89	4	47-25		4x5 1/2	4		No	S		No				
	TS-X15	510.00	150	89	4	45-40		5 1/8	4		No	S		No				
	TS-873	38.00	30	88	4	90-20		3 1/4	W		No	F		No				
	TS-875	60.00	30	88	4	90-20		3 1/4	W		No	F		No				
	TS-1018	60.00	40	88	4	90-20		3 1/4	2		No	F		No				
	TS-467	48.00				50-20		4	2		No	F		1 1/2	No	For Toyota dashboards.		

THE CERWIN-VEGA SCHOOL OF DRIVER EDUCATION.



THE SUBWOOFER, EXPLAINED.

In a typical car stereo system, you hear too much of the road and not enough bass. A Cerwin-Vega car subwoofer (a separate bass speaker, simply mounted in the trunk, or for that matter, anywhere else in your car) will overcome the inherent drone, rumble and noise of the road and give you powerfully deep bass and full, clean sound.



THE MYTH OF THE MEGA-AMP.

A highly-efficient Cerwin-Vega car subwoofer with a massive magnet assembly can be driven with as little as 5 watts of power through a single amplifier and a passive crossover.

On the other hand, if you live for loud, one of our car subwoofers can handle multiple amps and up to 300 watts of power.

LOOK. IN THE TRUNK. IT'S A SUBWOOFER.

A Cerwin-Vega car subwoofer is easily mounted in your trunk or rear deck, behind the rear seat or in a separate enclosure. This goes for *any* car. Meaning, you don't have to drive a new car, a slick car or a like-totally-awesome car to enjoy great sound.



TAKING THE LOW ROAD.

Bass frequencies are channeled to the subwoofer through the CSX-110 passive crossover. A complex little device that sends all frequencies above 110Hz to your mid-ranges and tweeters, while all low frequencies, from 110Hz down to 30Hz, are sent to the subwoofer.



MEET THE LOUD FAMILY.

You can hear the Loud Family of Cerwin-Vega car subwoofers (six models are available, with either single or dual voice coils) through selected car stereo outlets and better custom installation shops nationwide.

Class dismissed.



 **Cerwin-Vega!**

For More Information, Write or Call:
Cerwin-Vega: 555 East Easy Street, Simi Valley, CA 93065, (805) 584-9332 Telex: 662250
Cerwin-Vega Canada: 2360 Midland Ave., Unit 21/Scarborough, Ontario M1S 4A9
Cerwin-Vega Europe: Skanderborgvej 71/DK-8680 Ry, Denmark

Enter No. 10 on Reader Service Card

SPEAKERS

MANUFACTURER	Model	Price \$ (if sold individually)	Price \$ (if sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS										Notes
								Subwoofer Only (S), Woofer Only (W), Midrange Only (M), Tweeter Only (T)	Woofer Size, Inches	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Applied Tweeters = A, Removable Tweeters = P	Separately Mounted Drivers?	Flux Mount (F), Surface Mount (S), Conventional (C), Plate (P)	Maximum Required Mounting Depth, Inches	Weatherproofed?			
PYLE (Continued)	HW1570 Pro	131.95	280	35	8	25-4.5 ±3	W	15					F	6 1/2	Yes			
	HW1580 Pro	205.95	320	30	8	20-3.5	W	15					F	6 3/8	Yes			
	HW1880 Pro	269.95	350	25	8	20-3 ±3	W	18					F	7 3/4	Yes			
	WP5216 4	37.95	80	92	4	50-8 ±3	W	5 1/4					F	2 3/4	Yes			
	WP6520 4	46.95	120	92	4	40-6 ±3	W	6 1/2					F	3 1/4	Yes			
	WP6929 4	58.95	150	95	4	30-5.5 ±3	W	6 x 9					F	3 7/8	Yes			
	WP820 4	50.95	140	94	4	30-5.5 ±3	W	8					F	3 7/8	Yes			
	WP830 4	64.95	160	94	4	30-3 ±3	W	8					F	4 1/8	Yes			
	WP1020 4	56.95	150	95	4	25-5 ±3	W	10					F	4 3/8	Yes			
	WP1040 4	71.95	170	95	4	25-3 ±3	W	10					F	4 3/4	Yes			
	WP1240 4	78.95	180	96	4	20-3 ±3	W	12					F	5 1/4	Yes			
	WP1560 4	96.95	200	98	4	20-3 ±3	W	15					F	6 1/4	Yes			
	WP5216	36.95	80	92	8	50-8.5 ±3	W	5 1/4					F	2 3/4	Yes			
	WP6520	45.95	120	92	8	40-6.5 ±3	W	6 1/2					F	3 1/4	Yes			
	WP6929	57.95	150	95	8	30-6 ±3	W	6 x 9					F	3 7/8	Yes			
	WP820	49.95	140	94	8	30-6 ±3	W	8					F	3 7/8	Yes			
	WP830	63.95	160	94	8	30-3.5 ±3	W	8					F	4 1/8	Yes			
	WP1020	55.95	150	95	8	25-5.5 ±3	W	10					F	4 3/8	Yes			
	WP1040	70.95	170	95	8	25-3.5 ±3	W	10					F	4 3/4	Yes			
	WP1240	77.95	180	96	8	20-3.5 ±3	W	12					F	5 1/4	Yes			
	WP1560	95.95	200	98	8	20-3.5 ±3	W	15					F	6 1/4	Yes			
	W6520 4	45.95	120	92	4	40-6 ±3	W	6 1/2					F	3 1/4	Yes			
	W6929 4	56.95	150	95	4	30-5.5 ±3	W	6 x 9					F	3 7/8	Yes			
	W820 4	48.95	140	94	4	30-5.5 ±3	W	8					F	3 7/8	Yes			
	W830 4	63.95	160	94	4	30-3 ±3	W	8					F	4 1/8	Yes			
	W1020 4	54.95	150	95	4	25-5 ±3	W	10					F	4 3/8	Yes			
	W1040 4	70.95	170	95	4	25-3 ±3	W	10					F	4 3/4	Yes			
	W1240 4	75.95	180	96	4	20-3 ±3	W	12					F	5 1/4	Yes			
	W1560 4	94.95	200	98	4	20-3 ±3	W	15					F	6 1/4	Yes			
	W6520	44.95	120	92	8	40-6.5 ±3	W	6 1/2					F	3 1/4	Yes			
	W820	47.95	140	94	8	30-6 ±3	W	8					F	3 7/8	Yes			
	W830	62.95	160	94	8	30-3.5 ±3	W	8					F	4 1/8	Yes			
	W1020	53.95	150	95	8	25-5.5 ±3	W	10					F	4 3/8	Yes			
	W1040	69.95	170	95	8	25-3.5 ±3	W	10					F	4 3/4	Yes			
	W1220	59.95	160	96	8	20-5 ±3	W	12					F	5 1/4	Yes			
	W1240	74.95	180	96	8	20-3.5 ±3	W	12					F	5 1/4	Yes			
	W1260	82.95	190	97	8	20-3.5 ±3	W	12					F	5 1/4	Yes			
	W1270	102.95	210	97	8	20-3 ±3	W	12					F	5 5/8	Yes			
	W1560	93.95	200	98	8	20-3.5 ±3	W	15					F	6 1/4	Yes			
	W1570	110.95	220	98	8	20-3 ±3	W	15					F	6 1/2	Yes			
	W6517S	47.95	120	91	4	25-2.5 ±3	W	6 1/2					F	3 1/8	Yes			
	W820S	49.95	140	93	4	20-1.5 ±3	W	8					F	3 7/8	Yes			
	W1020S	56.95	150	93	4	20-1 ±3	W	10					F	4 3/8	Yes			
	W830D	67.95	160	92	4	25-2 ±3	S	8					F	4 1/8	Yes	Dual voice-coils.		
	W1040D	74.95	170	93	4	20-2 ±3	S	10					F	4 3/4	Yes	As above.		
	W1240D	85.95	180	94	4	20-4.5 ±3	S	12					F	5 3/4	Yes	As above.		
	W1570D	120.95	220	96	4	20-4 ±3	S	15					F	6 1/2	Yes	As above.		
	F810W	30.95	90	93	8	40-18 ±3	S	8					F	2 7/8	Yes			
	F820T	79.95	130	94	8	30-20 ±3	S	8					F	3 7/8	Yes			
	PR65	13.95						W	6 1/2				F	1 3/4	Yes			
	PR8	16.95						W	8				F	2 1/4	Yes			
	PR10	20.95						W	10				F	2 7/8	Yes			
	PR12	27.95						W	12				F	3 1/2	Yes			
	M5H	45.95	90	92	8	300-8 ±3	M	M					F	4	Yes			
	M510	30.95	90	92	8	500-10 ±3	M	M					F	2 3/8	Yes			
M516	34.95	100	94	8	500-10 ±3	M	M					F	2 1/4	Yes				
M516C	36.95	100	94	8	500-14 ±3	M	M					F	2 1/4	Yes				
MP516	37.95	100	94	8	500-10 ±3	M	M					F	2 1/4	Yes				
H3910	40.95	80	102	8	2k-15k ±3	M	M					F	7 1/2	Yes				
H3910E	42.95	80	102	8	2k-18k ±3	M	M					F	7 1/2	Yes				
K-D210		30.95	60	90	8	4k-20k ±3	T	T				F	5/8	Yes				
K-D2210		31.95	60	90	8	4k-20k ±3	T	T				F	5/8	Yes				
K-D2215H		54.95	60	90	8	4k-20k ±3	T	T				F	5/8	Yes				
K-D3580		54.95	80	94	8	4k-20k ±3	T	T				F	1 3/8	Yes	Includes crossover.			
K-D480		55.95	80	94	8	4k-20k ±3	T	T				F	1 1/2	Yes	As above.			
K-D4580		56.95	80	94	8	4k-20k ±3	T	T				F	1 1/2	Yes	As above.			
K-DS480		56.95	80	90	8	4k-20k ±3	T	T				F	1 3/8	Yes	As above.			
K-DS4580		57.95	80	90	8	4k-20k ±3	T	T				F	1 1/4	Yes	As above.			
K-R4580		99.95	120	92	8	4k-20k ±3	T	T				F	1 1/4	Yes				
K-T324		52.95	100	94	8	4k-20k ±3	T	T				F	1 1/2	Yes				
H2610		38.95	80	101	8	4k-20k ±3	T	T				F	4 1/2	Yes				
K-TP3S		23.95	140	90		5k-40k ±3	T	T				F	1	Yes				
K-TP375S		140	89			3k-20k ±3	T	T				F	1 1/8	Yes				
HTP35	23.95	140	94			4k-30k ±3	T	T				F	2 3/4	Yes				
HTP26	30.95	140	92			2k-40k ±3	T	T				F	4 1/4	Yes				
REALISTIC	12-1705	49.95	60					4 x 10	2		No	F	3 1/4					
	12-1859	99.95	120					6 x 9	3		No	F						
ROADSTAR	6700702	49.95	45	93	4	100-20 ±10		6	2		No	F	2	Yes				
	6700703	54.95	45	93	4	100-20 ±10		6	3		No	F	2	Yes				
	6700704	59.95	60	96	4	100-20 ±10		6 x 9	2		No	F	3	Yes				
	6700705	69.95	60	96	4	100-20 ±10		6 x 9	3		No	F	3	Yes				
	6700706	59.95	60	93	4	100-20 ±10		4 x 10	3		No	F	2 1/2	Yes				
	6700698	19.95	20	88	4	100-18		3 1/2	W		No	F	1 5/8	Yes				
	6700696	24.95	25	92	4	100-20		4	W		No	F	1 5/8	Yes				
	6700697	29.95	25	90	4	100-20		4	W		No	F	1 5/8	Yes				
	6700700	34.95	25	90	4	100-20		4 x 6	2		No	F	1 3/4	Yes				
	6700701	39.95	20	90	4	100-20		5 1/4	2		No	F	1 3/8	Yes				

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Maximum Power, Watts	Sensitivity, dB SPL (1 Watt/1 Meter)	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	DRIVERS												Notes
								Subwoofer Only (W)	Midrange Only (M)	Tweeter Only (T)	Woofer Size, Inches	Wizzer, (W) 2-Way (2), 3-Way (3), 4-Way (4)	Amplified Tweeters (A)	Pointable Tweeters (P)	Separately Mounted Drivers?	Flush Mount (F), Surface Mount (S), Convertible (C), Pole (P)	Maximum Required Mounting Depth, Inches	Weatherproofed?		
ROCKFORD FOSGATE	SPP-184	450.00	200	95.4	4	20-500 Hz	S	18						C		Yes	8-ohm version, Model SPP-188.			
	SPP-154	300.00	200	93.5	4	20-500 Hz	S	15						C		Yes	8-ohm version, Model SPP-158.			
	SP-124	285.00	200	92.5	4	20-500 Hz	S	12						C		Yes	8-ohm version, Model SPP-128.			
	SP-415	160.00	100	92.4	4	20-500 Hz	S	15						C		Yes	8-ohm version, Model SP-815.			
	SP-412	145.00	100	91.3	4	20-500 Hz	S	12						C		Yes	8-ohm version, Model SP-812.			
	SP-104	119.00	100	92.0	4	40-1	W	10						C		Yes	8-ohm version, Model SP-108.			
	SP-84	89.00	100	89.7	4	50-500 Hz	W	8						C		Yes	8-ohm version, Model SP-88.			
	SP-694	75.00	100	89.7	4	50-500 Hz	W	6 x 9						C		Yes				
	SP-64	75.00	100	89.0	4	80-2	W	6 1/2						C		Yes	8-ohm version, Model SP-68.			
	SP-54	45.00	100	92.0	4	100-5	M							C		Yes	8-ohm version, Model SP-58.			
	SP-44	40.00	50	88.0	4	275-10	M							C		Yes	8-ohm version, Model SP-48.			
	SP-34	35.00	50	89.0	4	250-10	M							C		Yes	8-ohm version, Model SP-38.			
	SPT-14/TX-124	46.00	50	88.0	4	1.5k-20k	T							C		Yes	Includes crossover; 8-ohm version, Model SPT-18/TX-128.			
	SPT-4/TX-184	28.00	50	91.3	4	3k-20k	T							C		Yes	Includes crossover; 8-ohm version, Model SPT-8/TX-188.			
ROYAL SOUND	RS-500N	30.00	50	89	4	80-15 ± 15		5 3/4			No		S		Yes					
	RS-510N	40.00	50	87.5	4	60-17 ± 15		5 3/4	2	P	No		S		Yes					
	RS-520N	60.00	50	86	4	60-18 ± 15		5 3/4	3	P	No		S		Yes					
	RS-630	60.00	120	93	4	40-18 ± 10		6 1/2	3	P	No		C	2 1/4	Yes					
	RS-900	60.00	120	93	4	40-22 ± 10		6 x 9	3	P	No		C	2 3/4	Yes					
	RS-1460	150.00	100	91.5	4	60-17 ± 10		5 3/4	2	P	No		S		Yes					
	RS-1690	150.00	200	93	4	60-19 ± 10		6 1/2	3	P	No		S		Yes					
	RS-1990	150.00	400	95	4	40-22 ± 10		6 x 9	3	P	No		S		Yes					
	RS-6045NII	150.00	150	87	4	20-18 ± 10		6 x 9	3	P	No		S		Yes					
SABRE SOUND	CF 150	595.00	300	93	4	30-35		12	3	A	Yes		S		Yes	Fits rear wells of 1962-87 Camaros and Firebirds.				
	SS T	349.95	200	92	4	40-35		8	3	A	Yes		S		Yes	Mounts behind seat in trucks.				
	SS Z/RX	395.95	200	91	4	40-35		6 1/2	2	A	Yes		S		Yes	For Mazda RX-7 and Nissan 300ZX and 280Z.				
	SS H	429.95	200	92	4	40-35		8	3	A	Yes		S		Yes	Fits rear cavity of hatchbacks, lastbacks, vans, RVs, and 4 x 4 vehicles.				
	SS D	295.95	150	90	4	45-22		6 1/2	2	A	Yes		S		Yes	Mounts on rear decks.				
SANSUI	SB-4900X	230.00	200	92	4	28-30	S	6 x 9	4		No		C	3 1/8	No					
	SB-W6900	219.00	200	91	4	30-7		6 x 9			No		C	3 3/4	No					
	SB-3900X	200.00	160	92	4	28-25		6 x 9	3		No		C	3 3/8	No					
	S-1630	199.00	120	90	4	35-21			3		No		C		No					
	SB-3901	180.00	130	93	4	30-22		6 x 9	3		No		C	2 5/8	No					
	SB-2900X	160.00	130	92	4	28-22		6 x 9	2		No		C	3 3/8	No					
	SB-3600X	160.00	120	90	4	30-22		6 1/2	3		No		C	2 1/4	No					
	SB-3500X	120.00	70	90	4	45-22		5 1/4	3		No		C	1 3/4	No					
	SB-2600	110.00	100	91	4	30-22		6 1/2	2		No		F	2 1/4	No					
	SB-3501	110.00	70	91	4	48-22		5 1/4	3		No		F	1 3/4	Yes					
	SB-1120	110.00	40	88	4	50-17		5	2		No		F	1	Yes					
	SB-2601	100.00	60	90	4	40-20		6 1/2	2		No		F	1 3/4	Yes					
	SB-2400	90.00	70	90	4	50-22		4	3		No		F	1 3/4	No					
	SB-2500	80.00	50	90	4	50-20		5	2		No		F	1 3/4	No					
	SB-1400	80.00	100	90	4	50-20		4	2		No		F	1 3/4	No					
	SB-1401	56.00	40	90	4	50-20		4	2		No		F	1 3/4	No					
	SB-050	40.00	20	90	4	95-20		3 1/2	2		No		F	2	No					
	SB-D460	39.00	45	90	4	60-19		4 x 6	2		No		F	1 3/4	No					
	SANYO	SP30	14.95	20	88	4	80-20		3			No		F	1 1/2	Yes				
SP41A		14.95	10	88	4	80-15		4	2	A	No		F	1 5/8	Yes					
SP43		19.95	20	89	4	80-15		4	2	A	No		F	1 3/4	Yes					
SP45		39.95	30	90	4	80-20		4	2	P	No		F	1 1/2	Yes					
SP60		11.95	10	88	4	65-13		6 1/2			No		F	1	Yes					
SP61		14.95	15	90	4	65-13		6 1/2			No		F	1	Yes					
SP62		19.95	20	88	4	60-15		6 1/2	2	A	No		F	1 1/4	Yes					
SP63		29.95	25	92	4	60-15		6 1/2	2	A	No		F	1 3/4	Yes					
SP64A		39.95	20	92	4	60-19		6 1/2	2	A	No		F	1 3/4	Yes					
SP65		49.95	30	92	4	60-20		6 1/2	2	A	No		F	1 3/4	Yes					
SP93		54.95	50	93	4	50-20		6 x 9	2	A	No		F	3 3/4	Yes					
SP94A		59.95	40	93	4	50-20		6 x 9	3	A	No		F	3 3/4	Yes					
SP95		79.95	50	93	4	50-20		6 x 9	3	A	No		F	3 3/4	Yes					
FSP402		49.95	40	89	4	70-20		4	2	A	No		F	2	Yes					
FSP652		59.95	40	91	4	60-20		6 1/2	2	A	No		F	2	Yes					
FSP693		99.95	80	92	4	50-20		6 x 9	3	A	No		F	3 3/8	Yes					
SP89A		89.95	40	88	4	80-20		4	2	A	No		F	3 3/8	Yes					
SP1000		59.95	50	91	4	70-20		5	2	A	Yes		F	2	Yes					
SP3000		129.95	150	94	4	50-20		6 x 9	4	A	Yes		F	3 3/4	Yes					
SP2000		79.95	100	92	4	60-20		6 1/2	3	A	Yes		F	2	Yes					
SAS	T62 Bazooka	199.00	100	98	4	39-1.5	W	6 1/2							Yes	Tube enclosure.				
	T82 Bazooka	279.00	150	100	4	39-1.5	W	8						Yes	As above.					
	T16 Bazooka		100	98	4	39-1.5	W	6 1/2						Yes	As above.					
	T18 Bazooka	279.00	150	100	4	39-1.5	W	8						Yes	As above.					

Impress Your Speakers

Let's face it—car speakers can be pretty blasé! It takes sheer gut-wrenching power to impress them, and Cooustic car amplifiers deliver just that, along with amazing clarity and solid resolution.

Your speakers will be pleased to know that Cooustic power amplifiers use 20-mil copper clad G-10 glass epoxy PC boards, 10 gauge power and ground wire, high speed HEX-FET® switchers, plus fully complimentary 150-watt 15-amp darlington audio outputs. If that doesn't perk up their tweeters, tell them the AMP-190 and AMP-380 audio inputs directly accept 8-pin din and RCA connectors, low power or high power radios by simply flipping a switch.

In bridged mode, the HEX-FET® switching power supply develops **substantially** more power into 8 ohms than into 4 ohms. For example, the AMP-380 delivers 175 watts RMS mono into 4 ohms and over **300 watts RMS** into 8 ohms!

This means it is not necessary for you to buy two power amplifiers to drive your speakers when the AMP-190/AMP-380 can produce double the power of most other car amplifiers...that's twice the power for virtually half the price.

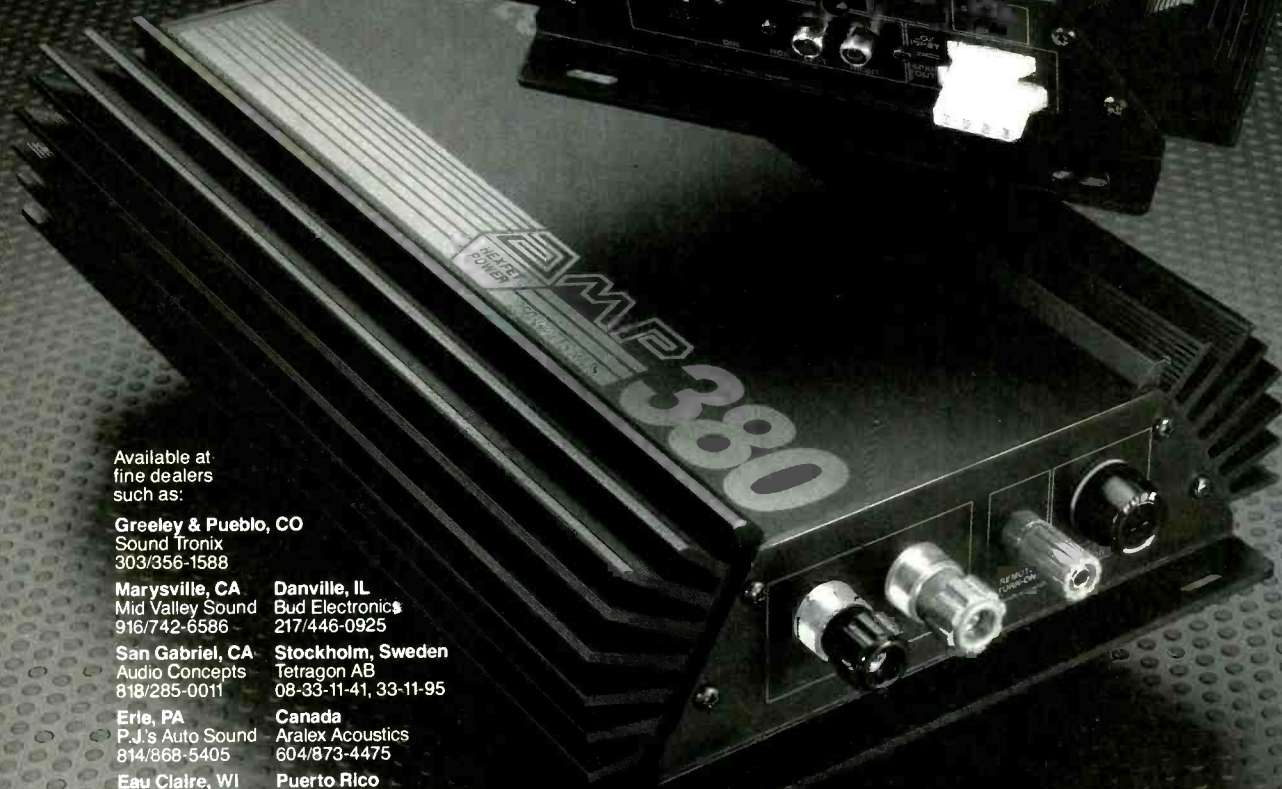
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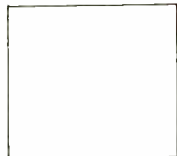
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1515 Broadway, New York, NY 10036

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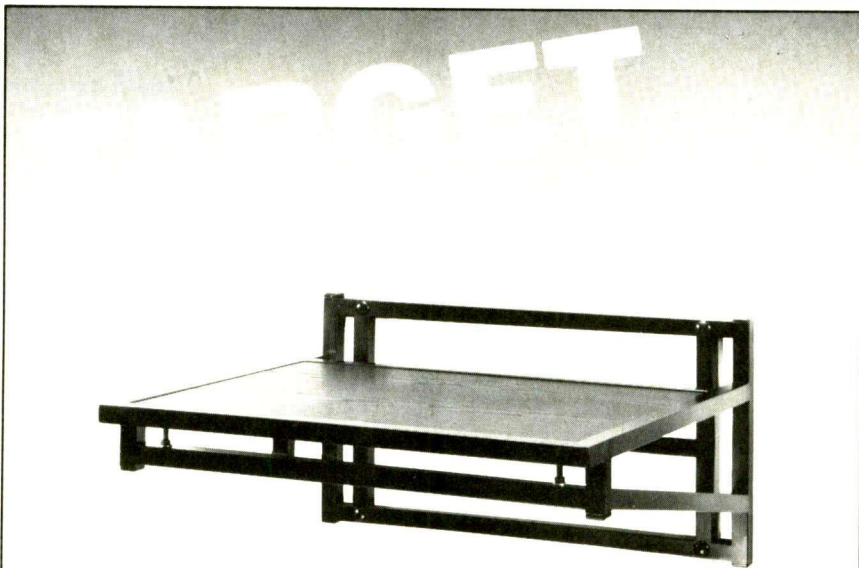
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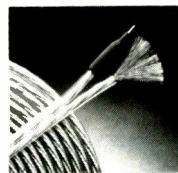
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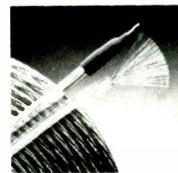


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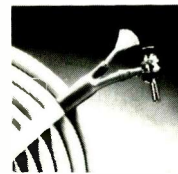


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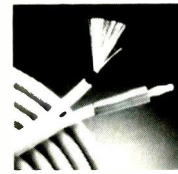


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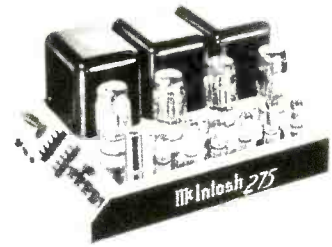
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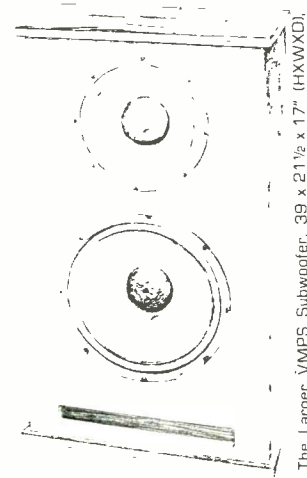
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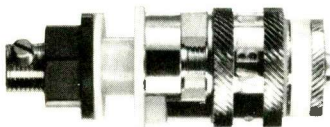
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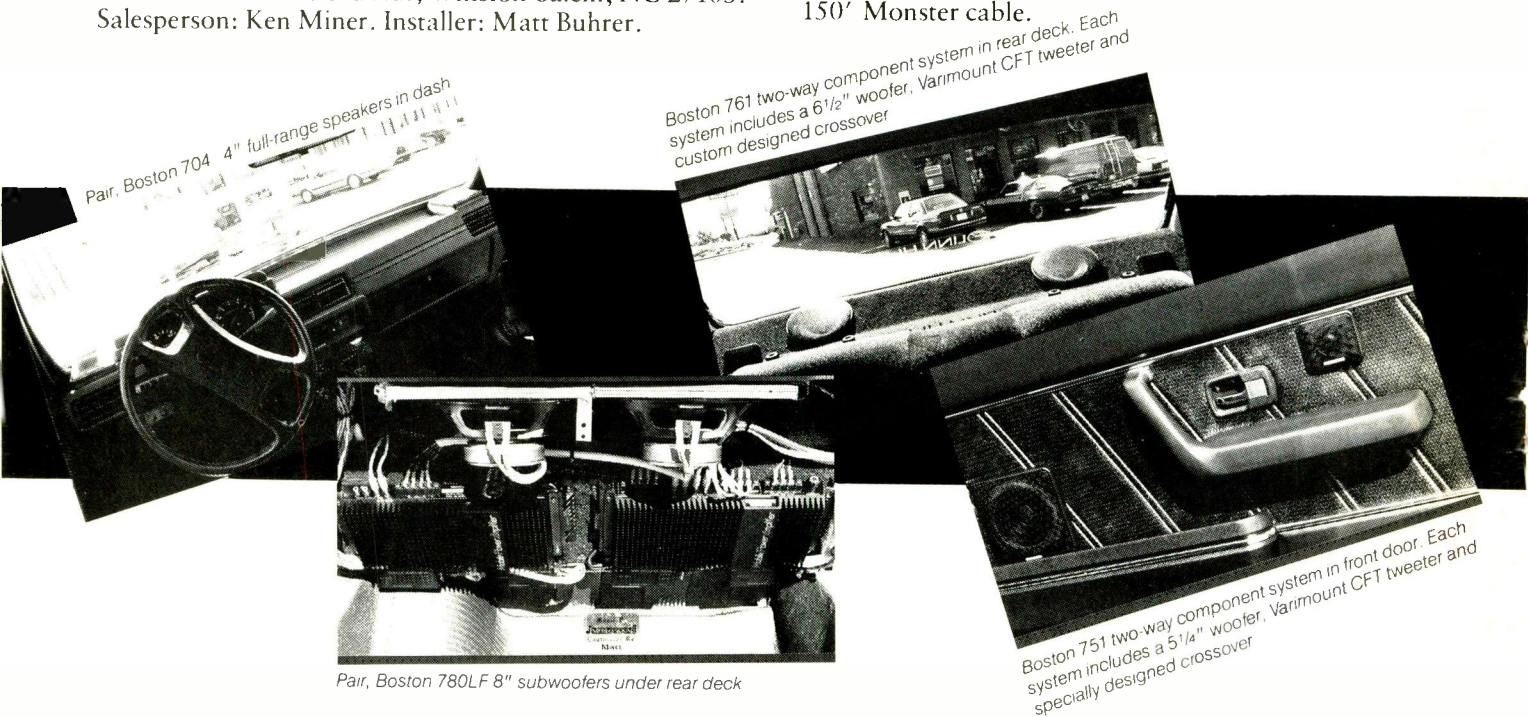
Installation of the Month Contest

The May Winner: Bart Near, Pfafftown, NC

Bart Near of Pfafftown, NC sent us a description of his system, installed in his 1984 Audi 4000S, and photos that clearly show excellent usage of Boston speakers' flexibility of placement, a well-planned system design and quality of installation.

Mr. Near's Boston Acoustics dealer: Stereo Sound, 1608-A South Stratford Rd., Winston-Salem, NC 27103. Salesperson: Ken Miner. Installer: Matt Buhner.

Mr. Near's Boston Acoustics and Nakamichi system: TD500 cassette deck in factory location in dash, EC200 crossover in storage space left of steering wheel. PA100 power amp (driving the 704s), and DB50 dual amp balancer under dash. PA350 4-channel amp (driving the 751 and 761 systems) and PA300 2-channel amp (driving the 780LF subwoofers) mounted in trunk. 150' Monster cable.



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1. All speakers used must be Boston Acoustics (of course).
2. Give us your name, address, telephone number; year, make and model of your car; dealer name and address; names of salesperson and installer; brands and models of all components in your system; any other appropriate details.
3. Your photography is important. Photographs must be high quality black and white prints, minimum size 3" x 5". For the best results they should be well illuminated. All materials become the property of Boston Acoustics. No polaroids, negatives, color prints or slides accepted. Submit as many photos as you wish for best representation. Include one external view of your car.
4. Entries must be postmarked by the 5th of the month for issue two months later (ex: May 5th for month of July). Entries will be judged on appropriate use of components, quality and neatness of installation, clarity of photographs. Last entries due October 5, 1987. Send your completed form along with photographs to: Installation Contest, Boston Acoustics, Inc., 247 Lynnfield Street, Peabody, MA 01960. For a list of winners write to Boston Acoustics.
5. Grand prize winner will be chosen at random from all entries and announced in the December, 1987 *Audio Magazine*. All decisions will be made by Boston Acoustics and will be final.
6. The contest is open to all residents of the U.S.A. and Canada except employees of Boston Acoustics and CBS Inc. and their families. Void where prohibited by law.
7. Value of grand prize (cruise) is \$6,000. Taxes are the responsibility of the winner. There will be no prize substitutions.

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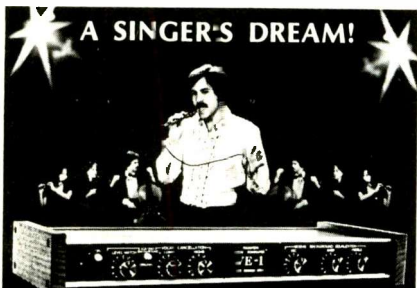
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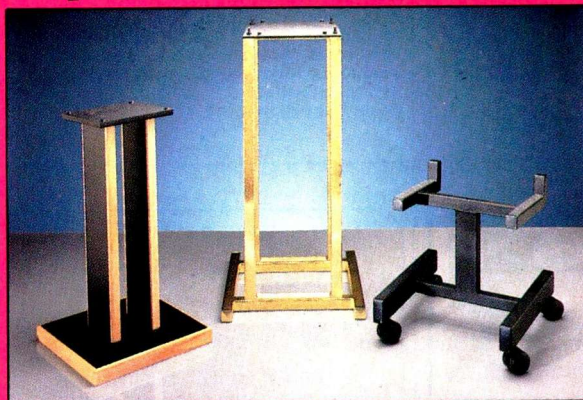
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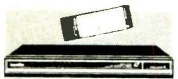
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"If you knew Peggy Sue,
Then you'd know
why I feel blue.
About Peggy,
Bout my Peggy Sue;
Oh, well, I love you, gal,
Yes, I love you, Peggy Sue:
I love you, Peggy Sue,
With a love so rare and true,
Oh, Peggy, Mr Peggy Sue;
Oh, well, I love you, gal,
Yes, I want you, Peggy Sue."

PEGGY SUE
Buddy Holly

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