

Audio

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DIGITAL BONUS
COMPACT DISCS REVIEWED

ANNUAL CAR STEREO DIRECTORY

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on Over

1100

Car Radios, Amps,
Speakers and
Equalizers

TESTED:

**GRACE F9E PHONO
CARTRIDGE**

Please Listen To The Ear

**BOS
A-
Ext**

**ISTICS
ER
/ Bargain**



NO NOISE IS GOOD NOISE.



3 Heads (Ferrite Play, Sendust Rec), 3 Motors, Direct Drive Capstan Motor, Dual Capstan, dbx, Dolby B & C NR, dbx Disc Position, Manual & Reference Bias/Level/EO Calibration, Digital Real Time Tape Counter, 30-dot FL Bar Graph Meter, Monitor Sync, Auto Tape Select, Block Repeat (Memory Repeat), Auto Locator, Memory Stop/Play, Computomatic Program System, Power Assisted Eject Door, Pitch Control, Auto Spacer, Resonance Free Diecast Chassis, Remote Control.

Teac hates noise. So we've quietly gone about our business of stamping it out.

Our new Z-6000 cassette deck has not one noise reduction circuit, but four. Both Dolby* B and Dolby C NR, plus the added benefits of dbx** and dbx disc. Features usually found only on professional equipment, now standard with Teac. So your Z-6000 will never meet a tape it doesn't like.

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OR IS IT
MEMOREX**



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JULY 1983

VOL. 67, NO. 7

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J&R MUSIC WORLD

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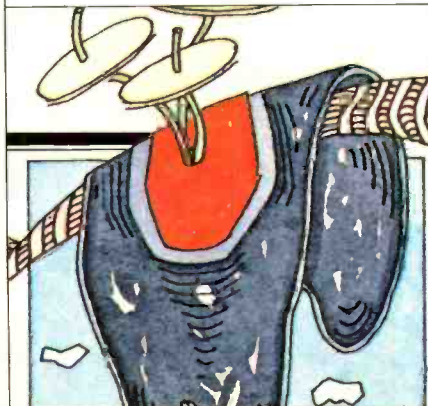
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The Cover Equipment: Left column, Jensen J2041 speaker, EQA5000 graphic equalizer and RE530 radio; Alpine 3502 power amp. Right column, Alpine 6292 speaker and 3015 computer EQ; Nakamichi TD1200 cassette deck; B & W 501 speaker; Nakamichi PA300 power amp. Bottom front, Nakamichi SP400 speaker.

The Cover Photographer: Robert Lewis.

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Only for those who demand the best. Those who want sound that's pure and distinctive... who hear subtleties others miss. For those discriminating listeners, the R-851 is well worth the quest.

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Switch on the R-851, switch from one function to another. Try Phono. Tape 1. Tape 2. Auxiliary. Back to Phono.

Absolute silence (of course, you'll get sound on AM/FM). The silence is the mark of a great receiver. And great engineering.

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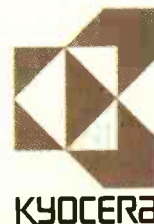
Sound that takes you closer to the source.

We've turned on the R-851 for some very experienced—even jaded—audio ears, and all we can say is it stops 'em every time. The sound is different. The sense of *being there* is almost overpowering. All this comes from 85 watts per channel of power* (with dynamic power far above this figure) and some of the most sophisticated circuitry in the business. Above all, it uses MOS FET's, the new breed of output transistors, in the amplifier section. They can handle the transients, the power surges, the power requirements of present-day sound (and tomorrow's digital sound) better than bipolar transistors ever could—and give you a sonic purity like no other (many claim MOS FET's have picked up the warm, rich sound of the great tube amps and gone a step beyond!).

Fine tuned for every audio need.

From front end to output jacks, the R-851 offers every feature an audio enthusiast might want. The most commonly used controls are right up front—the more esoteric ones are placed behind a neat flip-down front panel. There's microprocessor-controlled quartz-locked tuning with 14 station programmable memory (7 AM & 7 FM); automatic station seek; 3-band parametric-style equalizer; fluorescent display panel; and two-way tape monitoring and dubbing.

If you need some help in finding that one Kyocera dealer in twenty, contact: Kyocera International, Inc., 7 Powder Horn Drive, Warren, NJ 07060 (201) 560-0060.



*85 watts RMS per channel, both channels driven, at 8 Ohms with no more than 0.015% THD from 20-20,000 Hz.

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No hangover!

Hangover—a rather loose term to describe the stored energy resonance in a loudspeaker, the principal cause of coloration that immediately tells you you're listening to a loudspeaker.

Take it away and there's a new world—the loudspeakers have nothing more to say—instead there's just the orchestra and the magic of the music.

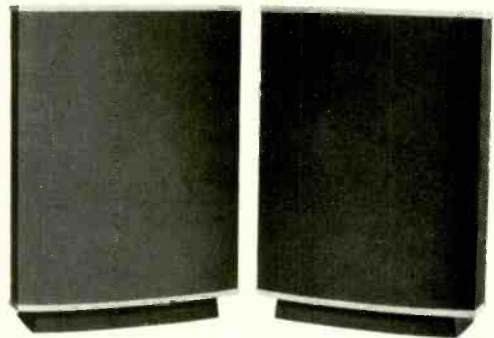
If music is an important part of your life, then a pair of ESL-63 loudspeakers could be the best investment you've ever made.



Perhaps even something to celebrate about.

For further details and the name and address of your nearest QUAD ESL-63 retailer, write: QUAD, 425 Sherman Avenue, Palo Alto, CA 94306.

In Canada: May Audio Marketing Ltee, Ltd., Longueuil, Quebec J4G 1P8



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for the closest approach
to the original sound

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Heybrook Turntable

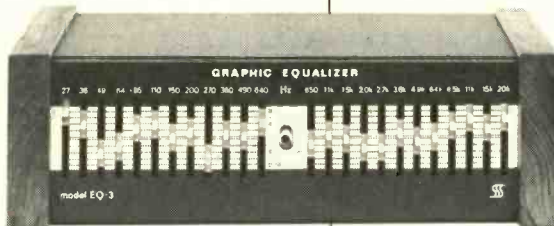
Made in Britain by Mecom Ltd. and available in the U.S. from D'Ascanio Audio, the Heybrook TT2 is belt driven, with platter and arm board resting on a T-shaped subchassis suspended by three coil

springs beneath the top plate for isolation and a low suspension frequency. The top plate itself is laminated and about 3 inches thick, with no large air space beneath it to act as a resonator. The two-speed table is rated at less than 0.1% DIN peak-weighted wow and flutter, less than 0.1% speed drift (peak to peak) and better than -73 dB rumble (DIN B). Prices: Walnut, \$500.00; black, \$525.00.

For literature, circle No. 100

Symmetric Sound Equalizer

The layout fools you: The EQ-3 does not have 12 EQ bands per channel, but 24 bands, with both channels ganged. Alternate bands are in independent circuits, to prevent interaction. Distortion is rated under 0.02%, and S/N at least 88 dB at 2-V rated output. Prices: Kit, \$110.00 (mono), \$200.00 (stereo); assembled, \$175.00 (mono), \$325.00 (stereo). For literature, circle No. 103



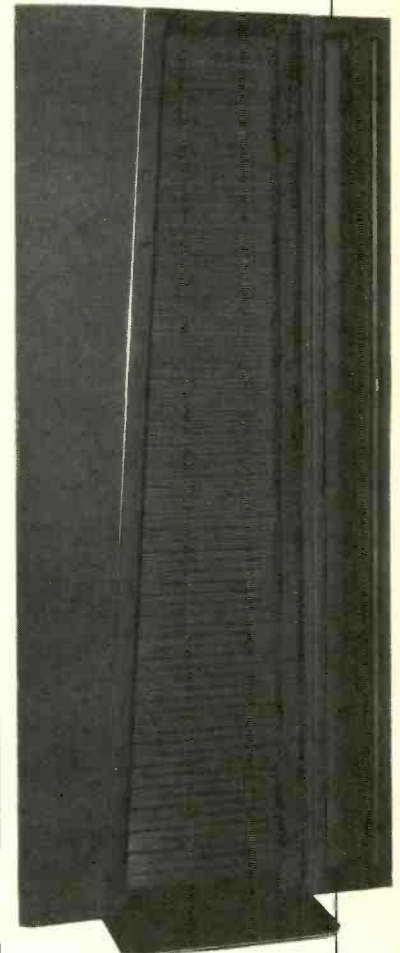
Stylast Stylus Treatment

Based on the same principles as the LAST Record Preservative, Stylast is designed to lower stylus friction and increase the life of the cantilever suspension blocks. Price: \$19.95.

For literature, circle No. 101

Apogee Speaker System

From Apogee Acoustics, a new U.S. firm, comes this three-way, full-range ribbon speaker. Standing 80 inches tall, 35 inches wide and 4 inches deep, it has a trapezoidal woofer ribbon averaging 12 inches wide, a 2-inch-wide midrange ribbon, and a half-inch tweeter ribbon. This dipole is designed to be placed three to four feet in front of a wall. To our educated ears, it sounded impressive; look for a test report in future months. Price: \$6,100.00 per pair. For literature, circle No. 102



JVC Mini Video System

If this camera outfit looks a trifle lumpy, it's because it includes the VCR. The GZ-3SU camera from JVC

weighs only 2¾ pounds. When mounted on the bracket with JVC's similarly sized Model HR-C3U VHS-C recorder, it still weighs only 10½ pounds, putting an entire home video outfit on the user's shoulder. The camera has 270-line resolution, 45 dB video S/N, 30-lux sensitivity, and a 6:1, f/1.2 power-zoom macro lens. Prices: Camera, \$895.00; shoulder frame, \$150.00; VCR, \$850.00. For literature, circle No. 104



Our stereos have played so well at home, we've decided to take them on the road.



When we started Sherwood 30 years ago our philosophy was simple: design the finest possible audio equipment, then lower its price. And although a car careening down a pot-holed highway has little in common with a well-behaved listening room, the lessons learned designing top-rated home equipment helped us overcome the problems of music on the road.

Our top-of-the-line, auto reverse CRD-300 is a case in point. To overcome road noise, it delivers 12 watts per channel from 40 Hz to 20 kHz with no more than 0.5% THD or IMD into 4 ohms. Its built-in pre-amp outputs and fader allow additional amplification. Separate bass and treble controls tailor the sound to your requirements while completely shielded input and outputs keep out interference.

The auto-loading cassette deck locks the tape against our Super Hi-B Permalloy head. With a capstan for each tape direction and a four gap head, alignment is exact. Frequency response is ± 3 dB from 30 Hz to 17 kHz, wow-and-flutter is better than .12% and S/N is 65 dB.

The FM section is, of course, Quartz Synthesized with digital read-out and 6 AM and 6 FM pre-sets. Unexpected is its MOS FET front end; Local/Distant circuitry; pilot cancelling PLL MPX demodulator; impulse noise suppression; ANRC; and multipath stabilizing circuitry.

We've taken our act on the road. And in the Sherwood tradition, we've made sure you can afford the price of admission.



17107 Kingsview Ave., Carson, CA 90746 In Canada: The Pringle Group; Don Mills, Ont.



On the occasion of its 25th anniversary,
The National Academy of Recording Arts and Sciences
presents the Official Grammy Awards Archive Collection

Now—the most acclaimed performances by the greatest artists of the past 25 years —in one collection for the first time

*Frank Sinatra ... Barbra Streisand ... The Beatles ... Elvis Presley ...
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Willie Nelson ... Carole King ... and more. Together in the first comprehensive collection
of original Grammy Award recordings. Including out-of-issue pressings and hard-to-find rarities.*



*"I applaud
this collection!
Because these are
the great perfor-
mances of the best
popular music
of our time—and
you can't get any better than that.
The Grammy Award recordings will
go on and on, as long as people
enjoy melody and rhythm and style.
That's why I said 'Count me in.'
And I hope you love every
minute of it."*

Frank Sinatra

The Grammy Award is the highest honor in the recording field. It is presented each year to the most distinguished individuals in the music world by The National Academy of Recording Arts and Sciences, the professional organization dedicated to fostering the highest standards of artistic achievement in the field of recording.

This year marks the 25th anniversary of the Grammy Awards. And, on this important occasion, The National Academy of Recording Arts and Sciences will issue a special silver anniversary record collection—the *first* collection it has ever authorized.

This will be the Official Grammy Awards Archive Collection of The Greatest Recordings of Our Time. Assembled with the cooperation of every major record company, this collection will represent the *best* of the *best*. The greatest performances of the greatest music of our time—selected out of all those ever nominated for a Grammy Award, with the assistance of a special committee established by the Academy.

These superb recordings have now been brought together for the first

time in one complete record collection, to enjoy for years to come.

Twenty-five years of great music
All of the favorites of the past quarter-century are included in the collection. For example:

Frank Sinatra with his recording of the nostalgic ballad, *My Way*. Elvis Presley and *Are You Lonesome Tonight*. Barbra Streisand with *People*. Barry Manilow with *Mandy*. Peggy Lee's classic, *Fever*. Willie Nelson's award-winning *Georgia On My Mind*. Diana Ross' interpretation of *Touch Me in the Morning*. Ray Charles and *I Can't Stop Loving You*. Anne Murray with *Snowbird*. And Judy Garland at Carnegie Hall with *Over the Rainbow*.

And there are famous groups as well. The Beatles—Peter, Paul and Mary—the Fifth Dimension—the Beach Boys—Chicago—the Bee Gees—Paul McCartney and Wings. And great instrumentalists such as Herb Alpert with *A Taste of Honey*, Chuck Mangione with *Feels So Good*, Mason Williams doing *Classical Gas*, and Michel Legrand's beautiful *I Will Wait For You*.

Rare and out-of-issue pressings

Some of the original recordings which

The Greatest Recordings of Our

are included in this outstanding collection are now out of issue—and others are very difficult to come by. Among these rare recordings are: Nat 'King' Cole crooning *Ramblin' Rose*. The Kingston Trio doing *Tom Dooley*. George Harrison and *My Sweet Lord*. Dionne Warwick singing *Do You Know the Way to San Jose?* And Ramsey Lewis with *The In Crowd*.

In addition, there are memorable recordings by composers performing their own songs: Carole King with *You've Got A Friend*, Paul Williams' interpretation of *We've Only Just Begun*, Johnny Mercer singing *I Wanna Be Around*, and Harry Chapin's classic *Cat's in the Cradle*.

On superior proof-quality records
To produce the records for this 25th anniversary collection, The National Academy of Recording Arts and Sciences has appointed The Franklin

Mint Record Society, one of America's leading producers of high-quality records.

These records will be pressed in a dust-free, atmosphere-controlled "clean room," where standards of quality control are stricter than in other facilities. A special anti-static vinyl compound will be used in the production of the records, which resists the accumulation of dust in the sensitive record grooves. This exclusive compound, together with the careful pressing technique, creates a record of exceptional fidelity that is heavier and more durable than ordinary records. A record of true *proof quality*. (The collection is also available on high-quality tape cassettes.)

Attractive library albums provided

To protect the records or tapes, a set of custom-designed library albums will be provided as part of the

collection. Each album will hold four records (or cassettes), and each will be accompanied by specially written commentaries describing the Grammy Award recordings contained in each album. The commentaries will provide in-depth information and little-known sidelights on the artists and their music, and give you an insider's view of some actual recording sessions.

The albums will be illustrated with photographs of performers, composers, instrumentalists and band leaders. Many have never been published before.

Subscribe by July 31st

The Greatest Recordings of Our Time will not be sold in any record or music stores. It is available *only* by subscription and *only* from The Franklin Mint Record Society.

There will be 100 proof-quality records in the collection, and the issue price for each proof-quality record is \$10.75, with cassettes priced at \$1 more.

To acquire this historic 25th anniversary Grammy Award collection, please mail your application to The Franklin Mint Record Society, Franklin Center, PA 19091, by July 31, 1983.



Subscription Application

The Greatest Recordings of Our Time

Please mail by July 31, 1983

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9th ANNUAL CAR STEREO DIRECTORY



Photograph: Robert Lewis

Car stereo has become big business (bigger than home component sales, in fact), which accounts for the number and variety of brands and products in this, our Ninth Annual Car Stereo Directory. As usual, data have been supplied (or not supplied) by the manufacturers.

Also as usual, we've updated our categories to reflect new trends. In all three product areas, we now show which manufacturers offer application guides—lists of which car models can accept which pieces of their sound gear. In some cases, these guides are available to consumers; in others, they must be consulted at a dealer's showroom. In radio/tape units, we've switched from microvolts to dBf for FM sensitivity and added categories for automatic local/distance controls and number of tone controls. We no longer list fast tape wind, as virtually all players have it; this is probably the last year we'll ask whether a deck plays cassettes or 8-track tape. In speakers, we now list the critical dimension of mounting depth. And since more and more amplifiers and equalizers now have preamp-level inputs, we've added a column for that, as well as for front/rear faders.

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Separate Controls for Each Stereo Channel?	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts into 4 Ohms, per IHF A-202	TID at Rated Output, % per IHF A-202	Input Levels: Preamp (P), Speaker (S), Selectable (Sel.)	Fader Control?	Application Guide Available?	Dimensions, inches	Notes
ADS	P100	320.00	A/E	1	No	+3	90	50	0.08	Sel.	No	No	12¼ x 6¼ x 2	Electronic protection, remote on. Electronic protection. As above; bridgeable.
	P80	259.00	A				90	40	0.1	Sel.	No	No	11¼ x 6¼ x 2	
	P120	329.00	A				90	60	0.1	Sel.	No	No	11¼ x 6¼ x 2	
ALPHASONIK (Continued)	A220	125.00	A	No			85	20	0.5	Sel.		No	2⅞ x 5½ x 6⅜	Input sensitivity, 100 to 500 mV. Input sensitivity, 200 to 500 mV.
	A240	175.00	A	No			90	40	0.5	Sel.		No	2⅞ x 7⅞ x 6⅜	

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AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Separate Controls for Each Stereo Channel?	Boost Cut Range, ± dB	S/N Ratio, dB	Watts into 4 Ohms, per IHF A-202	THD at Rated Output, % per IHF A-202	Input Levels: Preamp (P), Speaker (S), Selectable (Sel.)	Fader Control?	Application Guide Available?	Dimensions, Inches	Notes
ALPHASONIK (Continued)	A501	250.00	A	No		85	50	0.1	Sel.		No	2 1/8 x 9 1/2 x 6 3/8	Input sensitivity, 100 to 500 mV; bridgeable.	
	A265	350.00	A	No		85	65	0.01	Sel.		No	2 1/8 x 10 1/4 x 6 3/8	As above; Class A.	
	AS2001	145.00	A/E	1	No	+ 12	85	60†	0.25	S	No	5 1/4 x 2 1/4 x 6 1/2	†Mono; adjustable subwoofer crossover inc. (30 to 150 Hz).	
	PEQ-7	100.00	P/E	7	No	12	80		0.02	Sel.	Yes†	1 1/8 x 6 x 4 1/4	†Dual amp fader.	
	AEQ-720	150.00	A/E	7	No	12	75	20	1.0	Sel.	Yes	1 1/8 x 6 1/8 x 4 3/4	Preamp out, dual headphone jacks.	
	EX-2†	125.00	P	No	9	90		0.01	P		No	1 1/8 x 5 3/4 x 4	†Active crossover.	
	PA-1	130.00	P/E	3	No	15	70		P		No	1 1/2 x 7 x 4	Input sensitivity, 50 mV to 2.5 V.	
ALPINE	3000	219.95	A/E	5		12	75	18	8	P/S	Yes	Yes	7 1/8 x 1 1/8 x 5 3/8	Computerized graphic EQ.
	3006	69.95	A				75	18	8	P/S	Yes	Yes	4 x 1 1/8 x 6	
	3011	149.95	P/E	5		12	75		8	P/S	Yes	Yes	5 7/8 x 1 1/8 x 3 1/8	
	3015	399.95	P/E	7		12	85		8	P/S	Yes	Yes	6 1/4 x 2 x 5 1/2	
	3023	149.95	A/E	7		12	75	18	8	P/S	Yes	Yes	5 7/8 x 1 1/8 x 5 7/8	
	3214	109.95	A/E	7		12	75	18	8	P	Yes	Yes	5 7/8 x 1 1/8 x 5 7/8	
	3316	199.95	P/E	7		12	100		8	P	Yes	Yes	6 1/4 x 1 x 4 1/4	
	3502	349.95	A				100	50	0.04	P	Yes	Yes	7 1/8 x 3 1/2 x 9 3/4	
	3506	199.95	A				97	20	0.04	P	Yes	Yes	6 1/4 x 2 x 7 1/8	
	3508	249.95	A				97	30	0.04	P	Yes	Yes	6 1/4 x 2 3/4 x 7 1/8	
	3512	249.95	A				100	65	8	P	Yes	Yes	7 1/8 x 3 x 7 1/8	
	3516	59.95	A				75	18	8	P	Yes	Yes	6 1/4 x 1 1/8 x 2 3/4	
	3518	159.95	A				100	40	8	P	Yes	Yes	7 1/8 x 3 x 5 7/8	
	3650†	129.95	A				100		8	P	Yes	Yes	6 1/4 x 1 1/8 x 4 3/4	†Active crossover.
ARA/MOTOROLA	PA100	99.95	A			75	15	1.0	Sel.		No	6 x 5 7/8 x 1 1/8	Sel. 2/4 channel preamp.	
	PA200		P/A			75	15	1.0	Sel.		No	5 3/8 x 5 3/8 x 1 1/8		
	PEQ100	82.50	P/E	5	No	12	70		Sel.	Yes	No	4 1/4 x 6 3/4 x 1 1/8	Three-band ambience control inc.	
	PEQ200	132.50	P/E	7	No	12	70		Sel.	Yes	No	4 1/4 x 6 3/4 x 1 1/8		
AUDIOBAHN	AB 100 EQ	139.95	P/E	7	No	12	70	0.03	Sel.	Yes	No	4 1/2 x 1 1/2 x 3		
	AB 100 WPB	149.95	A	No	No		80	0.3	Sel.	No	No	7 1/2 x 2 x 4 1/2		
AUDIOMOBILE	SA450	269.95	A			110	20	0.05	Sel.		Yes	Yes	4 3/4 x 6 1/4 x 2	Input sensitivity adj.
	SA1000	399.95	A			100	50	0.2	Sel.		Yes	Yes	7 3/4 x 7 3/8 x 4 1/4	
	SA2000	599.95	A			100	100	0.2	Sel.		Yes	Yes	7 3/4 x 7 3/8 x 4 1/4	
	SP300	249.95	P/E	3	No	15	75	0.05	Sel.	Yes	Yes	4 1/2 x 1 5/8 x 4		
	AR-2	1399.95	P/A/E								Yes	Yes	10 x 23 x 4 1/4	
	AR-3	1649.95	P/A/E								Yes	Yes	10 x 23 x 4 1/4	
AR-4	1899.95	P/A/E								Yes	Yes	10 x 23 x 4 1/4	Inc. SP300, SA1000, and two SA450s. Inc. SP300, two SA1000s, and SA450. Inc. SP300, SA1000, SA2000, and SA450.	
AUDIOVOX/HI-COMP	HCE-707	109.95	A/E	7	No	12	80	12	1.0	Sel.	Yes	No	6 1/2 x 2 x 6 1/2	Echo.
	HCE-710	149.95	A/E	5	Yes	12	80	30	1.0	Sel.	Yes	No	7 x 1 1/8 x 7	
	AMP-800E	119.95	A/E	7	No	12	75	20	10.0	S	Yes	No	5 1/2 x 1 1/4 x 6 1/2	
	AMP-775	89.95	A/E	7	No	12	75	20	10.0	S	Yes	No	4 7/8 x 1 x 5 1/2	
	AMP-555	54.95	A/E	5	No	12	75	18	10	S	Yes	No	4 x 1 x 5 1/2	
	AMP-700	154.95	A/E	7	No	12	75	30	1.0	S	Yes	No	7 x 1 1/8 x 7	
AUM AUDIO	AA-9PC	179.95	P/E	9	No	12	75		0.03	Sel.	Yes	Yes	1 1/4 x 5 3/4 x 4	†Electronic crossover.
	AA-60C	259.95	A	No	No		85	60	0.05	Sel.	No	Yes	3 x 7 x 8	
	AA-100C	359.95	A	No	No		100	100	0.05	P	No	Yes	3 x 7 x 10	
	AA-200C	499.95	A	No	No		100	200	0.05	P	No	Yes	5 x 7 x 10	
	A-700A	139.95	P/A/E	7	No	12	75	60	0.05	Sel.	Yes	Yes	2 x 6 x 5 3/4	
	A-760LA	149.95	P/A/E	7	No	12	75	60	0.05	Sel.	Yes	Yes	1 1/2 x 6 1/2 x 6 1/4	
	A-1000A	159.95	P/A/E	10	No	12	75	60	0.05	Sel.	Yes	Yes	2 x 6 x 5 3/4	
	A-100A	159.95	A	No	No		75	100	0.05	Sel.	No	Yes	1 1/8 x 5 1/2 x 9 1/4	
	A-7PA	119.95	P/E	7	No	12	75		0.05	Sel.	Yes	Yes	2 x 6 x 5 3/4	
	A-3CO†	139.95	P/E	7	No		75		0.01	P	No	Yes	2 x 6 x 5 3/4	
AUTOTEK	EQL-200	79.95	A/E	5		12	60	20	10	S	Yes	No	5 1/2 x 7 1/8 x 2	Output protection. As above; high filter.
	EQL-300	99.95	A/E	5		12	60	20	10	S	Yes	No	5 1/2 x 7 1/8 x 2	
	EQL-400	119.95	A/E	7		12	60	20	10	S	Yes	No	5 1/2 x 7 1/8 x 2	
	EQA-140	139.95	A/E	7		12	70	20	8	Sel.	Yes	No	6 x 6 x 1 1/4	
	A-150	79.95	A				70	20	8	Sel.	No	No	6 x 4 3/8 x 1	
BGW SYSTEMS	602B	450.00	A			80	75	0.05	Sel.		No	3 1/4 x 5 1/2 x 5 3/4	Bridgeable; RCA inputs and strip outputs. As above.	
	600B	340.00	A			80	50	0.05	Sel.		No	3 3/4 x 7 7/8 x 5 1/2		
	302B	250.00	P/E	3	No	12	72		0.05	Sel.	No	1 1/8 x 4 3/8 x 3 1/2		
	304B†						72		0.05		No	1 1/8 x 4 3/8 x 3 1/2		†Active crossover.
BON SONIC	207EQB	49.95	A/E	7	Yes					Yes	Yes	5 x 1 x 7		
BOSE	1401-II	496.00†	A/E	††	No		70	25	0.09	Sel.		No	10 x 2 1/2 x 5	†System Inc. four speakers (see separate listing); ††fixed EQ.
CONCORD ELECTRONICS	HPA-25	120.95	A	No	No	80	12	0.8	Sel.	No	No	1 1/8 x 1 1/4 x 3 3/8	Line amps, one per channel.	
	HPA-51	199.95	A	No	No	86	50	0.5	Sel.	No	No	8 3/4 x 6 7/8 x 2 3/8		
	HPA-71	279.95	A	No	No	90	70	0.5	Sel.	No	No	8 1/2 x 9 x 8		
CRAIG	R501	49.95	P/A				15			Sel.	No	No		
	R502		P/A				25			Sel.	No	No		
	V506	49.95	A/E	5	No	12	65	15		S	Yes	No	1 1/4 x 5 1/2 x 3 3/8	
	V507A	79.95	A/E	7	No	12	80	15		S	Yes	No	1 1/4 x 5 3/4 x 5 7/8	

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Equalizer (E)	Number of EQ Bands	Separate Controls for Each Stereo Channel?	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts into 4 Ohms, per IEC A-202	THD at Rated Output, % per IEC A-202	Input Levels: Preamp (P), Speaker (S), Selectable (Sel.)	Fader Control?	Application Guide Available?	Dimensions, Inches	Notes
FULTRON	0733	149.95	A/E	7	No	12	63	40	0.05	Sel.	Yes	Yes	7 x 1 1/8 x 6 1/8	With Dynamic Noise Reduction.
	0732	119.95	A/E	7	No	12	64	22	0.05	Sel.	Yes	Yes	6 1/4 x 1 1/8 x 5 1/8	As above; echo.
	0731	69.95	A/E	5	No	12	64	16	0.05	S	Yes	Yes	3 3/8 x 1 1/4 x 5 3/8	
	0725	49.95	A/E	2	No	12	66	16	0.05	S	No	Yes	4 1/2 x 1 3/8 x 4 3/8	
	0735	179.95	A/E	7	No	12	65	40	0.05	Sel.	Yes	Yes	7 x 1 1/8 x 6 1/8	With Dynamic Noise Reduction.
JENSEN	A35	74.95	A	7	No	+18, -6	80	15	D.3	Sel.	No	No	3 1/4 x 4 1/2 x 1 3/4	Electronic protection. As above; four speaker outputs, panel or under dash mounting.
	EQA5000	139.95	A/E	7	No		80	15	D.3	Sel.	Yes	No	6 3/8 x 1 3/4 x 4 1/2	
JET SOUND ELECTRONICS	JS 41	59.95	A/E	3	No	12	70	15	1.0	S	No	Yes	4 1/2 x 1 3/8 x 5 3/4	
	JS 51	79.95	A/E	5	No	12	70	20	1.0	Sel.	No	Yes	4 1/2 x 1 3/8 x 5 3/4	
	JS 61	99.95	A/E	5	No	12	80	30	1.0	Sel.	Yes	Yes	4 1/2 x 1 3/8 x 5 3/4	
	JS 71	149.95	A/E	8	No	12	80	40	0.1	Sel.	Yes	Yes	7 1/4 x 1 3/8 x 6 3/4	
	JS 81	99.95	A	No	No	12	80	50	0.1	Sel.	No	Yes	7 1/4 x 1 3/8 x 6 3/4	
	JS 121	199.95	A/E	12	No	12	80	50	0.1	Sel.	Yes	Yes	7 1/4 x 1 3/8 x 6 3/4	
JVC	KS-E5	79.95	E	7	No	12	70			Sel.	No	Yes	4 x 1 1/4 x 4	Time delay inc.
	KS-E7	179.95	E	7	No	12	70			Sel.	Yes	Yes	6 x 1 1/4 x 6	
	KS-EA50	149.95	A/E	7	No	12	70	12	0.8	Sel.	Yes	Yes	6 x 1 1/4 x 6	
	KS-A50	79.95	A	No	No	12	70	12	0.8	Sel.	No	Yes	6 x 1 x 5 3/8	
	KS-A100	149.95	A	No	No	12	70	22	0.8	Sel.	No	Yes	6 x 2 x 7 1/8	
KENWOOD	KAC-901	369.00	A				92	100		P		Yes	11 5/8 x 2 3/4 x 8 3/8	Input sensitivity, 100 500 mV. As above.
	KAC-8200	299.00	A				100	75		P		Yes	7 3/4 x 2 3/8 x 7 1/4	
	KAC-801	249.00	A				80	50		P		Yes	11 1/2 x 2 3/4 x 6 7/8	
	KAC-7200	199.00	A				98	35		P		Yes	5 1/4 x 2 1/8 x 6	
	KAC-887	149.00	A				92	15 x 4	0.05	P		Yes	5 3/8 x 2 1/8 x 6 1/4	
	KAC-501	85.00	A				85	15	1.0	Sel.		Yes	5 7/8 x 1 x 5 3/8	
	KGC-7300	199.00	A/E	7		12	88	15 x 2, 5 x 2	1.0	P	Yes	Yes	5 7/8 x 2 x 5 3/8	
	KGC-7400	199.00	P/E	9		12	93		0.02	P	Yes	Yes	5 7/8 x 2 x 5	
KGC-447	149.00	P/E	5		12	70		0.02	P	Yes	Yes	4 1/2 x 1 3/4 x 3 1/2		
KEC-1000†	219.00	P	3			100		0.006	P	Yes	Yes	5 3/4 x 2 x 3 1/2	†Electronic crossover.	
KRACO	KE-7	169.95	A/E	7	Yes	12		20	1.0	S	Yes	Yes	7 1/8 x 7 7/8 x 2 5/8	
	KE-6	89.95	A/E	5	Yes	12		15	1.0	S	Yes	Yes	6 5/8 x 6 1/8 x 1 7/8	
	KE-5	79.95	A/E	5	Yes	12		15	1.0	S	Yes	Yes	5 1/2 x 7 1/2 x 2	
	KE-4	79.95	A/E	5	Yes	12		15	1.0	S	Yes	Yes	4 x 4 1/2 x 1 1/4	
	KE-3	59.95	A/E	3	Yes	12		10	1.0	S	No	Yes	5 1/2 x 2 x 6 1/2	
	PB-131	39.95	A					15	1.0	S	No	Yes	4 1/4 x 6 x 1 1/2	
LEAR JET	6860	149.95	A/E	10	Yes	12	60	20		Sel.	Yes	No	7 x 1 3/4 x 5 3/8	
	6863	99.95	A/E	10	No	12	45	22		Sel.	Yes	No	6 1/2 x 1 1/4 x 5 1/2	
	6862	79.95	A/E	7	No	12	45	22		Sel.	Yes	No	6 x 1 1/4 x 5 1/2	
	6861	59.95	A/E	5	No	12		25		Sel.	Yes	No	4 3/4 x 1 x 5 3/4	
	6021	49.95	A	No	No			12		S	No	No	4 x 1 x 4	
LINEAR POWER	LP300	699.95	A		No		95	300	0.15	Sel.			7 1/4 x 13 1/2 x 4 1/8	Input, 200 mV to 5 V. As above. Bi-amplifier, 60 watts mono below 100 Hz, 60 watts stereo to main speakers. Input, 200 mV to 5 V. As above. Input, 80 mV to 5 V; in-dash version, Model EQ1-D.
	LP1501	429.95	A		No		95	150	0.15	Sel.			7 1/4 x 9 1/2 x 4 1/8	
	LP2601	349.95	A		No		95	120	0.15	Sel.			8 x 10 x 2 3/8	
	LP 901	279.95	A		No		95	90	0.15	Sel.			7 1/4 x 6 1/2 x 4 1/8	
	LP 601	199.95	A		No		95	60	0.15	Sel.			8 x 6 1/2 x 2 1/4	
	LP 401	149.95	A		No		95	40	0.15	Sel.			8 3/8 x 5 x 1 3/4	
EQ-1	199.95	P/E	6	No	9	105		0.006	Sel.	No	No	4 1/2 x 5 3/8 x 1 1/4		
MAJESTIC ELECTRONICS	MEB 725M	59.95	A/E	7	Yes	12	50	30	0.5	Sel.	Yes	Yes	1 x 4 5/8 x 4 1/2	Four-speaker hookup. As above. As above; spectrum analyzer.
	MEB 565	99.95	A/E	5	Yes	12	55	30		Sel.	Yes	Yes	6 3/8 x 1 3/8 x 6 1/2	
	MEB 5426	149.95	A/E	5	Yes	12	70	30	0.5	Sel.	Yes	Yes	7 x 1 1/2 x 5 1/2	
	MEB 7500ET	189.95	A/E	7	Yes	12	65	75	0.5	Sel.	Yes	Yes	7 x 1 3/4 x 7	
	MEB 9120	179.95	A/E	9	Yes	12	65	75	0.05	Sel.	Yes	Yes	7 1/2 x 1 7/8 x 7	
	MA 150HD	99.95	A		Yes		65	75		Sel.	No	No	3 1/4 x 6 x 6 1/2	
MA 300HD	299.95	A		Yes		65	150		Sel.	No	No	6 3/4 x 3 x 11 1/2		
MARANTZ	SA 250	170.00	A/E	7		12	92	15	0.8	Sel.	Yes	Yes	1 7/8 x 6 3/4 x 5 3/8	
	SA 2020	65.00	A				92	10	0.5	Sel.	Yes	Yes	2 x 2 3/4 x 6	
METRO SOUND	EQ370	194.95	A/E	7	No	12	70	50	0.8	Sel.	Yes	No	6 1/4 x 1 3/4 x 6 1/2	Inc. DNR; all units have common floating inputs. Input, 65 mV to 2.5 V.
	EQ360	159.95	A/E	7	No	12	70	50	0.8	P	Yes	No	6 1/4 x 1 3/4 x 6 1/2	
	EQ355	119.95	A/E	7	No	12	70	36	0.8	P	Yes	No	6 1/4 x 1 3/4 x 6 1/2	
	EQ350	104.95	A/E	10	No	12	70	36	0.9	Sel.	Yes	No	6 1/4 x 1 x 5 1/4	
	EQ322	92.95	A/E	10	No	12	80	36	1.0	P	Yes	No	5 7/8 x 1 7/8 x 5 3/4	
	EQ312	82.95	A/E	7	No	12	80	30	1.0	P	Yes	No	5 7/8 x 1 3/4 x 5 3/4	
	EQ302	69.95	A/E	7	No	12	80	30	1.0	P	Yes	No	5 7/8 x 1 1/4 x 5 3/4	
	EQ340	98.95	A/E	7	No	12	80	30	1.0	P	Yes	No	5 7/8 x 2 x 5 3/8	
MGT	4030	84.95	P	3	Yes		70		0.05	Sel.	No	No	4 x 1 3/4 x 4	
	208	119.95	A/E	7	No	12		60	2	S	No	No	6 x 1 x 5 3/4	
	207	139.95	A/E	7	No	12		60	2	Sel.	No	No	5 3/4 x 1 1/4 x 4	
	206	99.95	A/E	5	No	12		60	2	S	No	No	5 7/8 x 1 1/8 x 3 7/8	
	202	79.95	A/E	2	No	10		40	2	S	No	No	5 3/8 x 1 1/2 x 4 1/8	
MITSUBISHI	CV-23	179.95	A/E	6	No	10	65	15	5	Sel.	Yes	No	2 x 5 3/4 x 6 1/4	
	CV-25	129.95	A		No		65	17	5	P	No	No	2 x 5 3/4 x 6 1/4	
	CV-24	49.95	A		No		60	4	5	P	No	No	2 x 5 3/4 x 3	

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Separate Controls for Each Stereo Channel?	Boost/Cut Range, ± (dB)	S/N Ratio, dB	Watts into 4 Ohms, per IHF A-202	THD at Rated Output, % per IHF A-202	Input Level: Preamp (P), Speaker (S), Selectable (Sel.)	Fader Control?	Application Guide Available?	Dimensions, inches	Notes
MONDLITHIC SOUND	EQ-4	279.00	P/E	4	No	16	80	0.01	Sel.	Opt.		1 1/2 x 4 1/4 x 3 1/2	Crossover Inc. †Electronic crossover.	
	PA-700	279.00	A				80	0.05	Sel.			2 1/4 x 6 3/4 x 8 1/2		
	PA-1100	379.00	A				80	0.05	Sel.			2 1/4 x 6 3/4 x 10		
	PA-1600	479.00	A				85	0.05	Sel.			2 1/4 x 6 3/4 x 10 1/2		
	PA-1600Q	479.00	A				85	0.05	Sel.	Yes		2 1/4 x 6 3/4 x 10 1/2		
	PA-2400	625.00	A				90	0.05	Sel.	Yes		2 1/4 x 6 3/4 x 15		
	PA-2500	650.00	A				90	0.05	Sel.	Yes		2 1/4 x 6 3/4 x 15		
EXO-2†	219.00			2			75 x 4	0.01	P			1 1/2 x 6 1/8 x 3 1/2		
NAKAMICHI	PA-300	340.00	A				115	70	0.003	P	No	No	12 5/8 x 1 1/8 x 6 3/8	
PANASONIC	CY-SG100	219.95	A/E	7	Yes		83	12.5	1	P/S	No	No	7 x 6 x 2	Ambience.
	CY-SG50	119.95	A/E	7	Yes		83	12.5	1	S	No	No	6 1/4 x 4 1/4 x 2	
	CY-SB25	79.95	A		No		85	12	1	S	No	No	5 1/2 x 4 1/4 x 1 1/2	
PARASOUND	160EQB	129.95	A/E	7		12	80	16	0.02	Sel.	Yes		7 x 1 3/8 x 6 1/4	
	600EQB	169.95	A/E	9		12	80	35	0.1	S	Yes		7 1/8 x 1 1/8 x 7 1/2	
	800A/B	169.95	A				80	80	0.8	Sel.			8 1/4 x 2 x 7 7/8	
PHILIPS AUTO AUDIO	EN600	299.95	P/E	6	No	12	80		0.05	P	Yes	No	1 3/4 x 6 3/4 x 5 7/8	Variable input sensitivity; crossover output. Fault monitor; short and thermal protection. As above; digital regulated power supply. As above.
	EN220	199.95	A				100	40	0.05	Sel.		No	2 7/8 x 5 1/8 x 7 1/4	
	EN250	349.95	A				100	100	0.05	Sel.		No	2 7/8 x 9 3/4 x 7 1/4	
	EN2100	499.95	A				100	200	0.05	Sel.		No	2 7/8 x 12 3/4 x 7 1/4	
PIONEER	GM-2	44.95	A				75	2.8	0.8	P		No	1 x 5 7/8 x 3 3/8	†Dual amp balance. Echo.
	GM-5	79.95	A				70	10	0.8	Sel.		No	1 x 5 7/8 x 6 3/8	
	GM-120	149.95	A				75	30	0.3	P		No	2 3/8 x 7 x 8 1/4	
	CD-5	129.95	P/E	7	No	12	70	70		P	Yes†	No	2 x 5 7/8 x 6 1/2	
	AD-360	149.95	A				70	45	5.0	S		No	2 1/8 x 9 x 8	
	BP-520	109.95	A/E	7	No	12	70	10	5.0	S	Yes	No	2 x 5 7/8 x 5 7/8	
	BP-720	169.95	A/E	7	No	12	70	10	5.0	S	Yes	No	2 x 5 7/8 x 5 7/8	
PROTON	P270†	79.95	P/E	7	No	12, 18	90	0.5	0.05	P	Yes	Yes	5 1/4 x 6 3/4 x 1	†Electronic crossover. Crossover inc. Bridgeable.
	P271	149.95	A				90	0.05	0.04	P	Yes	Yes	6 3/8 x 1 5/8 x 5 7/8	
	P222	129.95	A				90	0.04	0.04	Sel.	Yes	Yes	7 1/2 x 4 1/2 x 1 1/2	
	P250	269.95	A				90	0.04	0.04	Sel.	Yes	Yes	10 1/4 x 6 1/2 x 1 1/4	
PYRA-POWER	P-3120	49.95	A/E	3	No	12	70	60	0.5	S	Yes	Yes	4 3/4 x 1 1/4 x 5 1/4	Electronic protection. As above. As above.
	P-5120	69.95	A/E	5	No	12	70	60	0.5	S	Yes	Yes	4 3/4 x 1 1/4 x 5 1/4	
	P-7120	99.95	A/E	7	No	12	70	60	0.5	S	Yes	Yes	6 3/4 x 2 1/4 x 6 1/2	
ROCKFORD FOSGATE	Punch 40	200.00	A/E	2	No	†		20	0.05	Sel.	No	No	7 3/4 x 5 1/4 x 1 1/8	†Switched: +18 dB low, +12 dB high. ††Variable: ±18 dB low, ±12 dB high. Dbx NR decode inc. †††Variable: +18 dB low, +12 dB high; bridgeable, electronic crossover inc. Four 90-watt bridgeable amps, electronic crossover inc. As above; dbx NR decode inc.
	Punch 100	350.00	A/E	2	No	†		50	0.05	Sel.	No	No	7 3/4 x 7 1/2 x 1 7/8	
	Power II/250 Pre	485.00	P/A/E	2	No	†		75	0.05	Var.	No	No	7 3/4 x 9 1/4 x 2 1/8	
	Power II/Z Pre	660.00	P/A/E	5	No	††		75	0.05	Var.	No	No	7 3/4 x 9 1/4 x 2 1/8	
	ZX Pre	820.00	P/A/E	5	No	††		75	0.05	Var.	No	No	7 3/4 x 9 1/4 x 2 1/8	
	Power VI/250 Pre	740.00	P/A/E	2	No	†††		150	0.05	Var.	No	No	7 3/4 x 15 1/2 x 2 1/8	
	Power VI/Z Pre	920.00	P/A/E	5	No	††		150	0.05	Var.	No	No	7 3/4 x 15 1/2 x 2 1/8	
ZX Pre	1160.00	P/A/E	5	No	††		150	0.05	Var.	No	No	7 3/4 x 15 1/2 x 2 1/8		
ROYAL SOUND	IA400N	50.00	A/E	2	No	12	80	30	0.05	S	No	Yes	1 1/4 x 4 x 4 3/4	
	EA500	75.00	A/E	5	No	12	80	25	0.05	S	Yes	Yes	4 7/8 x 1 1/4 x 6	
	EA600	100.00	P/A/E	5	No	12	80	40	0.05	Sel.	Yes	Yes	6 3/8 x 2 3/8 x 7 1/2	
	EA700	200.00	P/A/E	7	No	12	80	60	0.05	Sel.	Yes	Yes	6 3/8 x 2 3/8 x 7 1/2	
	EA700N	100.00	A/E	7	No	12	80	35	0.05	S	Yes	Yes	4 7/8 x 1 1/4 x 6	
SANSUI	SM-100	230.00	A				80	40	0.99	Sel.		Yes	8 1/4 x 2 1/2 x 8 1/2	RCA and DIN outputs.
	SM-50	100.00	A				90	17	0.99	Sel.		Yes	3 1/2 x 1 1/8 x 6 1/2	
SANYO	PA6030	79.95	A				70	15	0.3	Sel.	No	No	6 x 3 3/8 x 1	
	PA6040	99.95	A				70	20	0.1	Sel.	No	No	7 1/8 x 6 x 2	
	PA6050	129.95	A				70	25	0.05	Sel.	No	No	7 1/2 x 8 x 2 1/4	
	PA6100	159.95	A				70	50	0.05	Sel.	No	No	7 1/2 x 7 1/2 x 3 3/4	
	PA6110	179.95	A				70	50	0.05	Sel.	Yes	No	7 1/2 x 7 1/2 x 3 3/4	
	EQZ6210	79.95	E	7	No	12	70	70	0.1	Sel.	Yes	No	6 1/2 x 4 3/4 x 2	
	EQA600	99.95	A/E	7	No	12	70	15	0.3	Sel.	Yes	No	6 x 5 3/4 x 2	
	EQA650	129.95	A/E	7	No	12	70	20	0.1	Sel.	Yes	No	5 7/8 x 6 5/8 x 2	
SHERWOOD	SCA-240	79.95	A				90	12	0.5	Sel.				Switching power supply.
	SCA-2100	199.95	A				90	50	0.5	Sel.				
SONY	XM-E7	219.95	A/E	7	Yes	12	84	14	0.5	Sel.	Yes	Yes	5 5/8 x 1 3/4 x 6	
	XM-120	349.95	A	2		6	92	60	0.1	Sel.	Yes	Yes	7 1/8 x 1 3/4 x 10 3/8	
	XM-100	259.95	A				80	30	0.8	P	Yes	Yes	8 5/8 x 2 1/4 x 5 1/4	
	XM-55	149.95	A				84	14	0.5	Sel.	Yes	Yes	5 3/8 x 1 3/8 x 6 1/2	
	XM-45	99.95	A				78	10	0.8	Sel.	Yes	Yes	5 3/8 x 1 3/8 x 5 1/4	
	XM-25	59.95	A				80	4	0.8	P	Yes	Yes	3 3/8 x 1 1/2 x 4 7/8	

AMPS/EQUALIZERS

MANUFACTURER	Model	Price, \$	Preamp (P), Amp (A), Equalizer (E)	Number of EQ Bands	Separate Controls for Each Stereo Channel?	Boost/Cut Range, ±dB	S/N Ratio, dB	Watts into 4 Ohms, per IHF A-202	THD at Rated Output, %	Input Levels: Preamp (P), Speaker (S), Selectable (Sel.)	Fader Control?	Application Guide Available?	Dimensions, inches	Notes
SPARKOMATIC	GE-1000	199.95	A/E	7		12	70	50	0.01		Yes		7 1/2 x 2 1/2 x 9 1/4	
	GE-50	69.95	A	5		12	70	22.5	10		Yes		4 3/4 x 1 3/8 x 4 3/4	
	LC 102	49.95	A/E	3		12	75	20	10		No		5 1/2 x 1 7/8 x 6 5/8	
	LC 52	29.95	A				70	20	10		Yes		4 1/8 x 1 1/4 x 4	
SPECO	EPB-100		A/E	7	No	12		100	10		Yes		5 x 5 1/4 x 1 1/4	Common or floating ground. As above.
	EPB-50		A/E	5	No	12		50	10		Yes		4 3/4 x 1 1/4 x 5 3/4	
	SPB-40		A		No	12		40	10		No		4 1/4 x 1 1/2 x 6 5/8	
TANCREDI	TXL-1000	99.95	A/E	10	Yes	12	70	30	0.5	S	Yes		1 1/4 x 6 1/2 x 5 1/8	
	TXL-700	79.95	A/E	7	Yes	12	70	30	0.5	S	Yes		1 1/4 x 6 7/8 x 5 1/8	
	TE-200	149.95	A/E	7	Yes	12	80	60	0.5	S	Yes		2 x 6 3/4 x 7 1/4	
	TE-100	99.95	A/E	7	Yes	12	80	60	0.5	S	Yes		5 1/8 x 2 x 7 7/8	
	TE-80A	89.95	A/E	7	Yes	12	70	30	0.5	S	Yes		2 1/8 x 5 5/8 x 6 1/2	
	TE-70	79.95	A/E	7	Yes	12	70	30	0.5	S	Yes		1 3/4 x 6 1/2 x 6 3/4	
	TA-100A	99.95	A		Yes		80	50	0.2	S	No		2 1/2 x 6 1/2 x 8 3/4	
YAMAHA	YPA-800	350.00	A				95	100†	1.0	Sel.	No		6 1/4 x 1 3/4 x 9 7/8	†Or 40 x 4, or 40 x 2 and 80 x 1; digital pulse-rate modulated, subsonic filter. Auto volume control, five EQ memories.
	YGE-600	200.00	E	5	No	12	95		0.02	Sel.	Yes		6 1/4 x 2 x 4 7/8	
ZAPCO	PEQ	320.00	P/E	9	Yes	18	85		0.05	P	No	No	8 x 4 x 1 1/4	Variable electronic crossover and parametric EQ inc. †Amp, 5 1/2 x 5 3/4 x 3 1/4; power supply, 7 x 3 3/8 x 2 1/2.
	PX	540.00	P/E	4	No	18	105		0.005	P	Yes	No	2 x 4 x 6 3/4	
	150H	550.00	A				110	150	0.15	P, S	No	No	Two Piece†	
	150HA 175HA	600.00 725.00	A A				110 110	150 175	0.07 0.03	P, S P, S	No No	No No	Two Piece† Two Piece†	

For Manufacturers' Addresses, see page 31

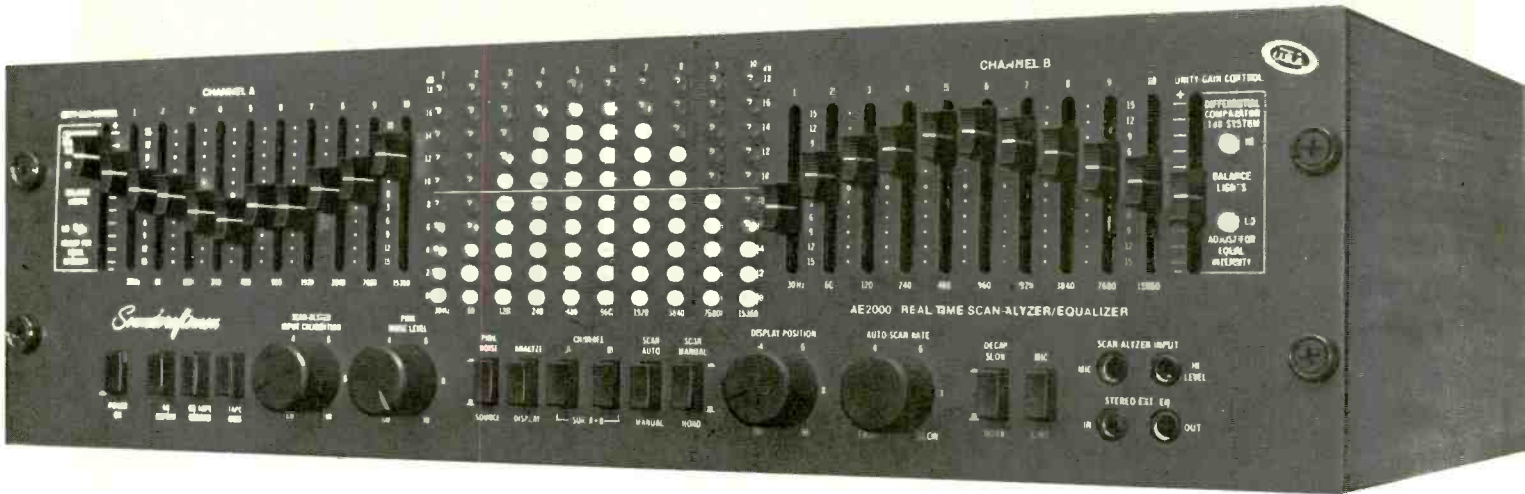
CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	FM Sensitivity, dB (For 30 dB Quieting)	Selectivity, dB	Outputs: Preamp (P), Speaker Level (S), Both (Both)	Average Watts Channel, per IHF A-202	Amplifier S/N Ratio, dB	THD at Rated Output, dB	Local Distance Control? Manual Switch (M), Automatic (A)	Total Number of Presets	Number of Tones or EQ Controls	Cassette (C), B-Track (B), Auto Reverse?	Noise Reduction Circuit? See Code	Tape EQ Switch?	In-Dash (I), Under-Dash (U), Convertible (C)	Application Guide Available?	Dimensions, inches	
ALPINE	7124	199.95	16.3	50	Both	6	60	8	A	1	C	Yes				Yes	2 x 6 1/4 x 4 1/2	
	7128	249.95	16.3	80	Both	6	55	8	M	10	2	C	Yes			Yes	2 x 7 x 5 1/4	
	7135	349.95	16.3	80	Both	6	60	8	M	10	2	C	Yes			Yes	2 x 6 1/4 x 5 1/8	
	7136	399.95	16.3	80	Both	6	65	8	M	10	2	C	Yes	B		Yes	2 x 6 1/4 x 5 1/8	
	7138	299.95	16.3	80	Both	6	65	8	M	10	2	C	Yes	B		Yes	2 x 7 x 5 1/4	
	7146	499.95	16.3	80	Both	6	65	8	M	10	2	C	Yes	B		Yes	2 x 7 1/8 x 5 1/8	
	7150	159.95	16.3	60	S	6	60	8	A	1	C	Yes				Yes	2 x 6 1/4 x 4 1/2	
	7151	199.95	16.3	80	Both	6	60	8	A	2	C	Yes				Yes	2 x 7 1/8 x 5 1/8	
	7152	269.95	16.3	80	Both	6	72	8	A	2	C	Yes	B/C			Yes	2 x 7 1/8 x 5 1/8	
	7154	349.95	16.3	80	Both	6	60	8	M	12	2	C	Yes			Yes	2 x 7 x 5 3/4	
	7155	399.95	16.3	80	Both	6	72	8	M	12	2	C	Yes	B/C		Yes	2 x 7 x 5 3/4	
	7225	249.95	16.3	60	Both	16	60	8	M	2	2	C	Yes			Yes	2 x 6 1/4 x 5 1/8	
	7337	449.95	16.3	80	P		65		M	10	2	C	No	B		Yes	2 x 6 1/4 x 5 1/8	
	7347	599.95	16.3	80	P		86		M	10	2	C	No	A/B/C		Yes	2 x 7 1/8 x 5 1/8	
	5114	149.95	16.3	80	S	6	55	8	M	2	2	C	Yes		U	Yes	2 x 6 1/4 x 5 1/2	
AMERICAN AUDIO	ET-8500AR	354.95	15	60	S	13	60	1		5	C	Yes	D	Yes	I	Yes	7 x 1 3/4 x 6	
	ET-8501AR	299.95	15	60	S	18	60	1		0	C	Yes	D	No	I	Yes	7 x 1 3/4 x 6	
	ET-8303AR	225.95	15	55	S	18	60	1		0	C	Yes	No	I	Yes	7 x 1 3/4 x 5 1/8		
	LD-7500AR	204.95	15	55	S	4	60	1		0	C	Yes	No	I	Yes	7 x 1 3/4 x 5 1/8		
	GE-7401AR	203.95	15	55	S	18	60	1		0	C	Yes	No	I	Yes	7 x 1 3/4 x 5 1/8		
	CS-6500AR	179.95	15	50	S	4	60	1		5	1	C	Yes	No	I	Yes	7 x 1 3/4 x 5 1/4	
	CS-6501AR	142.95	15	50	S	4.5	60	1		0	1	C	Yes	No	I	Yes	7 x 1 3/4 x 5 1/4	
	PR-6402	89.95	20	45	S	4	45	1	M	0	1	C	No	No	I	Yes	7 x 1 3/4 x 4 3/4	
	ARA/MOTOROLA	P-100	189.95	22 @ 50 dB	50	S	3	1.0	A	0	1	C	No		No	I	Yes	2 1/2 x 5 x 7
		P-200	215.95	22 @ 50 dB	50	S	3	1.0	A	5	1	C	No		No	I	Yes	2 1/2 x 5 x 7

CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	FM Sensitivity dB (For 30 dB Overhang)	Selectivity, dB	Outputs, Preamp (P), Speaker Level (S), Both (Both)	Average Waits Channel, per HF A-202	Amplifier S W Ratio, dB	THD at Rated Output, %	Local Distance Control?	Manual Switch (M)	Total Number of Presets	Number of Tone or EQ Controls	Cassette (C), B-Track (B)	Auto Reverse?	Noise Reduction Circuit? See Code	Tape EQ Switch?	In-Dash (I), Under-Dash (U), Convertible (C)	Application Guide Available?	Dimensions, inches
ARA/MOTORDLA (Continued)	P-300	239.95	22 @ 50 dB	50	S	3	1.0	A	0	2	C	Yes	B	Yes	I	Yes	2 1/2 x 5 x 7		
	P-400	282.50	22 @ 50 dB	50	S	3	1.0	A	5	2	C	Yes	B	Yes	I	Yes	2 1/2 x 5 x 7		
	P-500	299.95	22 @ 50 dB	50	Both	3	1.0	A	5	2	C	Yes	B	Yes	I	Yes	2 1/2 x 5 x 7		
	PER1000	415.95	22 @ 50 dB	50	Both	3	1.0	M	12	2	C	Yes	B	Yes	I	Yes	2 1/2 x 5 x 7		
	FEP23	414.00	19 @ 50 dB	50	S	4 x 2, 12 x 2	1.0	A	8	2	C	Yes	B	Yes	I	Yes	2 1/4 x 7 1/2 x 7		
	FEX23	280.00	19 @ 50 dB	50	S	4 x 2, 12 x 2	1.0	A	8	2	C		B		I	Yes	2 1/4 x 7 1/2 x 7		
	JEP23	383.00	19 @ 50 dB	50	S	12	1.0	A	8	2	C	Yes	D	Yes	I	Yes	3 3/8 x 5 1/4 x 7 1/2		
	JEX23	250.00	19 @ 50 dB	50	S	12	1.0	A	8	2	C		D		I	Yes	3 3/8 x 5 1/4 x 7 1/2		
AUDIOBAHN	AB 33 II	235.70	17.5	60	Both	5	50	5	M	10	2	C	Yes	B	No	I	Yes	7 x 2 x 5 1/2	
	AB 37	269.95	17.5	60	Both	5	50	5	M	10	2	C	No	B	No	I	Yes	7 x 1 1/4 x 5 1/8	
	AB 38 II	329.95	17.5	60	Both	5	50	5	M	10	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 1/8	
	AB 39 II ET	509.95	11.3	60	Both	5	50	5	M	12	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 1/8	
	AB 47	206.21	17.5	50	S	5	50	5	M	1	1	C	No	No	No	I	Yes	6 1/4 x 1 1/4 x 4 1/2	
	AB 45	199.95	17.5	50	S	5	50	5	M	10	1	C	No	No	No	I	Yes	6 1/4 x 1 1/4 x 4 3/4	
	AB 402 II	129.95	17.5	50	S	5	50	5	M	10	1	C	No	No	No	I	Yes	6 1/4 x 2 x 4 1/2	
	AB 1000 ET	569.95	11.3	60	P	5	50	5	M	12	5	C	Yes	B	Yes	I	Yes	7 x 2 1/4 x 6 1/4	
	AB 391 ET	509.95	11.3	60	Both	5	50	5	M	12	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 1/8	
	AB 381	329.95	15	60	Both	5	50	5	M	10	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 1/8	
	AB 351	249.95	15	60	Both	5	50	5	M	10	2	C	Yes	D	Yes	I	Yes	6 1/2 x 1 1/4 x 5	
	AB 410 ET	349.95	11.3	60	Both	5	50	5	M	12	2	C	Yes	D	Yes	I	Yes	7 x 1 1/4 x 4 3/4	
AB 500	399.95	15	60	S	5	50	5	M	2	2	C	No	D	Yes	C	Yes	6 3/4 x 1 1/8 x 5 1/4		
AUDIOVOX/HI-COMP	HCC-565	279.95	11	60	Both	13	70	1.0	A	5	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 1/2	
	HCC-1150	279.95	12	60	Both	13	70	1.0	M	12	2	C	Yes	B	Yes	I	Yes	6 1/4 x 2 x 5	
	HCC-1200	339.95	12	60	Both	8.5	70	5.0	M	12	2	C	Yes	B	Yes	I	Yes	6 1/4 x 2 x 5	
	HCC-1250	399.95	12	60	Both	13	70	1.0	M	12	2	C	Yes	B	Yes	I	Yes	6 1/4 x 2 x 5	
	AVX-965	349.95	12	60	S	20	70	10.0	M	12	1	C	Yes	B	Yes	I	Yes	6 1/4 x 2 x 5	
	AVX-940	224.95	12	60	S	5	70	10.0	M	12	1	C	No	No	Yes	I	Yes	6 1/4 x 2 x 5	
	AVX-955	279.95	12	60	S	5	70	10.0	M	12	1	C	Yes	No	No	I	Yes	6 1/4 x 1 1/4 x 5	
AUTOTEK	CSR-3050B	169.95	17.3	60	S	12	60	8	A	5	1	C	No			I	No	6 1/4 x 4 1/8 x 1 3/4	
	CSR-3250	219.95	17.6	70	S	5	60	8	M	5	1	C	Yes			I	No	6 1/4 x 4 3/8 x 1 3/4	
	CSR-2200	199.95	18.8	60	Both	5	60	8	M	2	2	C	Yes			I	No	7 x 5 1/2 x 2	
	CSR-2300	239.95	18.8	60	Both	5	60	8	M	2	2	C	Yes	B	Yes	I	No	7 x 5 1/2 x 2	
	CSR-3300	259.95	17.6	60	Both	5	60	8	M	5	2	C	Yes	B	Yes	I	No	7 x 5 1/2 x 2	
	CSR-3500	329.95	17.6	70	Both	5	70	8	M	5	2	C	Yes	B/D	Yes	I	No	7 x 5 1/2 x 2	
	CSR-5550	389.95	16	70	Both	5	70	8	M/A	10	2	C	Yes	B	Yes	I	No	6 1/4 x 4 5/8 x 2	
	BON SONIC	201	79.95	25		Both	5			A			C	No			I		2 x 4 3/4 x 7
R455		99.95	25		Both	5			A			C	Yes			I		2 x 5 1/4 x 7	
R560B		149.95	25		Both	25			A			C	Yes	Yes		I		1 1/2 x 5 3/4 x 7; Graphic EQ booster inc.	
BOSE	CRC	19		55	P			A	12	2	C	Yes	B	Yes	I	Yes	2 1/2 x 5 1/4 x 7		
CARRERA	CR4045	179.95	19.2	60	S	2.2	66	0.9	M/A	10	1	C	Yes	D	Yes	I		1 3/4 x 5 3/8 x 7	
	CR6065	249.95	22.0	60	S	2.2	66	0.9	A	10	1	C	Yes	D	Yes	I		1 3/4 x 5 3/8 x 7	
CONCORD ELECTRONICS	HPL-101	210.00	11.2	70	Both	5	0.8	M	0	2	C	No		No	I	No	2 x 4 3/4 x 7 1/8		
	HPL-118	319.95	11.2	70	Both	12	0.8	M	10	3	C	No	B	Yes	I	No	2 x 5 7/8 x 7		
	HPL-118F	329.95	11.2	70	Both	12	0.8	M	10	3	C	No	B	Yes	I	No	2 x 5 7/8 x 7		
	HPL-122	429.95	11.2	70	Both	5	0.8	M	10	2	C	No	B	No	I	Yes	2 x 4 3/4 x 7 1/8		
	HPL-502	250.00	11.2	70	Both	25	0.8		0	2	C	No	B	No	I	No	2 x 4 3/4 x 7 1/8		
	HPL-504	300.00	11.2	70	Both	25	0.8		0	2	C	No	B	No	I	No	2 x 4 3/4 x 7 1/8		
	HPL-525	425.00	11.2	70	Both	12 x 2, 5 x 4	0.8		10	2	C	No	B	No	I	No	2 x 4 3/4 x 7 1/8		
	HPL-532	500.00	11.2	70	Both	12 x 2, 5 x 4	0.8		10	2	C	No	B	No	I	No	2 x 4 3/4 x 7 1/8		
CRAIG	T103	109.95	21.1	70	S	4.5	60	1.0	M	2	1	C	Yes			C	Yes	1 3/4 x 5 3/4 x 5 1/2	
	T502	79.95		70	S	4.5	70	1.0	M	1	1	C	No			I	Yes	1 3/4 x 4 3/4 x 6 3/8	
	T503	129.95	22.7	62	S	4.5	62	1.0	M	1	1	C	No			I	Yes	1 3/4 x 4 3/4 x 6 3/8	
	T561	199.95	20.0	70	Both	4.5	70	1.0	M	8	2	C	Yes			I	Yes	2 x 4 3/4 x 6 3/8	
	T700	99.95	24.2	65	S	4.5	65	1.0	M	2	2	C	No			I	Yes	2 x 5 1/2 x 7	
	T701	149.95	24.2	65	S	4.5	65	1.0	M	1	1	C	Yes			I	Yes	1 3/4 x 4 3/4 x 7	
	T720	169.95	19.3	60	S	4.5	60	1.0	M	10	1	C	Yes			I	Yes	2 x 5 1/8 x 7	
	T721	199.95	24.2	65	S	4.5	65	1.0	M	12	1	C	Yes			I	Yes	2 x 5 1/8 x 7	
	T740	199.95	18.0	67	Both	4.5	67	1.0	M	2	2	C	Yes			I	Yes	2 x 5 1/8 x 7	
	T741	219.95	18.0	67	Both	4.5	67	1.0	M	2	2	C	Yes			I	Yes	2 x 5 1/8 x 7	
	T742	279.95	18.0	67	Both	12	67	0.5	M	2	2	C	Yes	B	Yes	I	Yes	2 x 5 1/8 x 7	
	T760	239.95	17.2	64	Both	4.5	64	1.0	A	10	2	C	Yes	O	Yes	I	Yes	2 x 5 1/8 x 7	
	W460	369.95	19.3	50	S	12	50	0.5	A	12	2	C	Yes	B	Yes	I	Yes	2 x 5 1/8 x 7	
	T780	349.95	17.2	68	Both	12	68	0.5	A	10	2	C	Yes	B	Yes	I	Yes	2 x 5 1/8 x 7	
T860E	269.95	17.2	67	Both	4.5	67	1.0	A	10	2	C	Yes	D	Yes	I	Yes	2 x 5 1/4 x 7		
CYBERNET	CMS 3000	499.00	14.8	60	Both	18 x 4	80	10	M	12	2	C	Yes	B	Yes	U	No	3 x 7 1/2 x 10 5/8	
FUJITSU TEN	CE-4434	15	60	S	3	10	5	M	10	2	C	Yes	B	Yes				7 x 2 x 4 3/4	
	CE-4830	15	64	S	10	70	3	M	10	2	C	Yes	B	Yes				7 x 2 x 5 3/8	

THE ULTIMATE EQUALIZER



THE SOUNDCRAFTSMEN AE2000... WORLD'S MOST ACCURATE ANALYZER/EQUALIZER



Like other Real Time Analyzers, the Soundcraftsmen AE2000 utilizes a Full Frequency Spectrum Display System for **broad (2dB) adjustments**... But it is the **ONLY DUAL-SYSTEM analyzer!**... It also includes our exclusive Differential/Comparator® System which is accurate to within **0.1dB**. **Ten times more accurate than any other system!**... No other Analyzer/Equalizer at any price can equal the **0.1dB readout accuracy of the Differential/Comparator® System.**

The AE2000 combines this Revolutionary Analyzer circuitry with a superb 10-Band Precision-Coil Octave Equalizer (no "artificial" IC's), identical to the DC2215, which is generally considered to be the ultimate in Octave Equalizers. The Differential/Comparator® system is used in the equalizer section to assure TRUE UNITY-GAIN within 0.1dB, regardless of the EQ curve selected. This guarantees maximum headroom for wide-dynamic-range material, highest gain, lowest noise, without overloading. With the AE2000 the peaks and valleys found in every listening environment can be effectively "neutralized" quickly and easily to realize the full potential of your sound system.

And at only **\$699.00 RETAIL**, the AE2000 is a full **\$250.00** below the price of the AS1000 Analyzer and the DC2215 Equalizer separately!



DC2215 GRAPHIC EQUALIZER

The equalizer section of the fabulous AE2000 is available separately as the DC2215. Truly the world's finest equalizer at only **\$399.**

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\$19.95 EQ EVALUATION KIT, including 12" LP Frequency Spectrum Analysis Test Record, 2 sets of Computone Charts, Connector Cable, complete instructions. **JUST WRITE TO US OR CIRCLE Reader Service Card #30.** We'll send Free Special Offer Details and 16-page full-line color brochure featuring "WHYS AND HOWS OF EQUALIZATION."



CAR RADIOS/TAPE PLAYERS

NR Code A = dbx B = Dolby B C = Dolby C D = ONR	MANUFACTURER	Model	Price, \$	FM Sensitivity dBf (For 30 dB Distortion)	Selectivity, dB	Outputs: Preamp (P) Speaker Level (S)	Average Watts Channel, per HF F-202	Both (Both)	Amplifier S/N Ratio, dB	THD at Rated Output, %	Local Disturbance Control? Manual Switch (M)	Total Number of Presets	Number of Tone or EQ Controls	Cassette (C), B, Track (B)	Auto Reverse?	Noise Reduction Circuit?	Tape EQ Switch?	In-Dash (I), Under-Dash (U), Convertible (C)	Application Guide Available:	Dimensions, Inches
FULTRON	7600	349.95		50	Both	4	70	3.0	A	12	2	2	C	Yes	D	Yes	I	Yes	7 x 2 x 5/4	
	6900	299.95		50	Both	4	70	3.0	A	12	2	2	C	Yes	D	Yes	I	Yes	7 x 2 x 4 3/4	
	6800	249.95		50	Both	4	70	3.0	A	12	1	1	C	Yes	D	No	I	Yes	7 x 2 x 4 3/4	
	6700	199.95		50	Both	4	70	3.0	A	5	2	2	C	Yes	D	No	I	Yes	7 x 1 3/4 x 4 3/4	
	6600	169.95		50	Both	4	67	3.0	M	5	1	1	C	Yes	D	No	I	Yes	7 x 1 3/4 x 4 3/4	
	5700	169.95		50	Both	4	70	3.0	A	0	2	2	C	Yes	D	No	I	Yes	7 x 1 3/4 x 4 3/4	
	5200	119.95		50	Both	4	67	3.0	A	0	1	1	C	Yes	D	No	I	Yes	6 3/4 x 1 3/4 x 4 3/4	
	5300	139.95		50	Both	4	67	3.0	A	0	2	1	C	Yes	D	No	I	Yes	6 3/4 x 1 3/4 x 4 3/4	
	5000	89.95		50	Both	4	63	3.0	M	0	2	1	C	Yes	D	No	I	Yes	6 3/4 x 1 3/4 x 4 3/4	
	JENSEN	RE530	499.95	14.8	65	Both	4		2.5	A	10	2	2	C	Yes	B/O	Yes	I	Yes	2 x 5 3/4 x 7 1/2
RE520		419.95	14.8	60	Both	4		2.5	A	10	2	2	C	Yes	B	Yes	I	Yes	1 3/4 x 4 3/4 x 7 1/2	
RE518		399.95	14.8	60	S	4		2.5	M	10	2	2	C	Yes	B	Yes	I	Yes	1 3/4 x 4 3/4 x 7 1/2	
RE512		369.95	14.8	60	S	4		2.5	M	10	2	2	C	Yes	No	No	I	Yes	1 3/4 x 4 1/2 x 6 1/4	
RE508		299.95	14.8	60	S	4		2.5	A	8	1	1	C	Yes	No	No	I	Yes	1 3/4 x 4 3/4 x 7 1/2	
R408		289.95	14.8	65	Both	4		2.5	A	5	2	2	C	Yes	B	Yes	I	Yes	1 3/4 x 5 3/8 x 7 1/4	
R220		249.95	14.8	60	Both	3.5		2.5	A	5	1	1	C	Yes	No	No	I	Yes	1 3/4 x 4 3/4 x 6 1/4	
R210		199.95	17.3	60	S	3.5		2.5	A	5	1	1	C	No	No	No	I	Yes	1 3/4 x 4 3/4 x 6 1/4	
JR105		169.95	14.8	65	S	3.5		2.5	A	0	2	2	C	No	No	No	I	Yes	1 3/4 x 4 3/4 x 7 1/2	
JET SOUND ELECTRONICS		9353	109.95	17.2	30	Both	8	50	1.0	M	0	1	1	C	No	No	No	I	Yes	1 5/8 x 4 1/4 x 6 5/8
	9401	159.95	14.7	30	Both	8	50	1.0	M	0	1	1	C	Yes	No	No	I	Yes	1 5/8 x 4 3/4 x 6 1/4	
	9417	229.95	14.7	30	Both	8	50	1.0	M	0	2	2	C	Yes	B	Yes	I	Yes	1 5/8 x 4 3/4 x 6 5/8	
	9416	269.95	14.7	30	Both	8	50	0.5	M	10	2	2	C	Yes	No	Yes	I	Yes	1 5/8 x 4 1/4 x 6 5/8	
	9419	299.95	14.7	30	Both	8	50	0.5	M	10	2	2	C	Yes	B	Yes	I	Yes	1 5/8 x 4 3/4 x 6 5/8	
	9428	199.95	23.3	30	Both	7	40	1.0	M	5	2	2	C	Yes	D	Yes	I	Yes	1 5/8 x 4 3/4 x 6 5/8	
	JSR ELECTRONICS	JSR245	39.97	26.8	30	Both	6	40	0.3	No	0	1	1	C	No	No	No	I	No	6 x 7 x 1 1/8
JVC	KS-R10	179.95	16.3	65	Both	3	70	0.8	M	0	2	2	C	No	B	Yes	I	Yes	6 3/8 x 1 3/4 x 4 3/4	
	KS-R15	209.95	16.3	65	Both	3	70	0.8	M	0	2	2	C	No	B	Yes	I	Yes	6 3/8 x 1 3/4 x 4 3/4	
	KS-R30	239.95	16.3	65	Both	3	70	0.8	A	5	2	2	C	Yes	B	Yes	I	Yes	6 3/8 x 2 x 4 1/2	
	KS-R35	269.95	16.3	65	Both	3	70	0.8	A	5	2	2	C	Yes	B	Yes	I	Yes	6 3/8 x 2 x 4 1/2	
	KS-R55	329.95	16.3	65	Both	8	70	0.8	M	12	2	2	C	No	B	Yes	I	Yes	6 3/8 x 2 x 5 1/8	
	KS-R75	379.95	16.3	65	Both	8	70	0.8	M	12	2	2	C	Yes	B	Yes	I	Yes	6 3/8 x 2 x 5 1/8	
	KS-C100	399.95	16.3	65	P		70		M	12	2	2	C	Yes	B/C	Yes	I	Yes	6 3/8 x 2 x 5 1/8	
	KS-Q8	16.3	65	Both	8	70	0.8	M	10	2	2	2	C	No	B	Yes	I	Yes	7 1/8 x 2 x 5 3/8	
	KENWOOD	KRC-1022	659.00	14.8	65	P				M	12	2	2	C	Yes	B	Yes	I	Yes	7 x 2 x 6 1/8
KRC-922		599.00	14.8	65	P				M	10	2	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 3/4	
KRC-722		499.00	14.8	65	P				M	10	2	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 3/4	
KRC-7100		469.00			Both				M	24	2	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 3/4	
KRC-712		429.00	14.8	65	Both		15 x 2, 4 x 2	1.0	M	10	2	2	C	Yes	B	Yes	I	Yes	7 x 2 x 5 3/4	
KRC-512		399.00	15.3	65	Both	4		1.0	A	10	2	2	C	Yes	B	Yes	I	Yes	6 1/4 x 1 3/4 x 4 3/4	
KRC-3100		299.00			Both	4		1.0	M	10	2	2	C	Yes	Yes		I	Yes	7 x 2 x 4 7/8	
KRC-2100		259.00			Both	4		1.0	A	5	2	2	C	Yes			I	Yes	7 x 2 x 5 1/4	
KRC-112		199.00	15.8	65	Both	5		1.0	A	5	1	1	C	Yes			I	Yes	6 1/4 x 2 x 4 1/2	
KZC-657		299.00			Both	15		1.0	A	1	2	2	C	Yes	B	Yes	U	Yes	6 3/4 x 2 3/8 x 6 1/2	
KRACO	ETR-1089	279.95	26.8	40	S	15	45	10	No	12	2	2	C	Yes	B	Yes	C	Yes	7 x 5 x 2	
	ETR-1088	249.95	26.8	40	S	15	45	10	No	12	2	2	C	Yes	D	Yes	C	Yes	7 x 5 x 2	
	KHP-1085	249.95	26.8	40	S	15	50	10	No	0	2	2	C	Yes	B	Yes	C	Yes	7 x 5 1/2 x 2	
	KGE-803	249.95	28.1	45	S	15	40	10	No	0	5	5	C	Yes	No	No	C	Yes	7 x 5 1/2 x 1 3/4	
	KID-597	239.95	26.8	50	S	5	47	10	No	8	1	1	C	Yes	No	No	C	Yes	7 x 5 1/2 x 2	
	KID-595	159.95	29.3	40	S	5	40	10	M	0	1	1	C	No	D	No	C	Yes	7 x 5 x 2	
	KGE-801	239.95	29.3	50	S	15	48	10	No	0	5	5	C	No	D	No	C	Yes	7 x 5 x 2	
	KXI-89	189.95	30.3	35	S	4.5	45	10	No	10	1	1	C	No	No	No	C	Yes	6 1/4 x 5 x 1 3/4	
	LEAR JET	A-16	349.95	17.2		Both		16 x 4		M	12	2	2	C	Yes	D	Yes	I	No	7 x 2 x 5
		A-10	299.95	17.2		Both		7 x 4		M	12	1	1	C	Yes	D	Yes	I	No	7 x 2 x 5
A-14		249.95	17.2		S		7 x 4		M	12	1	1	C	Yes	D	No	I	No	7 x 2 x 5	
A-26		199.95	23.3		Both		4.5 x 4		M	5	2	2	C	Yes	D	Yes	I	No	7 x 2 x 5	
A-30		179.95	24.3		S		18 x 4		M	0	5	5	C	Yes	D	No	I	No	7 x 1 3/4 x 5	
A-31		149.95	23.3		S		17 x 4		M	0	5	5	C	No	D	No	I	No	7 x 2 x 5	
A-89		149.95	24.3		Both		6 x 4		M	0	2	2	C	Yes	No	No	I	No	6 1/4 x 1 3/4 x 5	
A-90		129.95	24.3		S		6		M	0	1	1	C	Yes	No	No	I	No	6 3/4 x 1 3/4 x 4 3/4	
A-77		99.95	24.3		S		6 x 4		A	0	1	1	C	No	D	No	I	No	6 1/4 x 1 3/4 x 4 3/4	
A-76		99.95	23.3		S		5 x 4		A	0	1	1	C	No	D	No	I	No	6 3/4 x 1 3/4 x 4 3/4	
6313	79.95	23.3		S		5		A	5	1	1	C	No	D	No	I	No	6 1/2 x 1 3/4 x 1 3/4		
MAJESTIC ELECTRONICS	MCR 1000AN	99.95	19.2	75	S	6	60		M	0	0	0	C	No			I	No	6 3/4 x 1 3/4 x 4 3/4	
	MCR 1700AN	129.95			Both		45		M	0	0	0	C	Yes			I	No	6 3/4 x 1 3/4 x 4 3/4	
	MCR 1100	89.95			S	8	45		M	0	0	0	C	No			I	No	6 3/8 x 1 3/4 x 4 3/4	
	MCR 2300	149.95		75	S	25	60	5.0	M	0	0	0	C	Yes	D		I	No	7 x 1 3/4 x 4 7/8	
	MCR 2500	169.95	19.2	75	S	25	60	5.0	M	0	0	0	C	Yes	D		I	No	7 x 1 3/4 x 4 7/8	
	MCR 2900	189.95	25.2		Both	7	50		M	10	10	10	C	Yes	D		I	No	6 7/8 x 1 3/4 x 4 7/8	
	MCR 3600PLL	299.95			Both	8	50	5.0	M	12	12	12	C	Yes	D		I	No	7 x 1 3/4 x 4 3/4	
	MCR 3800HP	299.95	34.7		S	25	50	5.0	M	12	12	12	C	Yes	D		I	No	7 x 1 3/4 x 5	
MARANTZ	CAR 302	250.00	14.77	65	Both	4		0.9	A	5	2	2	C	No	B	No	I	Yes	2 7/8 x 7 1/8 x 4 3/4	
	CAR 320	165.00	16.38	60	S	4		0.9	M	5	1	1	C	Yes	B	No	I	Yes	1 3/4 x 6 3/4 x 4 3/4	
	CAR 322	250.00	14.77	65	S	4		0.9	M	2	2	2	C	Yes	B	Yes	I	Yes	1 3/4 x 6 3/4 x 4 3/4	
	CAR 355	300.00	14.77	65	Both	4		0.9	M	1	1	1	C	Yes	B	Yes	I	Yes	2 x 7 x 4 3/4	
	CAR 300</																			

CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price, \$	FM Sensitivity, dB/ (For 30 dB Distortion)	Selectivity, dB	Outputs: Presamp (P), Speaker Level (S), Both (Both)	Average, Watts Channel, Per Hr. A-202	Amplifier S, M Ratio, dB	THD at Rated Output, dB	Local Dist. Control? Manual Switch (M)	Total Number of Presets	Number of Tapes or ED Controls	Cassette (C), B-Track (B)	Auto Reverse?	Noise Reduction Circuit? See Code	Tape EQ Switch?	In-Dash (I), Under-Dash (U), Convertible (C)	Application Guide Available?	Dimensions, Inches
MITSUBISHI	CZ-747	499.95	24	80	P			A	10	2	C	Yes	B	Yes	I	Yes	2 x 7 x 4 3/4	
	RX-735	319.95	23	65	S	4	55	A	12	1	C	Yes	No	No	I	Yes	2 x 7 x 4 3/4	
	RX-909	319.95	22	86	S	14	55	A	5	2	C	Yes	D	No	I	Yes	2 x 7 x 6	
	RX-755	269.95	22	86	S	4	50	A	5	1	C	Yes	No	No	I	Yes	2 x 7 x 6	
	CZ-725	229.95	22	80	P		50	M	2	2	C	Yes	B	Yes	I	Yes	2 x 6 1/4 x 4 3/4	
	RX-707	229.95	22	86	S	4	50	M	5	1	C	Yes	No	No	I	Yes	2 x 7 x 4 3/4	
	RX-726	199.95	22	80	S	4	50	M	1	1	C	Yes	No	No	I	Yes	2 x 6 1/4 x 4 3/4	
	RX-711	179.95	23	65	S	4.5	50	M	5	1	C	No	No	No	I	Yes	2 1/2 x 7 1/2 x 4 3/4	
	RX-723	139.95	22	68	S	3.5	50	M			C	No	No	No	I	Yes	1 3/4 x 6 1/4 x 4 1/2	
NAKAMICHI	TD-1200	1260.00	20	60	P			A	10	3	C	Yes	B/C	Yes	I	Yes	7 1/4 x 2 1/4 x 6	
PANASONIC	CQ-S703	229.95	14 @ 50 dB	35	S	3 x 4	50	3	A	5	1	C	No	No	I	Yes	2 x 5 1/4 x 7	
	CQ-S713	219.95	14 @ 50 dB	35	S	3 x 4	50	3	A	5	2	C	No	B	No	I	Yes	2 x 5 1/2 x 7
	CQ-S708	219.95	19 @ 50 dB	35	S	3	50	3	A	5	2	C	No	No	I	Yes	2 x 5 1/2 x 7	
	CQ-S717	219.95	14 @ 50 dB	35	S	3	50	3	A	5	1	C	Yes	No	I	Yes	2 x 5 1/2 x 7	
	CQ-S687	189.95	14 @ 50 dB	35	S	3 x 4	50	3	A	5	1	C	No	No	I	Yes	2 x 5 1/2 x 7	
	CQ-S682	189.95	14 @ 50 dB	35	S	3 x 4	50	3	A	5	1	C	No	No	I	Yes	2 x 5 1/2 x 7	
	CQ-S678	189.95	14 @ 50 dB	35	S	3	50	3	A		1	C	No	No	I	Yes	1 3/4 x 5 1/4 x 7	
	CQ-S958	539.95	19 @ 50 dB	35	Both	3.0 x 4	50	3.0	A	10	2	C	Yes	B	Yes	I	Yes	2 x 5 7/8 x 7
	CQ-S818	349.95	19 @ 50 dB	35	Both	3.0 x 4	50	3.0	A	10	1	C	No	Yes	I	Yes	2 x 5 x 6 1/4	
	CQ-S903	429.95	19 @ 50 dB	35	Both	4.0 x 4	50	1	M	12	2	C	Yes	B	Yes	I	Yes	2 x 5 x 7
	CQ-S788	299.95	19 @ 50 dB	35	S	3.0 x 4	50	3	A	10	1	C	No	Yes	I	Yes	2 x 5 x 6 1/4	
	CQ-S768	289.95	14 @ 50 dB	35	S	3.0 x 4	50	3	A	5	2	C	Yes	Yes	I	Yes	2 x 5 1/4 x 7	
	CQ-S763	269.95	14 @ 50 dB	35	S	3.0 x 4	50	3	A	5	2	C	Yes	B	Yes	I	Yes	2 x 5 1/4 x 7
	CQ-S747	249.95	14 @ 50 dB	35	S	14 x 4	50	3	A	0	2	C	No	B	Yes	I	Yes	1 3/4 x 5 1/2 x 7
	CQ-S668	169.95	14 @ 50 dB	35	S	3	50	3	A	5	1	C	No	No	I	Yes	2 x 5 1/4 x 7	
	CQ-6868	149.95	14 @ 50 dB	35	S	2	50	3			1	C	No	No	I	Yes	1 3/4 x 5 1/4 x 7	
	RM-710	1399.95	18 @ 50 dB	45		15 x 4	70	0.02	M	12	EQ	C	Yes	B	Yes	†	Yes	1 5/8 x 9 x 28; †Overhead.
RM-310	599.95	23 @ 50 dB	35		10 x 4	80		M		EQ	C	No	No	†	Yes	1 5/8 x 8 5/8 x 27 1/8		
PARASOUND	RDR90	169.95	14	60	Both	4	60	0.8	M	10	2	C	Yes		I		6 3/4 x 1 3/4 x 5 1/4	
PHILIPS AUTO AUDIO	AC825	599.95			P			M	12	2	C	No	B	Yes	I	No	2 x 7 x 6	
PIONEER	KP-2000	129.95	23.2	50	S	3.2	5.0			1	C	No	No	I	Yes	2 x 7 1/8 x 5 1/4		
	KP-2500	149.95	19.2	50	S	3.2	5.0			1	C	No	No	I	Yes	2 x 7 1/8 x 6		
	KP-2205	159.95	23.2	50	S	3.2	5.0			1	C	No	No	I	Yes	1 3/4 x 7 1/8 x 4 3/4		
	KP-4500	169.95	19.2	50	S	3.2	5.0			1	C	Yes	No	I	Yes	2 x 7 1/8 x 6		
	KP-3500	179.95	23.2	50	S	3.0	5.0	M		1	C	No	No	I	Yes	2 x 7 1/8 x 6		
	KP-4205	184.95	23.2	50	S	3.2	5.0			1	C	Yes	No	I	Yes	1 3/4 x 7 1/8 x 4 3/4		
	KP-5500	189.95	14.3	74	S	3.0	5.0			5	1	C	No	No	I	Yes	2 x 7 1/8 x 6	
	KP-A400	209.95	17	70	S	3.2	5.0			5	1	C	No	No	I	Yes	2 x 7 1/8 x 5 1/4	
	KP-A500	239.95	17	70	Both	3.2	5.0			5	2	C	No	No	I	Yes	2 x 7 1/8 x 5 1/4	
	KP-6500	219.95	19.2	74	S	2.9	5.0			5	1	C	No	No	I	Yes	2 x 7 1/8 x 6	
	KP-A600	249.95	17	70	S	2.9	5.0			5	1	C	Yes	No	I	Yes	2 x 7 1/8 x 5 1/4	
	KE-2100	229.95	14.3	74	S	3.2	5.0			10	1	C	No	No	I	Yes	2 x 7 1/8 x 6	
	KP-7500	259.95	19.2	74	S	2.9	5.0			1	1	C	Yes	D	Yes	I	Yes	2 x 7 1/8 x 6
	KP-A700	259.95	17	70	Both	3.2	5.0			5	2	C	Yes	No	I	Yes	2 x 7 1/8 x 5 1/4	
	UKE-3100	269.95	19.2	50	S	3.2	5.0			15	1	C	No	No	I	Yes	2 x 7 1/8 x 4 3/4	
	KE-5100	289.95	19.2	70	S	2.9	5.0			15	1	C	No	No	I	Yes	2 x 7 1/8 x 6	
	KE-6100	329.95	19.2	70	S	2.9	5.0			15	1	C	No	D	Yes	I	Yes	2 x 7 1/8 x 6
	UKE-7100	349.95	19.2	70	S	3.2	5.0			15	2	C	Yes	D	Yes	I	Yes	2 x 7 1/8 x 4 3/4
	KE-7200	379.95	17	70	S	3.2	5.0			15	2	C	Yes	D	Yes	I	Yes	2 x 7 1/8 x 4 3/4
	UPX-9600	299.95	19.2	70	P					5	2	C	Yes	D	Yes	I	Yes	2 x 7 1/8 x 4 3/4
	KEX-20	299.95	19.2	74	P					15	2	C	No	D	Yes	I	Yes	2 x 7 1/8 x 6
	KEX-50	379.95	19.2	70	P					15	2	C	No	D	Yes	I	Yes	2 x 7 1/8 x 6
	KEX-65	419.95	19.2	70	P					15	2	C	Yes	D	Yes	I	Yes	2 x 7 1/8 x 5 1/4
	TP-6006	129.95			S	3.0	5.0	M		1	8				U	Yes	2 x 7 1/8 x 6 1/8	
	KP-575	129.95			S	3.0	5.0			1	1	C	Yes	No	U	No	2 x 4 3/4 x 6 1/8	
	KP-500	189.95	14.3	74	S	3.0	5.0			2	2	C	No	No	U	No	2 x 7 3/8 x 7 1/2	
	KPX-600	139.95	14.3	74	P					2	2	C	No	No	U	No	2 3/8 x 7 7/8 x 6 7/8	
	KP-404G	159.95			P					2	2	C	No	Yes	U	No	2 x 5 1/8 x 5 1/4	
	KP-909G	379.95			P					2	2	C	No	D	Yes	U	No	2 x 5 1/8 x 6 1/4
	GEX-60	219.95	19.2	70	P					15	2				U	No	2 x 5 1/8 x 5 1/4	
GEX-90	299.95	19.2	70	P					15	2				U	No	2 x 5 1/8 x 5 1/4		
PROTON	P202	199.95	19.2	60	Both	6	100	0.5	M	0	2	C	No	B	Yes	I	Yes	6 1/4 x 1 5/8 x 5 1/2
	P202A	219.95	19.2	60	Both	6	100	0.5	M	0	2	C	No	B	Yes	I	Yes	6 1/4 x 1 5/8 x 5 1/2
	P204	299.95	22.1	60	Both	6	100	0.5	M	10	2	C	Yes	B	Yes	I	Yes	6 1/2 x 2 x 5 1/8
	P212	369.95	22.1	60	Both	6 x 4, 18 x 2	100	0.3	M	10	2	C	Yes	B	Yes	I	Yes	6 3/4 x 2 x 5 3/4
	P207	479.95	22.1	60	P				M	10	2	C	Yes	B/C	Yes	I	Yes	7 1/8 x 2 x 5 3/8

CAR RADIOS/TAPE PLAYERS

MANUFACTURER	Model	Price \$	FM Sensitivity (db)		Selectivity (db)	Outputs	Preamp (P)	Speaker Level (S)	Average Wdth (S)	Both (Both)	Amplifier S/N Ratio (db)	THD at Rated Output, %	Local Distance Control?	Manual Switch (M)	Automatic (A)	Total Number of Presets	Number of Tone or EQ Controls	Cassette (C) & Track (B)	Auto Reverse?	Noise Reduction Circuit?	Tape EQ Switch?	In-Dash (I) Under-Dash (U)	Convertible (C)	Application Guide Available?	Dimensions Inches	
			(For db dB Quieting)	(For db dB Quieting)																						
ROYAL SOUND	RS1900	100.00	11	50	S	10		70	10	M	0	1	C	No	No	No	No	No	No	No	No	No	No	Yes	1 3/4 x 4 7/8 x 7	
	RS2410	200.00	11	50	S	10		70	10	M	0	1	C	Yes	No	No	No	No	No	No	No	No	Yes	1 3/4 x 4 7/8 x 7		
	RS2500	300.00	14	65	Both	10 x 4		70	10	A	0	2	C	Yes	No	No	No	No	No	No	No	No	Yes	2 x 4 7/8 x 6 3/8		
	RS2610N	400.00	10	40	Both	10		70	10	A	12	2	C	Yes	No	No	No	No	No	No	No	No	Yes	1 3/4 x 4 7/8 x 7		
SANSUI	CX-900	500.00	14.8	65	P					A	18	2	C	Yes	B/C	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 x 2 x 6 7/8	
	CX-910	500.00	14.8	65	P					A	18	2	C	Yes	B/C	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 3/8 x 2 1/4 x 6 3/4	
	RX-700	420.00	14.8	65	Both	40				A	18	3	C	Yes	B	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 x 2 x 7 1/2	
	RX-710	420.00	14.8	65	Both	40				A	18	3	C	Yes	B	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 3/8 x 2 1/4 x 6 7/8	
	RX-500	360.00	14.8	65	Both	12				A	18	3	C	Yes	B	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 x 2 x 7 1/2
	RX-510	360.00	14.8	65	Both	12				A	18	3	C	Yes	B	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7 3/8 x 2 x 7 1/2
SANYO	FT50	49.95			S	3.8		10.0				1	C	No							C	Yes	Yes	4 3/4 x 6 1/4 x 1 3/4		
	FT802	79.95			S	3.0		10.0				1	C	Yes							C	Yes	Yes	6 x 2 x 5 3/4		
	FT804	99.95			S	8.0		5.0				2	C	Yes							C	Yes	Yes	6 x 2 x 5 3/4		
	FTC1	59.95	26.2		S	3.0		10.0	M			1	C	No							C	Yes	Yes	6 1/4 x 4 1/2 x 1 3/4		
	FTC29	79.95	26.2	35	S	3.0		10.0	M			1	C	Yes							C	Yes	Yes	6 1/4 x 4 3/4 x 1 3/4		
	FTC38	99.95	23.8	60	S	9.5		1.0	M			1	C	Yes							C	Yes	Yes	6 1/4 x 4 3/4 x 1 3/4		
	FTC40	119.95	21.6	60	S	9.5		1.0	M			2	C	Yes							C	Yes	Yes	6 1/4 x 4 3/4 x 2		
	FTC45	119.95	21.6	60	S	3.0		10.0	M		5	1	C	Yes							C	Yes	Yes	6 1/4 x 4 7/8 x 1 3/4		
	FTC27	149.95	20.2	60	S	9.5		1.0	M			2	C	Yes	B	No					C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTC46	149.95	21.6	60	S	9.5		1.0	M		5	1	C	Yes							C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTC12	149.95	20.2	60	S	2.4		5.0	M			1	C	Yes							C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTC18	149.95	21.6	60	S	9.5		1.0	M			1	C	Yes							C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTC48	159.95	23.8	60	S	9.5		1.0	M		5	2	C	Yes	B	Yes					C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTC68	179.95	21.6	70	Both	9.5		1.0	M			2	C	Yes	B	Yes					C	Yes	Yes	6 1/4 x 5 1/8 x 2		
	FTC70	179.95	21.6	70	Both	9.5		1.0	M			2	C	Yes	B	Yes					C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTV75	199.95	25.8	35	S	3.0		10.0	M		5	2	C	No							C	Yes	Yes	6 1/4 x 4 7/8 x 2		
	FTV80	99.95	21.6	60	S	9.5		1.0	M			1	C	Yes							C	Yes	Yes	7 1/8 x 5 1/8 x 2		
	FTV84	129.95	23.8	60	S	9.5		1.0	M			2	C	Yes							C	Yes	Yes	7 1/8 x 5 1/8 x 2		
	FTV90	149.95	23.8	60	S	9.5		1.0	M			2	C	Yes	B	Yes					C	Yes	Yes	7 1/8 x 5 1/8 x 2		
	FTV88	149.95	21.6	70	S	3.0		10.0	M			1	C	Yes							C	Yes	Yes	7 1/8 x 5 1/8 x 2		
FTV98	179.95	21.6	70	Both	9.5		1.0	M		5	1	C	Yes	B	Yes					C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTV92	179.95	21.6	70	S	9.5		1.0	M			5	2	C	Yes	B	Yes				C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTV100	199.95	21.6	70	S	9.5		1.0	M			5	2	C	Yes	B	Yes				C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTV590	279.95	20.2	70	P							10	2	C	Yes	B	Yes				C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTC120	269.95	16.8	70	Both	10.0		1.0	M			2	C	Yes	B/C	Yes					C	Yes	Yes	6 1/4 x 5 1/8 x 2			
FTX140	299.95	16.8	70	Both	15.0		0.3	M			2	C	Yes	B/C	Yes					C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTX160	349.95	16.8	70	Both	15.0		0.3	M			6	6	C	Yes	B/C	Yes				C	Yes	Yes	7 1/8 x 5 1/8 x 2			
FTX180	399.95	17.6	70	Both	15.0		0.3	M			12	6	C	Yes	B/C	Yes				C	Yes	Yes	7 1/8 x 5 1/8 x 2			
SHERWOOD	CRD-100	219.95	17.3	65	Both	12		0.5	M		0	1	C	Yes	B	Yes				C	Yes	Yes	Yes	2 x 5 7/8 x 7 1/4		
	CRD-200	299.95	16.3	65	Both	12		0.5	M		10	2	C	Yes	B	Yes				C	Yes	Yes	Yes	2 x 5 7/8 x 7 1/4		
	CRD-300	379.95	14.8	65	Both	12		0.5	M		10	2	C	Yes	B	Yes				C	Yes	Yes	Yes	2 x 5 7/8 x 7 1/4		
SDNY	XRM-10	379.95	20	60	S	4		1.0				2	C	Yes						C	Yes	Yes	Yes	7 1/8 x 6 x 2		
	XR-15	199.95	20	60	S	4		1.0				2	C	Yes						C	Yes	Yes	Yes	7 1/8 x 5 7/8 x 2		
	XR-25	239.95	20	65	Both	4		1.0				4	C	Yes						C	Yes	Yes	Yes	6 3/8 x 4 3/4 x 1 3/4		
	XR-45	279.95	20	70	Both	4		1.5	M		10	2	C	Yes						C	Yes	Yes	Yes	7 1/8 x 5 1/8 x 2		
	XR-65	229.95	20	70	Both	4		1.5	M		10	3	C	Yes	B	Yes				C	Yes	Yes	Yes	7 1/8 x 5 1/8 x 2		
	XR-75	474.95	20	70	(2) P				M		12	2	C	Yes	B	Yes				C	Yes	Yes	Yes	7 1/8 x 6 x 2		
	XR-85	479.95	20	70	Both	14		0.5	M		12	2	C	Yes						C	Yes	Yes	Yes	7 1/8 x 6 x 2 1/4		
	XR-100	649.95	20	70	(2) P				M		12	2	C	Yes	C	Yes				C	Yes	Yes	Yes	7 1/8 x 6 x 2		
	XT-11	349.95			P							2	C	Yes	B	Yes				C	Yes	Yes	Yes	7 1/8 x 6 x 2		
	XK-25	349.95			P							2	C	Yes	B	Yes				C	Yes	Yes	Yes	U	Yes	7 1/8 x 6 x 2
	SPARKOMATIC	SR 308	249.95	10.8			22.5		60	10	M		10	2	C	Yes	D	Yes			C	Yes	Yes	Yes	7 x 1 7/8 x 5 1/4	
SR 305		139.95	23.3	50		22.5		60	10	M		5	5	C	No					C	Yes	No	Yes	7 x 1 3/4 x 5 1/8		
SR 306		129.95	23.3	50		22.5		60	10	M		1	1	C	No					C	Yes	No	Yes	7 x 1 3/4 x 5 1/8		
SS 31E		129.95				22.5		60	10	M		2	C	Yes	D	Yes	U	Yes		C	Yes	Yes	Yes	5 1/4 x 1 3/4 x 6 3/4		
SR 304		119.95	23.3	50		5		60	10	M		1	C	Yes						C	Yes	No	Yes	6 3/8 x 1 3/8 x 4 3/8		
SR 303		119.95	23.3	50		5		60	10	M		1	C	Yes						C	Yes	No	Yes	7 x 1 3/4 x 4 3/8		
SR 300		89.95	29.3	50		4.5		60	10	M		1	C	No						C	Yes	No	Yes	7 x 1 3/4 x 4 3/8		
SR 200		89.95	29.3	50		5		60	10	M		1	C	No						C	Yes	No	Yes	7 x 1 3/4 x 4 3/8		
SS 30E		89.95				22.5		60	10	M		2	C	No	D	Yes				C	Yes	Yes	Yes	5 1/4 x 1 3/4 x 5 5/8		
SR 120		79.95	29.3			4.5		60	10	M		5	1	C	No					C	Yes	Yes	Yes	7 x 1 3/4 x 4 3/8		
SR 35		69.95	32.8			4.5		60	10	M		1	C	No						C	Yes	Yes	Yes	7 x 2 x 4 3/4		
SR 110		39.95				2		60	10	M		5	1	C	No					C	Yes	Yes	Yes	6 1/4 x 1 3/4 x 3 3/4		
SS 200		34.95				2		55	10	M																

SPEAKERS

MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4), Flush Mount (F), Surface Mount (S), Convertible (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes	
ACOUSTIC RESEARCH	AR1CS	129.99		100	5 1/4	4	63-30, -3 dB	2	F	1 1/4	No	86 dB SPL (1 watt/1 meter). 90 dB SPL (w/m). 85 dB SPL (w/m); brackets opt.
	AR3CS		64.99	20	4	4	110-30	W	F	1 3/4	No	
	AR1MS	110.00		185	4 1/2	4	95-25, -3 dB	2	S	No	No	
ADS	300I	134.50		100	5 1/4	4	50-20 ± 3	2	F	1 1/2	No	†Surface-mount tweeter; flush-mount woofer in 4 1/2-inch hole with 1 5/8-inch maximum depth. AX-1 electronic crossover inc.
	320I	189.50		100	5 1/4	4	58-20 ± 3	2	†	†	No	
	CS400		250.00	100	(2) 7	4	32-150 Hz ± 3		F	3 1/2	No	
ADS	200c	134.50		50	4	4	85-20 ± 3	2	S	No	No	
	300c	174.50		75	5 1/4	4	68-20 ± 3	2	S	No	No	
AFS KRIKET	8272		102.50	60	5 1/4	4	60-20	2	F	3		
	8232		92.50	50	5 1/4	4	60-20	2	F	2 1/2		
	8234		133.95	60	5 1/4	4	55-22	2	F	2 1/2		
	8231		68.95	50	5 1/4	4	60-15	W	F	2 1/2		
	8424		114.95	25	4	4	65-22	2	F	1 1/2		
	8422		84.95	25	4	4	65-20	2	F	1 1/2		
	8421		52.50	25	4	4	65-15	W	F	1 1/2		
	8074		154.95	60	4 x 10	4	55-22	2	F	3 3/8		
	8072		102.95	60	4 x 10	4	55-20	2	F	3 3/8		
	8032		94.95	50	4 x 10	4	55-20	2	F	3		
	2031	28.95		50	4 x 10	4	55-20	W	F	3		
	2122	37.50		25	4 x 6	4	60-20	2	F	1 3/8		
	8976		218.95	100	6 x 9	4	35-22 ± 5	3	F	3 3/4		
	8974		179.95	90	6 x 9	4	40-22	2	F	3 3/4		
	8972		128.95	80	6 x 9	4	40-18	2	F	3 3/4		
	8932		94.95	70	6 x 9	8	45-18	2	F	3 3/4		
	8931		71.50	70	6 x 9	8	45-15	W	F	3 3/4		
	2734	59.95		35	5 x 7	6	60-20	2	F	2 1/2		
	2121	24.95		25	4 x 6	4	60-15	2	F	1 3/8		
	7311	16.50		25	3 1/2	4	80-15	W	F	1 3/8		
0002		77.50	60	5	4	5k-22k	W	C	5 1/8			
0003		64.95	60	5	4	100-5		C	2			
0004		102.50	100	6 x 9	4	35-5		F	3 3/8			
ALPHASONIK	TPX-3†	25.00	50.00	150								†Crossover.
	W6920G	54.00	108.00	60	6 x 9	4	40-3 ± 4	W	F	3 3/4	No	
	W620G	54.00	108.00	60	6	4	45-3 ± 4	F	F	3 3/4	No	
	WP820	54.00	108.00	60	8	4	40-3 ± 4	W	F	3 3/4	No	
	M55G	26.10	52.20	20		8	1.1k-6k ± 4	F	F	2	No	
	T35G	13.30	26.60	10		8	2.5k-18k ± 4	F	F	1	No	
DT12G	13.30	26.60	10		4	3k-20k ± 4	F	F	1 1/2	No		
ALPINE	6108		99.95	80	8	4	35-400 Hz		F	3 1/2	Yes	90 dB SPL (1 watt/1 meter). 92 dB SPL (w/m). 89 dB SPL (w/m). 88 dB SPL (w/m). 90 dB SPL (w/m). 91 dB SPL (w/m). As above. As above. 89 dB SPL (w/m). 90 dB SPL (w/m). 91 dB SPL (w/m). 90 dB SPL (w/m). 93 dB SPL (w/m). 91 dB SPL (w/m). 89 dB SPL (w/m). 86 dB SPL (w/m). 91 dB SPL (w/m). 86 dB SPL (w/m). 91 dB SPL (w/m). 89 dB SPL (w/m). 91 dB SPL (w/m). 89 dB SPL (w/m). 91 dB SPL (w/m). 89 dB SPL (w/m).
	6112		159.95	150	12	4	20-400 Hz		F	5 3/8	Yes	
	6117		99.95	80		4	2k-30k	2	S		Yes	
	6130		44.95	20	3 1/2	4	130-20	W	F	1 1/2	Yes	
	6141		49.95	20	4	4	80-20	W	F	1 1/2	Yes	
	6142		49.95	40	4 x 6	4	80-20	W	F	1 1/2	Yes	
	6151		59.95	60	5 1/4	4	65-20	W	F	1 1/2	Yes	
	6161		69.95	60	6 1/2	4	60-20	W	F	1 1/2	Yes	
	6162		79.95	100	6 1/2	4	40-3		F	2 3/8	Yes	
	6203		79.95	40	6 1/2	4	70-20	2	F	2 3/8	Yes	
	6205		99.95	40	6 x 9	4	50-18	2	F	3	Yes	
	6207		129.95	80	5 1/4	4	50-20	2	F	1 5/8	Yes	
	6209		99.95	80	6 x 9	4	45-25	2	F	3	Yes	
	6214		99.95	60	4 x 10	4	60-20	2	F	2 5/8	Yes	
	6216		69.95	40	4	4	60-20	2	F	1 3/8	Yes	
	6217		109.95	60	4	4	80-20	2	F	1 1/2	Yes	
	6226		89.95	80	6 1/2	4	45-20	2	F	2 1/2	Yes	
	6227		199.95	80	5 1/4	4	70-35	2	F	1 3/4	Yes	
	6236		79.95	60	5 1/4	4	50-20	2	F	1 3/8	Yes	
	6292		119.95	80	6 x 9	4	30-20	2	F	2 1/4	Yes	
6352		89.95	60	5 1/4	4	65-20	3	F	1 1/2	Yes		
6363		119.95	80	6 1/2	4	65-20	3	F	1 1/2	Yes		
6391		149.95	100	6 x 9	4	30-20	3	F	3 3/4	Yes		
ALTEC LANSING	TK-1	79.95	40	3	4	4	5k-18k ± 4	C	C	7/8		†Five components: two TK-1s, two SK-1s, and one SW-1.
	SK-1	129.95	80	5 1/4	4	4	100-10 ± 5	C	C	2		
	SW-1	259.95	40	6 x 9	1k		39-150 Hz ± 4	C	C	2 3/8		
	AL-1	389.95†	Inc.				39-18	3	C			
	6 x 9-4A Duplex	179.95	100	6 x 9	4	4	80-18 ± 6	2	C	1 3/4		
6 x 9-4B Super Duplex	259.95	150	6 x 9	4	4	60-18 ± 5	2	C	2			
6 x 9-4C Duplex II	129.95	100	6 x 9	4	4	90-16 ± 6	2	C	2 1/8			
SK-2 Duplex	119.95	100	5 1/4	4	4	100-18 ± 6	2	F	2 1/8			
ARA/MOTOROLA	6700638		70.95	25	6 x 9	6	60-20 ± 5	3	F	3 3/4	No	GM dash upgrade.
	6700639		64.25	25	6 x 9	6	60-20 ± 5	2	F	3 3/4	No	
	6700641		29.25	20	4 x 6	6	130-17 ± 5	2	F	2	No	
	6700642		54.25	25	6	6	60-20 ± 5	3	F	2 1/2	No	
	6700643		42.50	25	6	6	60-20 ± 5	2	F	2 1/2	No	
	6700646		34.25	20	5 1/4	6	150-15 ± 5	2	F	1 1/2	No	
	6700647		32.50	25	4	6	150-15 ± 5	2	F	2	No	
	6700649		17.50	20	3 1/2	6	100-15 ± 5	W	F	1 1/2	No	
AUDAX	EZ-302		250.00	30	4	4	50-20	2	S		No	
	HIF 13 J	22.99		30	5 1/4	8	42-5		F	2 1/2	No	
	HIF 17 JS	24.99		30	6 1/2	8	29-5		F	3 3/8	No	

SPEAKERS

MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Watts	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Whizzer (W) 3-Way (3) 2-Way (2) Surround (S) Tweeter (T) Convertable (C)	Max. Required Mounting Depth, Inches	Application Available?	Notes
AUDIO PRO	B2-07	595.00		30 inc.	(2) 4½			40-250 Hz, -2 dB	S		Yes	Crossover Inc.
AUDIO SOURCE	LS-5 LS-Four LS-Eight	79.95 84.95 24.95	159.90 169.90 49.90	40 50 40	4 x 2¾ 4 3	4 4 4	100-20 ±3 100-20 ±3 100-20 ±5	2 2 2	S F S	1¼	Yes Yes Yes	
AUDIOVOX/HI-COMP	PPS-692 TRYVOX-100 TRYVOX-20 TRYVOX-25 COSP-20		149.95 79.95 62.95 55.95 39.95	200 100 30 25 100	6 x 9 6 x 9 6 x 9 5¼ 5¼	4 4 4 4 4	30-20 50-20 70-17 70-16.5 50-16	2 3 3 3 2	F F F F F	4½ 4½ 4½ 2½ 2½	Yes Yes Yes Yes Yes	
AUM AUDIO	MAESW-1220 MAESW-620 MASW-1220 MASW-620 MABM-1020 MABM-810 MABM-510 MABM-410 MAT-136	109.95 99.95 61.95 49.95 53.95 33.95 29.95 27.95 31.95		125 100 125 100 125 100 70 50 100	12 6½ 12 6½ 10 8 5¼ 4 3	4 4 4 4 4 4 4 4 8	20-500 Hz ±3 30-500 Hz ±3 20-1 ±3 30-3 ±3 40-4 ±3 150-10 ±3 150-6 ±3 200-7 ±3 2k-20k ±3		S S S S S S S S C	14 8 2½ 2½ 4¼ 2½ 1¾ 1¾ ¾	Yes Yes Yes Yes Yes Yes Yes Yes Yes	
BECKER ELECTRONICS	Radian C Series 693 Triad RCS 413 Triad RCS 62 RCS 52 RCS 42 RCS 40 RCS 692 RCS 65 RCS 462 RCS 30 RCS 41 RCS 6s RCS 6d RCS 611 RCS 611 RCS 690 RCS 217TW RCS 134 MD RCS 150 MD RCS 626 RCS 1026 RCS 1226 RCS 102SUB RCS 693C RCS 252C		149.00 129.00 99.00 98.00 79.00 59.00 189.00 199.00 99.00 49.00 149.00 159.00 189.00 199.00 89.00 89.00 89.00 109.00 119.00 199.00 239.00	100 50 45 40 25 25 100 80 25 25 80 80 50 80 100 80 80 100 100 150 100	6 x 9 4 x 10 6¼ 5¼ 4 6 x 9 6½ 4 x 6 3½ 4 6½ 6½ 5 6½ 6 x 9 5 5¼ 8 12 10 6 x 9 (2) 5	4 4	38-20 ±6 45-20 ±6 55-20 ±6 62-20 ±6 60-20 ±6 60-20 ±6 38-20 ±6 42-20 ±6 100-20 ±6 150-12 ±6 100-20 ±6 45-2.5 ±6 100-20 ±6 60-20 ±6 38-4 ±6 3k-20k ±6 1k-8k ±6 100-5 ±6 50-4 ±6 34-2 ±6 29-2 ±6 22-1.5 ±6 38-20 ±6 100-20 ±6	2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 2 2 2 2	F S S	4¼ 3¾ 1½ 2½ 1½ 4¼ 2½ 1¾ 1½ 2¼ 2¼ 3¾ 3¾ 4¼ 4¼ 5¾ 4¾ 5¾ 4¾	Yes Yes	Biamp capable. As above. As above. Fits 4 x 10-inch cutouts. Fits 6 x 9-inch cutouts. Model RCS 693 in cloth-covered enclosure with handle.
BON SONIC	593 693 694 695 BX330 BX550		59.95 69.95 79.95 89.95 109.95 129.95	25 25 25 25 25 25	5¼ 6 x 9 6 x 9 6 x 9 6 x 9 6 x 9	8 8 8 8 8 8		3 3 4 5 3 5	F F F F S S			
BOSE	1401-II		496.00†		4½	0.5			F	1¼	No	†System Inc. four speakers and EQ/amp (see separate listing).
BOSTON ACOUSTICS	C700		198.00	100	5¼	4	50-20 ±3	2	F	1½	No	
B & W	LM-1 LM-1PM		590.00 530.00		4 4	4/8 4/8	95-25 ±4† 31-25 ±5†	2 2	S C		No No	†At 8 ohms; at 4 ohms, 80 Hz to 16 kHz, ±4 dB. †At 8 ohms; at 4 ohms, 31 Hz to 16 kHz, ±5 dB.
CANTON	HC 100 AC 200 Pullman		250.00 350.00 400.00	35 30 50	4½ 4½ (4) 4½	4 4 4	48-30 ±6 48-25 ±6 45-30 ±6	2 2 3	S S S		No No No	Internally biamped.
CERWIN-VEGA	CS-18A CS-17 CSW-16 CSW-21		199.95 159.95 79.95 89.95	150 100 150 250	6 x 9 6 x 9 6 x 9 12	4 4 4 4	30-20 ±2 40-20 ±2 30-3 ±3 12-250 Hz ±3	2 2 2 2	F F F F	3 3 3 6	Yes Yes Yes Yes	Circuit breaker for HF; IM and Doppler filter. As above. Mounting baffle and porting tube inc.
CONCORD ELECTRONICS	HPS-151 HPS-260 HPS-263 HPS-265 HPS-266 HPS-271		79.95 99.95 129.95 109.95 139.95 159.95	30 50 90 80 120 120	6½ 6 x 9 6½ 6½ 6½ 6 x 9	4 4 4 4 4 4	50-20 40-20 40-20 40-20 40-20 40-20	2 2 2 2 2 2	F C C C C C	1¼ 2¾ 2¾ 2¾ 2¾ 2¾	No No No No No No	Biamp capable. As above. As above.
CRAIG (Continued)	V191 V106 V107		34.95 20.95 21.95	10 10 8	5¼ 6¼ 6¼	4 6 6	95-16 ±6 130-15 ±6 70-17 ±10		C F F	1¾ 1½ 1¼	Yes Yes Yes	

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Flush Mount (F), Surface Mount (S) Convertible (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes	
CRAIG (Continued)	V230		44.95	20	6 1/4	6	70-20 ±10	3	F	2	Yes		
	V242		36.95	20	6 x 9	6	45-17 ±5	W	F	3	Yes		
	V252		49.95	20	6 x 9	6	40-20 ±10	3	F	3	Yes		
	V300A		24.95	15	3 1/2	6	130-18 ±6		F	1 1/2	Yes		
	V301A		44.95	15	4	6	120-25 ±8	W	F	1 1/2	Yes		
	V302A		42.95	15	5 3/8	6	110-13.5 ±10		F	1 1/4	Yes		
	V203A		42.95	10	6 1/4	6	80-17.5 ±8		F	1 1/4	Yes		
	V305A		54.95	25	6 1/4	8	70-17 ±9		F	2	Yes		
	V322A		59.95	20	4	6	120-20 ±9	2	F	1 1/4	Yes		
	V323A		69.95	25	6 1/4	6	70-21.5 ±9	2	F	2	Yes	Biamp capable.	
	V341		39.95	15	4 x 6	6	100-21 ±6	W	F	1 1/8	Yes		
	V363A		84.95	25	6 x 9	6	60-23 ±9	2	F	3	Yes		
	V351A		99.95	25	6 x 9	6	60-22 ±10	3	F	3	Yes	As above.	
	V822		99.95	80	6 1/4	6	60-10 ±3	2	F	2	Yes		
	V830		119.95	80	6 1/4	6	80-20 ±6	3	F	2	Yes		
	V862		129.95	100	6 x 9	6	60-22 ±6	2	F	3	Yes	As above.	
V851		139.95	100	6 x 9	6	60-22 ±6	3	F	3	Yes	As above.		
CYBERNET	CSP-120		149.00	60	4	8	100-20 ±5	2	S	4 1/2	No	Weather treated.	
DYNAMIC ACOUSTICS	HPP-5010		69.50	45	5 1/4	4	55-20 ±3	2	S	2 1/2			
	HPP-6515		99.50	65	6 1/2	4	50-20 ±3	2	S	3 1/8			
	HPP-6915		159.50	100	6 x 9	4	50-20 ±3	3	S	4 1/8			
	BHT-85D	20.00	40	4	4	1.5k-22k ±2		S	1 1/4				
	120DFW26P	30.00	50	4 1/2	4/8	75-5 ±2		C	2				
	130RFW10P	40.00	70	5 1/4	4/8	55-4 ±2		C	2 1/4				
	160RFW27P	45.00	80	6 1/2	4/8	55-3.5 ±2		C	3 1/2				
	CS-6900P	60.00	100	6 x 9	4	55-3.5 ±2		C	3 3/4				
	CS-8000P	65.00	100	8	4/8	55-3.5 ±2		C	3 1/2				
	DCM-1	159.50	50	4	4	80-20 ±2	2	S					
	DCM-2	129.50	60	4	4	75-20 ±2	2	S	1				
	EPI	LS-45		49.95	50	5 1/4	4	90-12		F	1 1/4	No	
LS-55			89.95	50	5 1/4	4	90-20	2	F	1 1/2	No		
LS-70			170.00	100	6	8	70-20 ±3	2	F	2 1/2	No	Fits 6 x 9-inch cutouts.	
LS-81			200.00	70	4 1/2	4	80-20 ±3	2	F	1 1/2	No	Adaptor for 4 x 10-inch cutout inc.	
LS-81C			230.00	70	4 1/2	4	95-20 ±3	2	S		No	Cabinet version of LS-81.	
LS-641			300.00	150	6	4	55-20 ±3	3	F	†	No	†Woofer, 3 1/4 inches; midrange/ tweeter, 3/4 inch.	
LS-841			340.00	150	8	4	45-20 ±3	3	F	†	No	†Woofer, 3 1/2 inches; midrange/ tweeter, 3/4 inch.	
FUJITSU TEN	SB-6002			25 inc.		200k	45-225 Hz		S				
FULTRON	9990		129.95	100	6 x 9	4		3	F	4	Yes	Biamp capable.	
	9696		79.95	40	6 x 9	4		4	F	3 3/4	Yes		
	9690		69.95	40	6 x 9	4		3	F	3 3/8	Yes		
	9670		54.95	35	6 x 9	4		2	F	3 1/2	Yes		
	9790		99.95	75	5 1/4	4		3	F	3 3/4	Yes	As above.	
	9490		59.95	30	5 1/4	4		3	F	3	Yes		
	9735		69.95	50	4 1/2	4		2	F	2 1/2	Yes	As above.	
	9435		39.95	20	4	4		2	F	2	Yes		
	9425		29.95	3 1/2	8	4		W	F	1 5/8	Yes		
	9260		119.95	50	4	4		2	S		Yes	As above.	
	9240		24.95	7	5	8			C	5/8	Yes		
INFINITY	A 693		179.00	70	6 x 9	4	40-22	3	F	3	No		
	A 63		139.00	50	6 1/2	4	60-22	3	S	2	No	Requires 5-inch cutout.	
	A 62		99.00	50	6 1/2	4	60-18	2	S	2	No	As above.	
	A 42		75.00	25	4 1/2	4	100-15	W	S	1 5/8	No	Mounting depth, 3/4 inch with A54 spacer.	
ISOPHON	3050		325.00	50	8 1/2 x 12	4	35-20	3	S	2 3/8	Yes	Biamp capable.	
	PSS 1016	40.00	80.00	20	4 x 6	4	75-13	W	F	1 5/8			
JBL	T545		219.95	100	6 x 9	4	40-18	3	F	3 3/8	Yes	Biamp capable; angled midrange and tweeter.	
	T540		179.95	100	6 x 9	4	40-18	2	F	3 3/8	Yes	Biamp capable; angled tweeter.	
	T425		179.95	75	6 1/2	4	70-18	3	F	2 1/4	Yes	Biamp capable; angled tweeter.	
	T420		149.95	75	6 1/2	4	70-18	2	F	2 1/4	Yes	Angled midrange and tweeter.	
	T205		119.95	50	4 1/2	4	90-18	2	F	1 1/4	Yes	Angled midrange.	
	T115		39.95	15	4 x 6	4	100-20	W	F	1 1/8	Yes		
	T105		29.95	15	3 1/2	4	120-20	W	F	1 1/2	Yes		
	LE10H-1	158.00	10	8	8	30-3		F	4 1/2	No			
	LE8T-H	135.00	5	8	8	35-15		F	3 1/8	No			
	2105H	63.00	5	5	8	300-15		F	1 1/4	No			
	LT-1		249.95	50	5 1/4	4	80-16	2	S		No	Swivel bracket inc.	
	JENSEN	J3033		159.95	100	6 x 9	4	38-40 ±3	3	F	3 3/8	Yes	
		J1242		159.95	55	6 x 9	4	40-20 ±3	4	F	4	Yes	
J2020			154.95	65	6 x 9	4	40-40 ±3	3	F	3 3/8	Yes		
J3023			139.95	75	6 1/2	4	52-40 ±3	3	F	1 1/8	Yes		
J1065			129.95	50	6 x 9	4	40-20 ±3	3	F	3 3/4	Yes		
J1365			129.95	50	6 x 9	4	40-20 ±3	3	F/S	†	Yes		
J1401			129.95	45	4 x 10	4	40-20 ±3	3	F	2 1/2	Yes		
J1279			124.95	75	6 1/2	4	52-40 ±3	3	S	1 1/8	Yes		
J2037			129.95	90	6 x 9	4	38-20 ±3	2	F	3 3/8	Yes		
J3013			109.95	75	6 1/2	4	52-40 ±3	2	F	1 1/8	Yes		
J1201			99.95	50	6 1/2	4	50-20 ±3	2	S	1 1/8	Yes		
(Continued)													

SPEAKERS

MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 3-Way (3), 4-Way (4), Surround (S), Center (C), Convertible (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes		
JENSEN (Continued)	J3003	89.95	50	4 1/2	4	63-40 ±3	2	F	1 7/8	Yes	Collar angled to direct sound. As above. As above. Fits 3 1/2- or 4 x 6-inch cutout.		
	J1069	84.95	45	6 x 9	4	40-18 ±3	2	F	3 3/4	Yes			
	J1369	84.95	50	6 x 9	4	40-16 ±3	2	F/S	1	Yes			
	J1405	84.95	45	4 x 10	4	45-18 ±3	2	F/S	2 1/2	Yes			
	J1188	84.95	45	6 1/2	4	58-18 ±3	2	F	1 7/8	Yes			
	J1077	79.95	45	5 1/4	4	60-18 ±3	2	F	2 1/2	Yes			
	J1186	76.95	40	4 1/2	4	65-18 ±3	2	C	2	Yes			
	J1093	71.95	40	4 1/2	4	65-18 ±3	2	F	2	Yes			
	J1292	59.95	40	5 1/4	4	58-16 ±3	2	W	1 1/4	Yes			
	J1283	49.95	30	4	4	65-20 ±3	2	F	1 7/8	Yes			
	J1245	49.95	40	6 1/2	4	50-14 ±3	W	C	1 7/8	Yes			
	J1435	37.95	25	4 x 6	4	65-18 ±3	W	W	1 7/8	Yes			
	J1445	34.95	25	4 1/2	4	70-17 ±3	W	C	1 7/8	Yes			
	J1350	32.95	25	3 1/2	8	80-15 ±3	W	F	1 1/2	Yes			
	J2080	59.95	65	8	6	35-1 ±3	W	F	4 1/8	Yes			
	J2060	44.95	65	6 1/2	4	52-5.6 ±3	W	F	2 1/2	Yes			
	J2094	54.95	75	8	8	1.7k-24k ±3	W	F	1	Yes			
JET SOUND ELECTRONICS	JSE 411	29.95	20	4	4	80-12.5	W	F	1	Yes	Biamp capable.		
	JSE 416	24.95	20	5 1/2	4	80-16	W	F	1	Yes			
	JSE 426	34.95	30	5 1/2	4	80-20	2	F	1	Yes			
	JSE 500	12.95	15	6 1/2	4	100-10	W	F	1 5/8	Yes			
	JSE 511	29.95	40	6 1/2	4	80-16	W	F	1 5/8	Yes			
	JSE 541	39.95	50	6 1/2	4	60-20	2	F	1 1/2	Yes			
	JSE 560	44.95	60	6 1/2	4	70-18	2	F	2 1/8	Yes			
	JSE 570	64.95	80	6 1/2	4	60-20	2	F	2 3/4	Yes			
	JSE 975	59.95	100	6 x 9	4	55-20	2	F	3	Yes			
	JSE 985	89.95	100	6 x 9	4	55-20	3	F	3	Yes			
	JSE 1043	79.95	100	4 x 10	4	60-19	3	F	2 3/4	Yes			
	JSE 1515	119.95	40	6	4	90-18	3	C	1 1/2	Yes			
	JSR ELECTRONICS	JSR210	24.97	25	6 x 9	8	50-18	3	F	2 1/2		No	
		JSR208	22.97	30	5 1/4	8	70-18	3	F	2 1/2		No	
JSR212		5.95	8	4	8	60-14	3	F	2	No			
JSR211		5.95	8	5 1/2	8	75-16	3	F	1 1/2	No			
JVC	CS-300	29.95	20	3 1/2	4	80-15 ±2	W	F	1 1/2	Yes			
	CS-410	49.95	30	4	4	45-16 ±2	W	F	1 3/4	Yes			
	CS-420	69.95	30	4	4	35-20 ±2	2	F	1 3/4	Yes			
	CS-610	59.95	40	6 1/2	4	40-18 ±2	W	F	1 7/8	Yes			
	CS-620	79.95	50	6 1/2	4	40-20 ±2	2	F	1 7/8	Yes			
	CS-4120	89.95	40	4 x 10	4	40-20 ±2	2	F	3	Yes			
	CS-6920	119.95	90	6 x 9	4	30-20 ±2	2	F	4 1/8	Yes			
	CS-6930	149.95	90	6 x 9	4	30-20 ±2	3	F	4 1/8	Yes			
	KENWOOD	KSC-1000	249.00	100	5	4	60-25	2	F	1 5/8		Yes	Rain shield inc. As above. As above. As above. As above. As above.
KFC-6900		199.00	100	6 x 9	4	35-21	3	F	4 1/8	Yes			
KFC-6910		149.00	80	6 x 9	4	40-20	3	F	4	Yes			
KFC-6920		125.00	80	6 x 9	4	45-20	2	F	4	Yes			
KFC-694		65.00	25	6 x 9	4	45-20	2	F	3	Yes			
KFC-571		119.00	60	5 x 7	4	50-20	2	F	2 3/4	Yes			
KFC-160		125.00	60	6 1/2	4	35-20	3	F	2 1/8	Yes			
KFC-1610		99.00	50	6 1/2	4	50-20	2	F	2 1/8	Yes			
KFC-1620		85.00	30	6 1/2	4	50-20	2	F	2 1/8	Yes			
KFC-1630		75.00	25	6 1/2	4	55-20	2	F	1 5/8	Yes			
KFC-1640		55.00	25	6 1/2	4	55-20	2	F	1 5/8	Yes			
KFC-120		75.00	25	5	4	60-20	2	F	1 7/8	Yes			
KFC-1220		65.00	25	5	4	60-20	2	F	1 3/4	Yes			
KFC-103		65.00	20	4	4	80-20	2	F	1 7/8	Yes			
KFC-83		32.00	20	3 1/2	4	96-20	2	F	1 7/8	Yes			
KFC-4610		75.00	20	4 x 6	4	60-20	2	F	1 7/8	Yes			
KSC-501B		159.00	50	4	4	60-20	2	S	Yes	Yes			
KFC-2020		149.00	100	8	4	20-3	2	F	1 1/4	Yes			
KRACO		THP-693	129.95	100	6 x 9	4	40-20	3	F	3	Yes		
		THP-413	129.95	75	4 x 10	4	70-15	3	F	2 3/4	Yes		
	THP-543	129.95	100	5 1/4	4	70-20	3	F	2 3/4	Yes			
	THP-692	109.95	100	6 x 9	4	45-18	2	F	3	Yes			
	TRI-369	69.95	20	6 x 9	8	60-17 ±5	3	F	3	Yes			
LEAR JET	6950	129.95	120	6 x 9	4	40-20	3	F	No	No			
	6540	99.95	120	5 1/4	4	50-18	3	F	No	No			
	6932	49.95	60	6 x 9	4	40-20	3	F	No	No			
	6521	49.95	25	5 1/4	4	70-16	2	F	No	No			
	6510	39.95	20	5	4	80-15	2	F	No	No			
LINEAR POWER	Bass Vent	199.95	150	(2) 8	4	28-120 Hz ±3		F	10	No			
MAJESTIC ELECTRONICS	MS 69120W	99.95	120	6 x 9	4	45-20	3	F	No	No	Mid-tweeter unit, inc. attenuator, pointable.		
	M2TS	39.95	40			350-20		S					
	MS 6565	69.95	60	6 1/4	4	60-20	2	F	1 1/4	No			
	MS 5600	119.95	80	4	4	30-20	3	S		No			
	MS 5500	79.95	120	6 1/2	4	50-20	3	F		No			
MS 6540	49.95	60	4	4	100-20	2	F	1 1/4	No				
MARANTZ (Continued)	MZS 350	44.00	20	3 1/2	4	150-18	2	F	1 1/2	Yes			
	MZS 410	40.00	20	4	4	120-14	1	F	1 1/2	Yes			
	MZS 412	90.00	90	4 x 10	4	80-20	2	F	3 1/2	Yes			
	MZS 420	60.00	50	4	4	120-18	2	F	1 3/8	Yes			

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Flush Mount (F), Surface Mount (S), Convertible (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes
MARANTZ (Continued)	MZS 620	90.00	50	5 1/4	4	120-18	2	F	1 3/4	Yes		
	MZS 630	120.00	100	5 1/4	4	100-18	3	F	2 3/4	Yes		
	MZS 692	100.00	100	6 x 9	4	60-18	2	F	3 3/4	Yes		
	MZS 693	140.00	100	6 x 9	4	50-20	3	F	3 3/8	Yes		
MATRECS	MTX Polyplex 4.5	99.95	60	4 1/2	4	90-20 ± 3	2	F	1 3/4	Yes		
	MTX Polyplex 5.3	109.95	60	5 1/4	4	75-20 ± 3	2	F	1 7/8	Yes		
	MTX Polyplex 6.5	119.95	60	6 1/2	4	60-20 ± 3	2	F	2 1/2	Yes		
	MTX Polyplex 6.9	139.95	60	6 x 9	4	55-20 ± 3	2	F	3	Yes		
	MTX Polyplex 7.0	179.95	100	6 x 9	4	45-20 ± 3	2	F	3 1/4	Yes		
METROSOUND	SK693XL	68.95	120	6 x 9	4	50-20	3	F	3	No		
	SK692XL	63.95	120	6 x 9	4	50-20	2	F	3	No		
	SK523XL	68.95	120	5 1/4	4	60-20	3	F	2 1/2	No		
	SK522XL	51.95	120	5 1/4	4	60-20	2	F	2 1/2	No		
	SK412XL	42.95	80	4 1/2	4	100-14	2	F	1 1/2	No		
	SK312XL	26.95	60	4 1/2	4	200-14	W	F	1 1/2	No		
MGT	W-4208	49.95	25	4	4	70-20	2	C	1 3/4			
	W-5206	49.95	25	5	4	80-20	2	C	1 3/8			
	W-4610	59.95	25	4 x 6	4	70-20	2	C	1 7/8			
	W-6913 C	84.95	100	6 x 9	4	40-20	2	C	2 7/8			
	W-6913 T	99.95	100	6 x 9	4	50-22	3	C	2 7/8			
	W-6206	59.95	25	6	4	80-20	2	S	1 3/8			
MITSUBISHI	SX-40SA	189.95	100	4	4	125-20 ± 3	2	S		Yes		
	SG697B	139.95	100	6 x 9	4	70-18 ± 3	3	F	3 7/8	Yes		
	SG69CB	99.95	40	6 x 9	4	90-17 ± 3	2	F	3 7/8	Yes		
	SG40CB	99.95	50	4 x 10	4	100-18 ± 3	2	F	3 3/4	Yes		
	SG13CD	79.95	30	5 1/4	4	115-18 ± 3	2	F	1 7/8	Yes		
	SG13WD	59.95	30	5 1/4	4	120-12 ± 3	2	F	1 7/8	Yes		
	SG10CE	64.95	30	4	4	140-18 ± 3	2	F	1 3/4	Yes		
	SG10WE	49.95	20	4	4	120-17 ± 3	2	F	1 3/4	Yes		
	SR35WA	34.95	20	3 1/2	4	180-12 ± 3		F	1 3/4	Yes		
	SB2SA	39.95	20	2	4	5k-12k ± 3	W	S		Yes		
	MONOLITHIC SOUND	MS-2	160.00	320.00	100	4	70-15 ± 3	2	S	6		
		MS-5	69.00	138.00	75	8	100-15 ± 3	2	S	2		
NAKAMICHI	SP-400	390.00	80	5	4	50-22	3	S	1 1/4	No	Separate crossover network.	
DROVOX MAGNUM	M 158	97.95	45	4 x 10	4	60-22	2	F	3		Fits 6 x 9-inch cutouts. As above. Fits 4 x 6-inch cutouts. As above.	
	M 181	144.50	100	8	4	20-4.5	2	F	3 1/2			
	M 183 D	179.95	100	8	4	20-19	2	F	3 1/2			
	211	70.00	25	4	4	160-22	2	F	2			
	212	58.30	25	4	4	100-16	W	F	1 3/4			
PANASONIC	EAB-009	299.95	60	6 1/2	4	35-25	2	S		Yes		
	EAB-069	89.95	30	6 1/2	4	40-25	2	F		Yes		
	EAB-080	179.95	100	8	4	30-20	2	F		Yes		
	EAB-049	69.95	30	4	4	50-25	2	F		Yes		
	EAB-692	89.95	30	6 x 9	4	40-25	2	F		Yes		
	EAB-691	64.95	30	6 x 9	4	40-20	W	F		Yes		
	EAB-940	119.95	100	6 x 9	4	40-25	2	F		Yes		
	EAB-930A	109.95	100	5 1/4	4	50-20	2	F		Yes		
	EAB-69A	89.95	25	6 x 9	4	45-20	3	F		Yes		
	EAB-06A	79.95	25	5 1/4	4	50-20	3	F		Yes		
	EAB-050A	52.95	25	5	4	50-16	W	F		Yes		
	EAB-040	49.95	25	4	4	70-18	W	F		Yes		
	EAB-063	84.95	25	6 1/2	4	40-25	2	F		Yes		
	EAB-062	74.95	25	6 1/2	4	45-25	2	F		Yes		
	EAB-061	59.95	25	6 1/2	4	45-20	W	F		Yes		
	EAB-030	29.95	20	3 1/2	4	100-20	W	F		Yes		
	EAB-911	39.95	20	5	4	50-15		F		Yes		
	EAB-909	34.95	8	5	4	50-15		F		Yes		
	EAB-915	39.95	20	4	4	60-15		F		Yes		
	EAB-412	79.95	25	4 x 10	4	60-25	2	F		Yes		
	EAB-411	64.95	25	4 x 10	4	60-20	W	F		Yes		
PARASOUND	SX40	44.50	40	4	4	80-20 ± 4		F	1 1/2		Requires only 1/2 inch in front of baffle. Low-pass networks inc.	
	SCX55	69.95	50	5 1/4	4	75-20 ± 3	2	F	1 1/2			
	SCX65	89.98	50	6 1/2	4	70-22 ± 3	2	F	1			
	STH96	109.95	60	6 x 9	4	60-20 ± 3	3	F	3			
	CMs250	149.95	60	4	4	65-22 ± 3	2	C	1 1/2			
	SW80	129.95	100	8	4	35-600 Hz ± 3		S	4			
	CMs300	179.95	60	4	4	60-22 ± 3	2	F				
PEERLESS AUDIO	Lemans TP165F	32.00	145.50	40	4	50-20	2	F	3 3/4	No	Blamp capable.	
	TX205F	35.00	80	6 1/2	8	50-4.5		F	3 1/4	No		
	TO125F	23.50	80	8	8	40-4		F	3 3/4	No		
	LK100T	15.00	50	5	4, 8	55-5		F	2 5/8	No		
	PHT19	15.00	100		4, 8	1.5k-18k		F	1	No		
	KO100T	19.00	100		4	2.5k-20k		F	1 3/4	No		
	TX255F	40.00	100	10	8	1.5k-20k		F	1 1/8	No		
	TD255F	49.00	100	10	4, 8	30-3.5		F	4 3/4	No		
			150	10	8	30-2.5		F	5	No		
PHILIPS AUTO AUDIO (Continued)	EN8895	399.95	200	(2) 5	4	20-22 ± 5	3	F	1 5/8	No	Blamp capable, midrange tweeter remote mount. Fits 6 x 9-inch cutout.	
	EN8390	199.95	100	5 1/4	4	50-20 ± 5	2	F	1 1/4	No		

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4), Surround (S), Subwoofer (S), Convenient (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes
PHILIPS AUTO AUDIO (Continued)	EN8365	169.95	80	4	4	80-20 ±5	2	S		No	Adjustable swivel mount. Blamp capable. Tweeter removable for separate mounting. Rain guards inc. As above. As above. Fits 4 x 6-inch cutouts. Adjustable swivel mount. Attenuator and crossover inc. For Ford/Chrysler cars; crossover inc. Crossover inc. As above; fits 3 1/2- or 4 x 6-inch cutouts.
	EN8869	199.95	200	6 x 9	4	35-22 ±5	3	F	3 1/4	No	
	EN8769	149.95	200	6 x 9	4	40-20 ±5	2	F	3 1/4	No	
	EN8749	129.95	100	6 x 9	4	40-20 ±5	2	F	2 3/4	No	
	EN8710	129.95	100	4 x 10	4	65-20 ±5	2	F	3	No	
	EN8885	179.95	120	6 1/2	4	25-22 ±5	3	F	2 7/8	No	
	EN8875	139.95	120	6 1/2	4	25-20 ±5	2	F	2 7/8	No	
	EN8855	119.95	100	5 1/4	4	35-20 ±5	2	F	2 7/8	No	
	EN8845	89.95	80	4	4	60-22 ±5	2	F	1 3/4	No	
	EN8741	59.95	80	4	4	60-20 ±5	2	F	1 3/4	No	
	EN8751	59.95	24	5	4	80-15 ±5	W	F	1 1/2	No	
	EN8846	89.95	60	3 1/2	4	100-22 ±5	2	F	1 1/2	No	
	EN8235	129.95	60	3 1/2	4	200-22 ±5	2	S		No	
	EN8320	69.95	100		4	2.7k-22k ±5	2	C	1	No	
	EN8335	49.95	100		4	2.7k-22k ±5	2	F	3/4	No	
	EN8340	49.95	100		4	2.7k-22k ±5	2	F	3/4	No	
	EN8346	49.95	100		4	2.7k-22k ±5	2	F	3/4	No	
EN6500	119.95	150	6 1/2	4	60-5 ±5	2	F	2 3/4	No		
EN6900	149.95	200	6 x 9	4	48-4 ±5	2	F	3 1/4	No		
EN8000	149.95	200	8	4	43-3 ±5	2	F	3 5/8	No		
PIONEER	P-10L	26.95	8	4	4	70-12		F	1 5/8	Yes	†Maximum music power. Tilt-axial. As above.
	TS-100DX	29.95	8	4	4	50-14		F	1 3/4	Yes	
	TS-1011	34.95	30†	4	4	50-16	W	F	1 3/4	Yes	
	TS-106	49.95	20	4	4	50-16		F	1 3/4	Yes	
	TS-107	54.95	20	4	4	50-20	W	F	1 3/4	Yes	
	TS-108	64.95	20	4	4	50-20	2	F	1 3/4	Yes	
	TS-1044K	74.95	30†	4	4	50-20		F	1 3/4	Yes	
	TS-121	44.95	20	5 1/2	4	80-16		F	1	Yes	
	TS-1211	49.95	20	5 1/2	4	70-17		F	1	Yes	
	TS-1222	54.95	20	5 1/2	4	50-20	W	F	1 3/8	Yes	
	TS-1200K	89.95	30†	5 1/2	4	50-20	2	F	1 3/8	Yes	
	P16L	29.95	8	6 1/2	4	50-10		F	1 3/8	Yes	
	TS-1611	39.95	30†	6 1/2	4	40-20	W	F	2	Yes	
	TS-160DX	34.95	20	6 1/2	4	40-20	W	F	2	Yes	
	TS-162DX	44.95	20	6 1/2	4	40-20	W	F	2 1/2	Yes	
	TS-1622	59.95	25	6 1/2	4	40-20	W	F	1 1/2	Yes	
	TS-164	59.95	20	6 1/2	4	40-16	2	F	2 1/2	Yes	
	TS-1644	59.95	25	6 1/2	4	40-20	2	F	1 1/2	Yes	
	TS-165	64.95	20	6 1/2	4	30-16	2	F	2 1/2	Yes	
	TS-167	69.95	20	6 1/2	4	30-20	2	F	2 1/2	Yes	
	TS-1633K	79.95	90†	6 1/2	4	30-20	2	F	1 3/4	Yes	
	TS-168	119.95	40	6 1/2	4	35-20	3	F	2 5/8	Yes	
	TS-1655K	124.95	90†	6 1/2	4	30-20	3	F	2 1/8	Yes	
	TS-1690K	149.95	90†	6 1/2	4	40-24	4	F	2 1/8	Yes	
	TS-87	29.95	20	3 1/2	4	100-18		F	1 1/2	Yes	
	TS-T3	49.95	60	3 1/2	4	250-20		F	1 3/4	Yes	
	TS-M2	49.95	20	2 5/8	4	450-20		S		Yes	
	TS-M6	79.95	20	2 5/8	4	350-22	2	S		Yes	
	TS-462	49.95	20	4 x 6	4	60-20	W	F	1 3/4	Yes	
	TS-411	69.95	20	4 x 10	4	50-20	2	F	2 3/4	Yes	
	TS-W203	149.95	60	8	4	28-10		F	3 1/4	Yes	
	TS-202	179.95	60	8	4	30-20	2	F	3 1/4	Yes	
	TS-205	199.95	60	8	4	30-22	3	F	3 1/4	Yes	
	TS-692	63.95	20	6 x 9	4	35-16	W	F	3 3/8	Yes	
	TS-6903	54.95	40†	6 x 9	4	40-19	W	F	3 1/4	Yes	
	TS-6904	84.95	80†	6 x 9	4	35-20	2	F	3 3/4	Yes	
	TS-6905	119.95	80†	6 x 9	4	30-20	3	F	4	Yes	
TS-6906	149.95	100†	6 x 9	4	35-22	3	F	4	Yes		
TS-6907	169.95	100†	6 x 9	4	30-22	4	F	4	Yes		
TS-5	29.95	8	5 1/4	4	180-13		S		Yes		
TS-55	37.95	40†	5 1/8	4	180-13		S		Yes		
TS-X1	49.95	20	3 1/2	4	120-18		S		Yes		
TS-X5	79.95	20	4	4	80-20	W	S		Yes		
TS-X6	109.95	20	4	4	80-20	2	S		Yes		
TS-X7	99.95	60†	4	4	70-20	2	S		Yes		
TS-X8	149.95	80†	4 5/8	4	55-20	3	S		Yes		
TS-X9	199.95	40	3 5/8	4	50-22	2	S		Yes		
TS-Z80	399.95	60	6 1/2	4	70-20	2	S		Yes		
POLK AUDIO	Mobile Monitor V	129.95†	100	5 1/4	4	40-20.5	2	F	1 3/4	No	†Three pieces per side: two drivers and one crossover.
	Mobile Monitor IV	99.95	100	5 1/4	4	40-20.5	2	F	1 3/4	No	
	Mobile Monitor III	74.95	100	5 1/4	4	40-20.5	2	F	1 3/4	No	
	Mobile Monitor I	34.95	50	4	4	80-15	2	F	1	No	
PRDTON	P283	79.95	40	4	4	60-20 ±5	2	F	2	Yes	Wedges opt. Boxes opt. 6 x 9 adaptor opt.
	P285	169.95	80	5 1/4	4	80-20 ±5	2	C	2	Yes	
	P289	99.95	80	6 x 9	4	60-20 ±5	2	F	2 5/8	Yes	
	P297	99.95	80	8	4	35-400 Hz	2	F	4 1/2	Yes	
	P298	69.95	139.95	120	10	4	25-400 Hz	F	5	Yes	
	P299	79.95	159.95	150	12	4	20-400 Hz	F	5 1/2	Yes	
PYLE INDUSTRIES (Continued)	HS100A	230.00	55	4	4	50-20 ±5	2	S		Yes	
	HS150P	215.00	55	4	4	50-20 ±5	2	S		Yes	
	HP523A	179.95	55	5 1/4	4	45-20 ±5	2	F	1 1/8	Yes	
	HP43A	155.95	55	4	4	100-20 ±5	2	F	7/8	Yes	
	F69C160-FC	149.95	70	6 x 9	4	40-20 ±5	2	F	4 1/4	Yes	

SPEAKERS

MANUFACTURER	Model	Price, \$ (If Sold Individually)	Price, \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Whizzer (W), 3-Way (3), 4-Way (4)	Flange Mount (F), Surface Mount (S), Compatible (C)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes
PYLE INDUSTRIES (Continued)	F69C200-FCD	155.95	85	6 x 9	4/8	50-20 ± 5	2	F	3 7/8	Yes	Biamp capable. As above.	
	F69C290-FCD	185.95	100	6 x 9	4/8	50-20 ± 5	2	F	4	Yes		
	F69C100-FT	125.95	55	6 x 9	4/8	55-20 ± 5	2	F	3 3/4	Yes		
	F69C200-FT	145.95	85	6 x 9	4/8	50-20 ± 5	2	F	3 7/8	Yes		
	F69C290-FT	175.95	100	6 x 9	4/8	50-20 ± 5	2	F	4	Yes		
	F69C100-WF	78.95	55	6 x 9	4/8	55-18 ± 5	2	W	3	Yes		
	F69C180-WF	85.95	55	6 x 9	4/8	50-18 ± 5	2	W	3 1/2	Yes		
	F410C100-FP	105.95	45	4 x 10	4/8	55-40 ± 5	2	F	3 3/8	Yes		
	F410C160-FP	124.95	50	4 x 10	4/8	55-40 ± 5	2	F	3 1/2	Yes		
	F410C100-WF	79.95	45	4 x 10	4/8	55-18 ± 5	2	W	2 5/8	Yes		
	F35C30-WF	19.95	30	3 1/2	4/8	100-18 ± 5	2	W	1 3/8	Yes		
	F35C55-WF	21.85	30	3 1/2	4/8	90-18 ± 5	2	W	1 1/2	Yes		
	F4C99-F	69.95	35	4	4/8	70-18 ± 5	2	W	1 3/8	Yes		
	F45C99-F	74.95	35	4 1/2	4/8	60-18 ± 5	2	W	1 5/8	Yes		
	F52C100-FP	99.95	45	5 1/4	4/8	60-40 ± 5	2	F	2	Yes		
	F52C165-FP	119.95	55	5 1/4	4/8	55-40 ± 5	2	F	2 1/4	Yes		
	F52C100-WF	75.95	45	5 1/4	4/8	60-18 ± 5	2	W	2	Yes		
	F65C120-CD	119.95	50	6 1/2	4/8	55-20 ± 5	2	F	2	Yes		
	F65C120-WCR	85.95	50	6 1/2	4/8	55-20 ± 5	2	W	2	Yes		
	F5C100-CR	23.50	45	5	4/8	50-18 ± 5	2	F	1 1/2	Yes		
	F46C75-FCD	40.95	35	4 x 6	4/8	70-20 ± 5	2	F	2 1/8	Yes		
	F46C55-WF	21.95	35	4 x 6	4/8	80-18 ± 5	2	F	1 3/4	Yes		
	F57C100-WF	24.25	45	5 x 7	4/8	60-18 ± 5	2	F	2 1/8	Yes		
	W52C165-F	29.95	55	5 1/4	8	50-8 ± 5	2	F	2 3/4	Yes		
	W65C200-F	33.95	85	6 1/2	8	40-7.5 ± 5	2	F	3 1/4	Yes		
	W65C200-F4	34.25	85	6 1/2	4	40-7 ± 5	2	F	3 1/4	Yes		
	W65C200-F4D	40.90	85	6 1/2	4	35-5 ± 5	2	F	3 1/4	Yes		
	W65C170-F4S	34.95	90	6 1/2	4	25-3.5 ± 5	2	F	3	Yes		
	W8C200-F	36.50	100	8	8	30-7 ± 5	2	F	3 5/8	Yes		
	W8C200-F4	36.95	100	8	4	30-6.5 ± 5	2	F	3 5/8	Yes		
	W8C290-F4D	48.95	105	8	4	25-4.5 ± 5	2	F	3 3/4	Yes		
	W8C300-F	47.95	115	8	8	25-4.5 ± 5	2	F	3 3/4	Yes		
	W8C300-F4	48.50	115	8	4	25-4 ± 5	2	F	3 3/4	Yes		
	W8C200-F4S	39.95	100	8	4	20-3 ± 5	2	F	4	Yes		
	W10C200-F	39.95	105	10	8	25-6.5 ± 5	2	F	4 3/8	Yes		
	W10C200-F4	40.50	105	10	4	25-6 ± 5	2	F	4 3/8	Yes		
	W10C300-F	52.50	120	10	8	20-4.5 ± 5	2	F	4 3/4	Yes		
	W12C200-F	45.50	115	12	8	20-6 ± 5	2	F	5 1/4	Yes		
	W12C200-F4	45.95	115	12	4	20-5.5 ± 5	2	F	5 1/4	Yes		
	W12C300-F	55.50	130	12	8	20-4.5 ± 5	2	F	5 1/4	Yes		
	W69C200-F	37.50	85	6 x 9	8	40-7 ± 5	2	F	3 1/2	Yes		
	W69C200-F4	37.95	85	6 x 9	4	40-6.5 ± 5	2	F	3 1/2	Yes		
	W69C290-F	44.50	100	6 x 9	8	35-7 ± 5	2	F	4	Yes		
	W69C290-F4	44.95	100	6 x 9	4	35-6.5 ± 5	2	F	4	Yes		
	W69C290-F4D	49.50	100	6 x 9	4	30-4.5 ± 5	2	F	4	Yes		
	W4C55-F4S	23.75	45	4	4	50-4.5 ± 5	2	F	1 7/8	Yes		
	W52C165-F4S	30.95	65	5 1/4	4	30-4 ± 5	2	F	2 3/4	Yes		
	W410C160-F	29.95	50	4 x 10	8	40-8 ± 5	2	F	3 1/8	Yes		
	M5C99-F	23.95	55	5	8	700-14 ±	2	F	2 1/8	Yes		
	M5C160-F	27.50	70	5	8	500-10 ± 5	2	F	2 1/4	Yes		
	M5C160-CR	27.95	70	5	8	500-14 ± 5	2	F	2 1/4	Yes		
	T17C55-X	45.95	45	1 3/4	8	4k-20k ± 5	2	F	1 1/4	Yes		
	T3C24-X	34.50	65	3	8	4k-20k ± 5	2	F	1 1/8	Yes		
	T3PA	22.25	100	2 1/2	8	3k-40k ± 5	2	F	3/4	Yes		
	T3PAS	28.95	100	3 3/4	8	3k-20k ± 5	2	F	1 1/2	Yes		
	H35A15-X	25.50	50	3 1/2	8	3k-20k ± 5	2	F	2 1/8	Yes		
	HT35P	22.50	100	3 1/2	8	4k-40k ± 5	2	F	2 3/4	Yes		
	CD4C30-X	44.50	50	4	8	4k-20k ± 5	2	F	1 3/8	Yes		
	CD4C80-X	47.50	55	4	8	4k-20k ± 5	2	F	1 3/8	Yes		
	QUAM-NICHOLS	30C25Z8	9.40	5	3	8-10	150-14		F	1 1/4		Kit. As above.
3C328U		10.55	5	3 1/2	8-10	130-12		F	1 3/8			
5C328		10.35	5	5	8-10	130-14		F	1 7/8			
52C10Z8		14.70	10	5 1/4	8-10	125-9		F	2 1/4			
52C10FEX		19.00	15	5 1/4	8-10	80-12	W	F	2 1/4			
68C20FEX		25.65	15	6 x 8	8-10	70-18	W	F	3 3/8			
69C10FEX		21.40	15	6 x 9	8-10	40-18	W	F	3 1/4			
69C10FECO		36.40	15	6 x 9	8-10	40-18	W	F	3 1/4			
69C30FEX		42.05	50	6 x 9	8-10	30-12	W	F	3 3/8			
20X		59.50	18	6 x 9	8-10	45-17	W	F	3 1/2			
20CO		35	6 x 9	8-10	35-19		F	3 1/2				
ROYAL SOUND	RS500N	30.00	50	5 1/4	4	80-15 ± 5	W	F	1 3/8	Yes	Weather resistant. As above. As above. As above. As above. As above.	
	RS510N	40.00	50	5 1/4	4	60-17 ± 5	2	F	1 3/8	Yes		
	RS520N	60.00	50	5 1/4	4	60-18.5 ± 5	3	F	1 3/8	Yes		
	RS530	60.00	75	6 1/2	4	90-17 ± 5	3	F	2	Yes		
	RS800	50.00	80	6 x 9	4	70-20 ± 5	2	F	2 1/2	Yes		
	RS900	60.00	100	6 x 9	4	60-20 ± 5	3	F	2 1/2	Yes		
SANSUI	SB-100	60.00	25	4	4	50-20	2	F	1 1/8	Yes	Aimable tweeter. As above.	
	SB-105	60.00	30	4	4	50-20	2	F	1 1/2	Yes		
	SB-135	90.00	40	5 1/4	4	48-21	3	F	1 3/4	Yes		
	SB-160	90.00	30	6 5/8	4	40-20	2	F	1 3/4	Yes		
	SB-165	100.00	60	6 5/8	4	40-21	2	F	2 1/4	Yes		
	SBF-703	200.00	60	6 5/8	4	38-22	3	F	2 1/2	Yes		
	SBF-707	260.00	70	8	4	28-22	3	F	3	Yes		
	SB-903	230.00	80	4 3/4	4	55-21	4	S	3	Yes		
	SB-907	430.00	110	5 1/8	4	43-22	4	S	3	Yes		
	SANYD (Continued)	SP41	19.95	10	4	4	80-15	W	F	1 5/8		Yes
SP42		34.95	20	4	4	80-20	2	F	1 7/8	Yes		
SP40		49.95	30	4	4	70-20	2	F	1 7/8	Yes		
SP24		39.95	20	4 x 6	4	80-20	2	F	1 3/4	Yes		

SPEAKERS

MANUFACTURER	Model	Price \$ (If Sold Individually)	Price \$ (If Sold in Pairs)	Recommended Max. Power, Watts	Woofer Size, Inches	Impedance, Ohms	Frequency Response, Hz to kHz, ±dB	Woofer (W), 2-Way (2), 3-Way (3), 4-Way (4)	Push Mount (F), Snap Mount (S)	Max. Required Mounting Depth, Inches	Application Guide Available?	Notes
SANYO (Continued)	SP55	29.95	15	5 1/4	4	80-12		F	1 1/8	Yes	Water-resistant cover.	
	SP56	39.95	20	5	4	70-20	2	F	1 1/8	Yes	As above.	
	SP700	15.95	5	6 1/2	4	100-10		F	1 3/4	Yes		
	SP62	24.95	20	6 1/2	4	70-15	W	F	1 1/4	Yes	As above.	
	SP64	44.95	20	6 1/2	4	60-17	2	F	1 3/4	Yes	As above.	
	SP9035	49.95	30	6 1/2	4	70-17	2	F	1 1/4	Yes	As above.	
	SP67	59.95	40	6 1/2	4	60-17	2	F	2	Yes	As above.	
	SP9046H	99.95	100	6 1/2	4	60-20	2	F	2 7/8	Yes	As above.	
	SP75	54.95	30	5 x 7	4	80-17	2	C	2	Yes	Dust-resistant netting.	
	SP92	69.95	40	6 x 9	4	55-17	2	F	4	Yes	Water-resistant cover.	
	SP94	79.95	40	6 x 9	4	55-20	3	F	3 3/4	Yes		
	SP96	99.95	100	6 x 9	4	55-20	3	F	4	Yes		
	SP16	59.95	40	4 x 10	4	80-17	2	F	3	Yes	Without grille, Model SP165, \$49.95/pair.	
	SP88	99.95	30	4	4	80-20	2	S		Yes		
SP90	219.95	100	4	4	80-20	2	S		Yes	Three-position high-frequency level control.		
SONY	XS-3	34.45	20	3 1/2	4	100-20 ±10	W	F	1 1/2	Yes	88 dB SPL (1 watt/1 meter).	
	XS-101	64.95	20	4	4	50-20 ±10	W	F	1 3/4	Yes	91 dB SPL (w/m).	
	XS-102	79.95	20	4	4	50-20 ±10	2	F	1 3/4	Yes	As above.	
	XS-211S	59.95	15	5	4	85-12 ±10	W	F	1	Yes	As above.	
	XS-301	89.95	20	5 1/4	4	47-20 ±10	2	F	1 1/2	Yes	92 dB SPL (w/m).	
	XS-410	139.95	40	4 x 10	4	65-20 ±10	3	F	3 3/8	Yes	91 dB SPL (w/m).	
	XS-606	99.95	30	6 1/2	4	45-20 ±10	2	F	2	Yes	92 dB SPL (w/m).	
	XS-613S	89.95	20	6 1/2	4	70-17 ±10	2	F	1 1/8	Yes	93 dB SPL (w/m).	
	XS-690	94.95	30	6 x 9	4	35-20 ±10	2	F	4	Yes	92 dB SPL (w/m).	
	XS-691	129.95	40	6 x 9	4	35-21 ±10	3	F	4	Yes	As above.	
	XS-880	189.95	60	8	4	30-21 ±10	3	F	2 1/2	Yes	As above.	
	XS-18	299.95	100	5	4	90-40 ±10	2	S		Yes	88 dB SPL (w/m).	
	XS-H1	129.95	60	6 1/2	4	5k-22k ±10		S		Yes	94 dB SPL (w/m).	
	XS-L16	129.95	40	6 1/2	4	30-3.5 ±10		F	2 1/2	Yes	89 dB SPL (w/m).	
	XS-L20	199.95	60	8	4	18-5 ±10		F	2 1/8	Yes	91 dB SPL (w/m).	
SPARKOMATIC	SK 6900	89.95	40	6 x 9	4-8	40-18	3	F	3	Yes		
	SK 6920C	47.95	25	6 x 9	4-8	30-15	2	F	3 3/8	Yes		
	SK 520C	44.95	25	5 x 7	4-8	60-15	2	F	5 1/2	Yes		
	SK 620C	39.95	25	6	4-8	50-15	2	F	2 3/4	Yes		
	SK 4120C	47.95	25	4 x 10	4-8	50-15	2	F	3 3/8	Yes		
	SK 410	29.95	20	2	4-8	90-15		S	5	Yes		
	SK 6950	99.95	100	6 x 9	4	50-20	4	F	4	Yes		
	SK 550	89.95	100	5 x 7	4	60-20	4	S	5 1/2	Yes		
	SK 650	74.95	100	6	4	70-20	4	F	3	Yes		
	SK 6922T	69.95	40	6 x 9	4	30-17	3	F	3 1/2	Yes		
	SK 522T	59.95	40	5 x 7	4	60-17	3	S	5 1/2	Yes		
	SK 622T	54.95	6	6	4	50-17	3	F	2 3/4	Yes		
	SK 400	24.95	20	3 3/8	4-8	90-15		F	1 3/4	Yes		
	SK 600	39.95	15	5 1/2	4-8	70-15	2	F	1 1/2	Yes		
	SK 300	19.95	20	3 3/8	4-8	90-15		F	1 1/2	Yes		
	SK 690	29.95	15	6 x 9	4-8	50-12		F	3 3/8	Yes		
	SK 510	29.95	15	5 x 7	4-8	60-12		S	5 1/2	Yes		
	SK 610	19.95	15	6	4-8	70-12		F	2 1/4	Yes		
	SPECO	SK6925TD	119.95	120	6 x 9	4	30-20	3	F	4		Blamp capable.
SK5A5SC		49.95	40	5	8	120-18	2	F	1 1/4			
SK6920Q		79.95	80	6 x 9	8	50-20	4	F	4			
TANCREDI	TSX-731	89.95	25	6 x 9	4	55-20 ±5	3	S	3 3/8			
	TSX-721	74.95	25	6 x 9	4	55-20 ±5	2	S	3 3/8			
	TSX-531	79.95	25	5 1/4	4	65-20 ±5	3	S	3			
	TSX-521	59.95	20	5 1/4	4	70-20 ±5	2	S	3			
	TSX-511	29.95	20	5 1/4	4	70-18 ±5		S	2 1/2			
	TSX-421	34.95	15	4	4	80-20 ±5	2	S	2 1/2			
	TSX-411	24.95	15	4	4	80-18 ±5		S	2 1/2			
ULTRA SOUND	US 369	69.00	50	6 x 9	4	50-20	3	F	4 7/8	No		
	US 369P	89.00	75	6 x 9	4	45-20	3	F	4 1/8	No		
	US 3410	63.00	50	4 x 10	4	50-20	3	F	4 3/4	No		
	US 36P	59.00	30	6 1/4	4	65-20	3	F	3	No		
	US 25	39.95	25	5 1/4	4	70-20	2	F	1 1/2	No		
	US 100	89.95	50	4	4	110-20	2	S		No		
VISONIK	D4000	107.00	214.00	50	4	50-22 +4, -8	2	S		No	Wedge-shaped enclosure.	
	D5000	138.00	276.00	50	4	50-25 +4, -8	2	S		No	As above.	
	D3200	80.00	160.00	45	4	60-22 +4, -8	2	F	1	No		
	D4200	90.00	180.00	50	4	80-22 +4, -8	2	F	1 1/4	No		
	D5200	98.00	196.00	50	4	60-22 +4, -8	2	F	1 1/2	Yes	Fits 4 x 6-inch cutout.	
	DMT-1	68.00	136.00	50	4	800-19 ±4	2	F	1	No	As above; blamp capable.	
YAMAHA	YCS-530	200.00	60	5 1/2	4	50-20	2	F	1 1/4		Waterproof.	
	YCS-691	180.00	60	6 x 9	4	40-20	2	F	2 7/8		As above; angled tweeter.	
	YCS-601	160.00	60	6 1/2	4	45-20	2	F	2 3/8		As above.	
	YCS-690	140.00	60	6 x 9	4	40-20	2	F	2 7/8		+1 1/8 with opt. adaptor.	
	YCS-600	100.00	50	6 1/2	4	45-20	2	F	2 1/8		+1 1/8 with opt. adaptor.	
	YCS-400	60.00	40	4	4	70-20	W	F	1 1/8			
	YCS-800	140.00	100	8	4	20-1		F	2 7/8		+3 1/2 if mounted below panel.	
	YCS-300	90.00	20		4	2k-20k		F	3/4		Crossover inc.	

For Manufacturers' Addresses, see page 31



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Unfortunately, standard turntable design has left too much to chance in terms of cartridge mounting and performance.

Technics turntables with the patented P-Mount tonearm/cartridge system have changed all that. By providing complete compatibility between tonearm and cartridge to achieve the optimum tonearm resonant frequency; the level at which annoying bass frequency interference is minimized. For the accuracy and fidelity conventional turntables can deny you.

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Trilling Adventures

Q. When I record some vocalists, I get a trilling "st . . . st . . . st" sound on the tape. It is even worse when the vocalist emphasizes a word with an "s" or a "t" in it. It sounds as though an AM radio were mis-tuned, and it is very annoying. I have tried almost everything to correct this, such as adjusting the manual bias and azimuth, cleaning and demagnetizing the heads, and using different brands of tapes and cassettes, but with no luck. Where do you think the problem lies?—Nang Tom, Ottawa, Ont., Canada

A. Your problem sounds like tape saturation, which would be caused by applying excessive signal level to the tape. Possibly the record-level indicator is misadjusted so that it doesn't adequately warn you of excessive recording level. Try recording at reduced levels. Alternatively, the fault may lie in the record amplifier, which, owing to poor design or faulty components, cannot adequately handle high signal levels.

High Recording Levels

Q. The owner's manual for my cassette deck recommends a peak level of about 0 to 1 dB on the meter to minimize distortion in recording. However, I have a B & O demonstration cassette that registers playback peaks of +5 to +8 dB without audible distortion. Shouldn't I be able to record at similar levels? Is my manual ultra-conservative?—James Macak, Milwaukee, Wisc.

A. First, unless a tape deck incorporates means of calibrating the meter's playback level indication for the specific tape in use, the recording and playback levels will not necessarily agree with each other. Playback level will vary with the tape's sensitivity, that is, with its signal output for a given signal input. It may well be that the demonstration cassette tape has high sensitivity. It may also have high MRL (maximum recording level), permitting a higher than typical signal level to be recorded on the tape without incurring excessive distortion. Further, the B & O tape was recorded with HX Pro circuitry that reduces the tendency toward tape saturation and hence distortion in the treble range. It does so by using high-frequency content of the audio

signal as part of the bias signal, which permits reducing bias current and in turn reducing the amount of treble boost. Therefore, it may be possible to record at a higher than usual level without incurring noticeable distortion and treble loss.

It could well be that your manual's recommendations for recording level are conservative, affording a safety margin to accommodate tapes with lower MRL—that is, the amount of signal one can record on the tape without exceeding 3% harmonic distortion. If you are using high-quality tape, you can probably exceed the manual's recommended recording level by several dB. It is advisable to experiment.

Tape Squeal

Q. Lately, I find that after several playings, some tapes emit a squealing noise when I play them on the cassette deck in my car. This only occurs with one brand of tape, and the same tapes sound fine in my home deck. Any suggestions?—Terry Racicot, Norman, Okla.

A. The cause of tape squeal is seldom easy to figure out. Some combinations of tape and deck—even when both are of high quality—don't work well together in a physical sense and are apt to squeal. As the tape wears, it loses some of its lubrication, increasing the chances of squeal. Yet this will occur with one deck and not with another.

A possible cure, though perhaps only temporary, is achieved by placing the tape and a well-moistened piece of blotting paper in a container for two or three days. Tape-head cleaners and lubricants may help, too. My only other suggestion is to try another brand of tape.

Dubbing Dolby

Q. Both of my cassette decks (different models, same manufacturer) have been calibrated by the factory service so that in both cases 0 VU on the meter in playback corresponds to Dolby level, namely 200 nWb/meter. I have made a calibration tape for myself, using the built-in 400-Hz tone of Deck A. This tape plays back at 0 VU on Deck A. I play this tape on Deck B, adjusting gain so as to read 0 VU. To dub a tape, I play it on Deck B and

record the copy on Deck A with both Dolby circuits off. My direct comparisons with tapes using the same procedures, but with both Dolby circuits on, show that the copies are more faithful to the original when all noise-reduction circuits are off during the copying process. Of course, either way yields copy tapes intended for playback with Dolby noise reduction on.—Steve Freides, New York, N.Y.

A. If everything is properly adjusted, yours is the best dubbing procedure inasmuch as it involves the least tampering with the audio signal. In your case, you have apparently insured good tracking between the two decks, and therefore proper signal transfer, by properly calibrating the decks to each other. However, many audiophiles are not in a position similar to yours, so that they are usually best off, at least from the viewpoint of maintaining correct frequency response, playing with Dolby NR on and recording with Dolby NR on. Still, it is worth experimenting to see what results one can get with the Dolby circuits off.

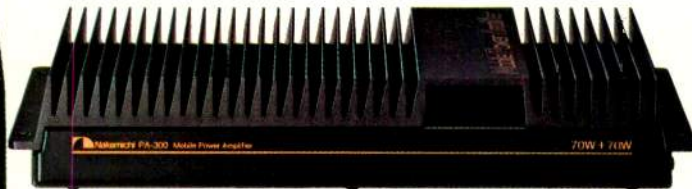
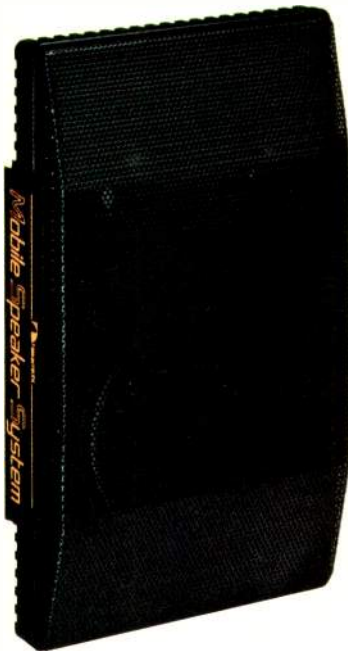
End of the Model Run

Q. I have been told that when a tape-deck model is being phased out, companies sometimes use cheaper parts in the last lot produced. A salesman told me this about a specific deck, and showed me a statement on the specification sheet that the company can at any time use different parts, without advance notice. I didn't believe him, and I still don't. Would you please elaborate on this?—Keith Andre, Cupertino, Cal.

A. In the first place, are you sure the statement on the spec sheet actually referred to parts? The usual disclaimer is that the company reserves the right to change specifications at any time, and usually refers to minor upgrades of features or performance which occur during the model run. If anything, the last run in the series might be superior to earlier units, since the last decks would incorporate all such changes and improvements made during the

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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“Correct azimuth alignment, so that the head gap is at right angles to the recorded track, assures consistency in playback.”

model run to improve performance or eliminate bugs.

The claim that cheaper parts are used in the last run sounds like fiction to me, too. I can't swear it never happens, but I see no reason why it should. A company generally orders or makes parts in substantial numbers, so it might cost *more* to special-order a run of inferior parts. The potential cost saving is usually quite small, and, in fact, using inferior parts could increase the company's costs for in-warranty repairs. Finally, a company has a good deal to lose by jeopardizing its reputation.

Low-Frequency Turnover

Q. Is the playback low-frequency turnover for cassette tapes 50 or 100 Hz? Both have been cited here.—Martin Nagel, Chagrin Falls, Ohio

A. I apologize for the confusion. The low-frequency turnover for cassette tapes used to be 100 Hz at 1 $\frac{1}{8}$ ips. Thus, the 1969 “Standards for Magnetic Tape Records” published by RIAA gave 100 Hz; the 1977 revision gave 50 Hz.

To fill out the picture: For all speeds and for both open-reel and cassette tapes, the low-frequency turnover is 50 Hz. I might also add that the high-frequency turnover is 1,326 Hz for Type I cassette tape (ferric) and 2,274 Hz for Types II (chrome and ferricobalt), III (ferrichrome) and IV (metal particle).

Azimuth Alignment

Q. I own a three-head cassette deck with facilities for adjusting the azimuth of the record head. I would like to know how the record-head alignment works. Is the record head being aligned with the playback head? But if that's the case, once the record head is aligned with the playback head, why is the alignment incorrect when I put the next tape in the deck?

When I purchased the deck, I failed to have the playback head alignment checked. I later discussed this with the dealer and was told that it doesn't matter. Yet tapes made on a deck that I previously owned are unusable on my new deck. The salesman said that head alignment has nothing to do with it and that the equalization curves of the two decks are different. He also said that the cassette industry has no

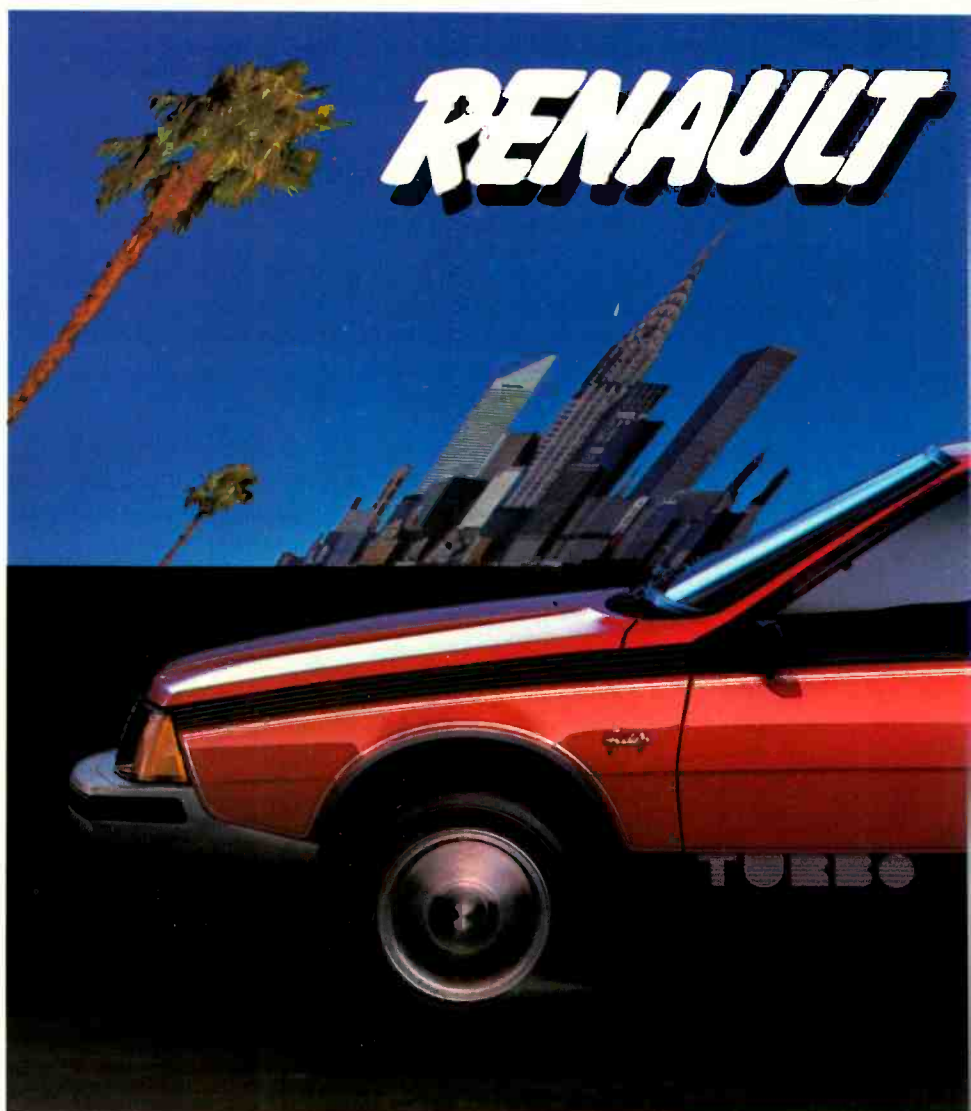
standardization for the playback equalization curves. Is playback head alignment critical?—Name withheld

A. Correct azimuth alignment, with the head gap at right angles to the recorded track, is very important if tapes recorded on one deck are to provide full treble response when played back on another. If the deck has a single record/playback head, any error caused by misalignment in recording will be compensated by equal error in playback, and treble response will be maintained—but only

for tapes made on that deck. With a three-head deck, alignment errors in one head will not be compensated by errors in the other, which makes the problem easier to spot.

Alignment is corrected by adjusting the playback head for maximum output from a high-frequency test tape with correct alignment. The record head, if separate, is then aligned to make tapes yielding maximum output at the playback head.

However, the tape guide system of a cassette may not be sufficiently pre-



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"There is no danger to your deck or mikes with an impedance mismatch of 100 ohms. Neither will performance suffer."

cise, allowing the tape to wander a bit with respect to the tape heads. The result is that azimuth alignment may differ from one cassette to another, from one side of a cassette to the other, and possibly from one time a cassette is played to another.

In a deck such as yours, the playback head's azimuth is aligned and locked, but the record head is left adjustable to compensate for the effects of tape wandering or "skew." Using a built-in indicator or automatic system which senses playback-head output,

the user can then align the record head to match the tape.

The new Nakamichi Dragon takes the opposite approach, with the record head fixed and the play head automatically adjusting itself to match the azimuth recorded on each tape.

With respect to what your audio salesman told you: It *does* matter whether the playback head has correct azimuth if you are to play tapes recorded on other decks. It is also possible that your former deck was out of alignment. The industry *does* have standard

playback EQ curves, which are quite carefully followed by all cassette decks with any pretension to quality.

Impedance Mismatch

Q. I recently purchased a tape deck with microphone inputs rated at 600 ohms, whereas my microphones are rated at 500 ohms. Would it damage my deck if I used these mikes?—Eric Zajack, Sterling Heights, Ill.

A. There is no danger to your deck, your mikes or the quality of their performance when used together.



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Static Charges

Q. I am plagued by problems with static electricity when playing records. The problems are most frustrating when they occur with high-quality audiophile records.

Even when there is no charge on the records, the charge—and problem—is often created in the process of cleaning the discs. My usual procedure involves slowly moving the record from its anti-static sleeve, hand-holding it, and “zapping” it four or five times with a Zerostat gun. I place the record on the turntable, put three drops of D4 fluid on the leading edge of a D4 Disc-washer brush, push the turntable platter turn button, clean the record for five or six revolutions, and then dry it for five or six revolutions. This is followed by again “zapping” the record four or five times with the Zerostat while the disc is still on the turntable. When the record is played, I hear several rapid, consecutive “pops” which reoccur throughout the recording. If the record is played again without removing it from the platter or cleaning it, most of the pops disappear.

Sometimes new, unplayed records have such a charge built up that they are difficult to remove from the sleeve. My attempts to neutralize this charge are no better after I try cleaning them.

Is there a safe, effective way to neutralize a charge that is present from the beginning or created in the cleaning process? The lack of humidity in the environment is not responsible; it has been rainy and humid in the Washington area.—John M. Francis, Landover Hills, Md.

A. I must say that I have not run into a problem quite like yours. Your area would certainly appear to be sufficiently humid to ease virtually any static problems.

My thoughts run to the phono cartridge itself. Some cartridge installations call for a jumper to be placed between one of the ground terminals on the cartridge and a mounting screw which holds the cartridge in its shell. Such jumper lugs are often supplied as part of the installation kit for either the shell or for the cartridge. Perhaps you can find one among the leftover hardware; use it and see if the problem is at least reduced.

Try using only paper sleeves. I have

had problems with some sleeves designed for “better record care”; I stopped giving them away with my lacquer years ago.

The Zerostat is a good aid. You know, of course, that neutralizing a charge requires both a squeeze and a release of the trigger while the gun is in proximity of the disc. It is, however, sometimes advantageous to actually place a charge on the disc. At least in the case of lacquer discs, I have found it best to use a positive charge. In other words, gently squeeze the trigger in the proximity of the disc and then release the trigger.

[Tracking the record with a grounded, carbon-fiber brush, such as those on some Shure cartridges or those sold for record cleaning by Hunt E.D.A. and others, might also help.—I.B.]

Adding Speakers

Q. I would like to add a second set of loudspeakers to my stereo system. I have 6-ohm speakers (90.5 dB SPL, 1 watt/meter efficiency), but I would like to add two 8-ohm speakers.

Is this advisable? If so, what efficiency should the 8-ohm speakers have if I want the same loudness from each set of speakers (when playing both sets at the same time in the same room)?

Because of space restrictions, the 8-ohm speakers will have to be mini-monitor types with good highs and good midrange, but not necessarily with good bass response. The listening room is small enough so that the 6-ohm speakers will provide satisfactory bass.—John C. Deuser, Appleton, Wisc.

A. If the instruction manual which was supplied with your power amplifier indicates that you should not operate your equipment at impedances below 4 ohms, I do not advise you to add another pair of speakers unless they are 16-ohm systems.

The combined impedance of the two pairs of speakers will be less than 4 ohms when using a pair of 8-ohm speakers. Why take chances, even though you might get away with it?

*What you could do, if you can find the space, is to obtain another, identical pair of speakers and connect a pair of speakers *in series* for each channel, for a combined impedance of 12 ohms. Because the speakers are of the*

same make and model, damping will not be compromised. Of course, use heavy-gauge speaker line for all connections. Much depends on the overall cable length, but No. 16 gauge line is generally a good choice.

I think that you will gain little by using four speakers instead of two. The main result gained from using four speakers is somewhat more bass. But you will not get the added bass where the additional speakers are deficient in it.

Noisy, Digitally Recorded Discs

Q. On my new, digitally recorded LP discs, I hear surface noise. I thought that such records were supposed to be noise free! Why aren't they?—Ralph Wilson, Waynesburg, Pa.

A. The fact that an original master recording was made using digital techniques does not alter the fact that this digitally recorded tape was then transferred to an analog disc, with all of the stages of plating and pressing such discs. No matter how the master was created, the LP disc is the limiting factor unless it is recorded using dbx, CX or some other noise-reduction system, for which the listener would need an appropriate decoder.

Electret Microphones

Q. What is the working principle of the electret microphone?—Ghislain Gauthier, Chicoutimi, Quebec, Canada

A. In a capacitor (condenser) microphone, the diaphragm forms one plate of a capacitor whose other plate is fixed. The fixed plate is charged by a high-voltage power supply in series with a high resistance (20 megohms or more), while the diaphragm is at ground potential. When the diaphragm is moved by the sound waves impinging on it, the charge which can be stored by the capacitor varies, increasing as the diaphragm moves closer to the charged plate and decreasing as it moves away. This changing charge produces a voltage across the resistor in series with the fixed plate—an audio signal. This signal then feeds an ampli-

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Suffice it to say, you can expect the same outstanding performance from our new A-90 integrated amplifier.

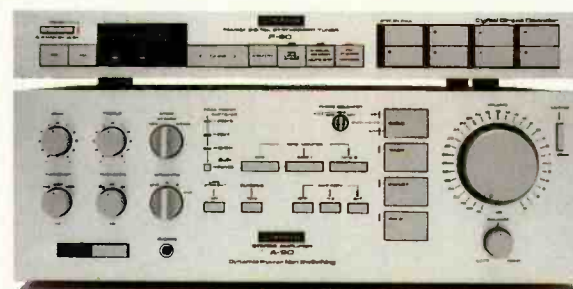
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"Switching to the mono mode can clean up sound on discs when there is rumble or distortion from pinch effect."

fier with a high-impedance input and a lower impedance output.

The electret version is similar in all respects but one: Its capacitor is not charged by a high-voltage power supply but carries its own, permanent charge. There are some waxes which, when heated in the presence of an electrostatic field, will assume the charge of that field and will retain it.

As I understand it, such a charged element is part of the diaphragm. As before, diaphragm motions change the charge on the capacitor, and the varying charge can be transformed into a usable audio voltage.

I have read that electret elements have limited lifetimes of perhaps 15 to 20 years because, during that time, their useful charges will diminish to a point where output falls too low to be of use. I can only say, however, that I have had some of these mikes for a long time (in some cases more than 15 years) and have noticed no significant lowering of output voltage.

Mono Mode Switch

Q. What are the purposes of the mono mode switch on an amp?—Stephen I. Leibowitz, New York, N.Y.

A. The mono mode switch cleans up the sound on some monophonically recorded discs. Distortion caused by pinch effect is reduced, as well as vertical rumble. The switch allows you to listen to weak FM-stereo broadcasts with less background noise, and it can be used for combining program material not really intended as a stereophonic source (such as sound-with-sound recordings, which might, for example, contain a voice on one channel and a guitar on another).

Spike Protection

Q. I am under the impression that voltage spikes can damage electronic equipment (TV, stereo equipment, computers, etc.). Every time I hear the rumble of thunder or the prediction of an electrical storm, I unplug all of my audio and TV equipment (sometimes at 3 or 4 AM!). What's the scoop, Joe? Do voltage spike protectors really work, or am I ready for the booby hatch?—Don May, East Aurora, N. Y.

A. Some equipment is sensitive to voltage spikes, especially computers and computer-like equipment (includ-

ing digitally controlled tuners, etc.). For this reason, spike protectors are generally used with such gear as a precaution. These protectors are plugged between the power line and the equipment to be protected.

Where there are overhead power lines, a lightning stroke can introduce

spikes which can cause problems. If the equipment is turned off, however, spikes will not find their way into the equipment unless the lightning scores a direct hit. Because such a hit is not common, I do not believe that you need to get up at some terrible hour just to unplug all of your equipment. **A**

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BERT WHYTE
JOHN M. EARGLE

TELARC TREAT

DIGITAL BONUS
COMPACT DISCS REVIEWED



Stravinsky: The Firebird; Borodin: Overture to Prince Igor, Polovetsian Dances. The Atlanta Symphony and Chorus, Robert Shaw.
Telarc CD-80039.

This was one of Telarc's earliest recordings on analog LP, and one that was deservedly highly praised. What a pleasure to have it in pure digital CD format. This is a prime example of how good a Compact Disc can sound with the aid of intelligent engineering. Jack Renner used their by-now-standard three-microphone spaced array, using omnidirectional Schoeps microphones. Jack positioned them to achieve a wonderfully natural balance, with a spacious ambience, good orchestral definition and stable instrument localization. Telarc has always sought to achieve wide dynamic range in their recordings and now on this CD, unfettered by the limitations of analog stylus/groove trackability, the "Firebird" is really stunning in this respect. Always noted for their heavy percussion, Telarc's bass drum is heard with great impact. The other end of this dynamic range can be equally thrilling. There is a string diminuendo just before the French horn entrance signaling the beginning of the finale, which reaches its pianissimo level against a

background of total silence. Jack Renner's simple but effective microphone placement gives us a ravishing string tone without a trace of edginess—it can be done! In the choral section of the "Polovetsian Dances," the balance between voices and orchestra is excellent—nowhere does one swamp the other. All in all, a splendid recording which fully exploits the resources of the Compact Disc and my newly acquired Sony CDP-101. *Bert Whyte*

Shostakovich: Symphony No. 5 in D minor. The New York Philharmonic, Leonard Bernstein.
CBS CD-35854.

The New York Philharmonic was on tour in Japan when this recording of Shostakovich's monumental Fifth Symphony was made during a concert in Tokyo's Metropolitan Festival Hall.

Musically, Leonard Bernstein's performance is an unqualified triumph. Technically, alas, the recording suffers from a common ailment of most digital recordings, multi-miking. I have this recording on an analog LP, and it displayed the same anomalies as I now hear in this CD, except that the digital disc magnifies them manyfold.

The recording was mastered on the 3M 32-track digital recorder. Now

many recording companies have a predilection for multi-mike recording, and the 3M recorder certainly allowed them to indulge in this respect. For some reason, practitioners of multi-mike techniques all tend to use certain professional microphones which have a very bright (or as the British say, a "tizzy") top end. These mikes are placed close in to individual musicians or groups of instrumentalists. When analog records are made, either from analog or digital master tapes, there is a certain amount of processing loss that finally shows up in the finished pressing. By their nature, analog discs have a higher noise level which tends to mask some sounds on the recording. In contrast, there is virtually no processing loss in a CD; since there is no noise in digital playback, no masking occurs and such a mike technique is starkly revealed.

The common ailment of many digital discs is first and second violins which are unbearably strident, edgy, shrill, overbright. Other instruments suffer similar problems, but not to the very pronounced degree of the high strings.

To make matters worse, multi-miking usually begets spotlighting of individual instruments, increasing their amplitude until they are grotesquely louder than the rest of the orchestra. On top of all that, selective equalization of the musical spectrum is employed, either during the recording or after the session. Sometimes this can be of help in a hall that is less than acoustically per-



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**DIGITAL BONUS
COMPACT DISCS REVIEWED**

"Ozawa does not shape this sprawling work well enough to hold the listener's attention."



Seiji Ozawa

fect, but more often the equalization is applied with too heavy a hand, especially in the low frequencies.

This digital recording of the Shostakovich Fifth Symphony has the wide dynamic range expected of this medium and it is certainly dead-quiet. The multi-miking does not furnish much in the way of depth perspective, and the various choirs of the orchestra seem compartmentalized—an isolated patch of woodwinds, a bunched-up group of trumpets. The contrabassi and the bass drum appear to have been equalized, as they are tubby and lack articulation. There is a harp passage that sounds odd—this was a live concert—yet the harp appears to be playing in a different acoustic perspective. Apparently, the harp was assigned a separate track and then run through an echo chamber.

The overall sound lacks cohesion and at times is jumbled and amorphous. While there are good sounds here and there which underscore the advantages of digital recording—magical pianissimos unsullied by any noise whatever—it is ultimately the strident high strings which mar this recording. Too bad, for Bernstein's reading is taut, supercharged, highly emotional and the playing of the Philharmonic is of very high order. *Bert Whyte*

Dvořák: Symphony No. 9. The Czech Philharmonic Orchestra, Vaclav Neumann.

Denon/Supraphon C37-7002.

As many readers may know, Denon, or Nippon Columbia, was the first company to record digitally. Their experience is considerable, and for years they have opted for sensible microphone placement, avoiding excessive highlighting or accenting of individual sections. The results have generally been excellent, and this recording is typical of that approach. The recording venue is Dvořák Hall in Prague, and the sound is gorgeous. Listen for the natural buzz in the muted strings in the largo second movement. Nothing could be more accurate.

By the way, this disc carries subsection coding, and the program indicates the points within each movement where the CD player can automatically cue up. *John M. Eargle*

Strauss: Also Sprach Zarathustra.

The Boston Symphony Orchestra, Ozawa.

Philips 400 072-2.

This disc has more extraneous noises than any of the lot. With such a busy score—and with so many open microphones—all kinds of studio noises come through. And then there are Ozawa's bounces on the podium. Problems such as these have been around for years, but the typical analog disc has tended to mask them a bit. With CDs, they are bared all the more.

But getting on to the music, Ozawa does not shape this sprawling work well enough to hold the listener's attention. In my opinion, the recording falls short in both the musical and technical departments. There is another version on CD, Mehta and the New York Philharmonic, which I have not had a chance to hear; it is probably a better entry. *John M. Eargle*

Night Passage: Weather Report
CBS/Sony CD-84597.

This CD demonstrates the fact that much pop-rock music will not sound that much better in the new medium than it did in the old. These sometimes interesting cuts of jazz-rock fusion have been so processed and contained within a narrow dynamic range that you might just as well be listening to FM. This album also demonstrates something that will be no better with CD than it was with the LP: The lack of program information about many pop productions. *John M. Eargle*

The Digital Masterpiece Series. The Philharmonia Hungarica, Zoltan Rozsnyai.
RealTime Records CD-RT2001,
\$17.95.

This is a potpourri of short classical selections such as Chabrier's "Española," Dukas' "The Sorcerer's Apprentice," Rossini's "Thieving Magpie Overture," and Liszt's "Les Preludes." All have appeared previously on analog LP and on dbx-encoded records. The Philharmonia Hungarica is an orchestra originally founded by refugee musicians who fled from the 1956 Hungarian uprising. Rozsnyai was their original conductor, and RealTime Records decided to reunite him with the orchestra for their digital recordings.

Engineer Kenny Kreisel recorded the orchestra in a church in Vienna, with a simple spaced array using two modified AKG 414 microphones. By judicious placement of his mikes, Krei-

Weather Report



sel has achieved a nicely balanced sound—very natural, extremely clean, and the first and second violins are smooth with plenty of presence without any stridency or edginess. The acoustic perspective is spacious without being over-reverberant, and a good front-to-back depth has been achieved. Dynamic range is outstanding, with the "Sorcerer's Apprentice" especially notable. This work also benefits from the absolutely quiet background. An unfortunately soggy bass drum mars the otherwise excellent percussion battery. As to the performance and playing, best to say they are serviceable and enjoyable. The sound is the thing here and nicely proves the point that CDs can fulfill their promise of superior music reproduction. *Bert Whyte*

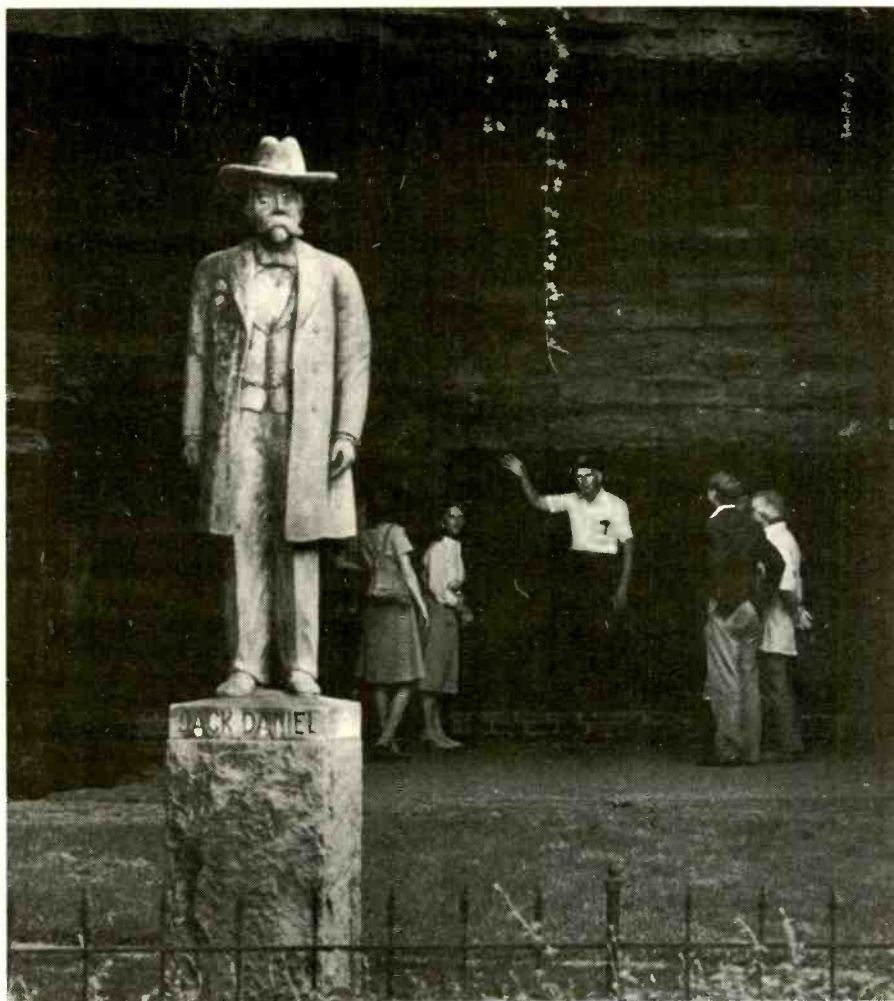
Prokofiev: Symphony No. 5 in B Flat, Op. 100. The Israel Philharmonic, Leonard Bernstein.
CBS CD-35877.

Here we have almost a carbon copy of the Shostakovich Symphony No. 5 Compact Disc. A sterling performance by Bernstein, great playing from the Israel Philharmonic, and, if anything, sound that is even more dismal than in the Shostakovich.

The high strings are dreadfully strident, the overall sound again lacks definition—a fact emphasized by the particularly lumpy and bloated bass response. Again, a pity, for the attributes of wide dynamic range and velvety silent background are obvious. *Bert Whyte*

Tchailkovsky: Symphony No. 5 in E minor, Op. 64. The Cleveland Orchestra, Lorin Maazel.
CBS CD-36700.

Many similarities between this recording and the Shostakovich and Prokofiev discs, the shrill high strings and compressed perspective, are still with us. However, overall balances between orchestral choirs are reasonable and there isn't much spotlighting. While the bass is a bit overblown, it isn't as turgid and amorphous as in the aforementioned releases. Here again, the recording shines in the areas of wide dynamic range and absence of noise. Maazel turns in a good perfor-



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**DIGITAL BONUS
COMPACT DISCS REVIEWED**

"Surprisingly, it turns out that some of the pop recordings are among the better-sounding CDs now available."



Don Menza's Big Band

mance, although the first movement seems surprisingly slow-paced. The Cleveland Orchestra plays with its usual precision and panache. *Bert Whyte*



Beethoven: Symphony No. 5; Schubert: Symphony No. 8. The Vienna Philharmonic Orchestra, Lorin Maazel. **CBS/Sony CD-36711.**

In the last few weeks, I have acquired a number of Compact Discs to go with my Nippon Electric Corporation CD-803 player. The resulting listening sessions have been something of a revelation, since listening to CDs at a trade show gives one no idea of just how detailed their sound can be.

There is usually too much background noise, and they are often played far too loudly, exceeding the peak power output capabilities of many power amplifiers. Played in the relative quiet of one's living room, the effect can be absolutely stunning—or disconcerting—depending on whose hand was at the controls during the recording.

The Beethoven and Schubert symphonies were recorded while the orchestra was on tour in Japan in 1981. In an effort to hold audience noises to a minimum, close miking was employed and natural-sounding artificial reverberation was added. The balance between direct and reverberant sound is not quite real, and the Beethoven in particular sounds edgy in tutti passages. The Schubert fares better, since it is a quieter work. Maazel's readings are resourceful and masterful. Overall, the recording is adequate for what it is, but the launching of CD deserves better. *John M. Eargle*

**Real HOT Jazz
RealTime Records CD-RT2002,
\$17.95.**

It has been said, with some justification, that pure digital discs, with their wide dynamic range and signal-to-noise ratio, would be of principal benefit to classical recordings.

Surprisingly, it turns out that some of the pop recordings are among the better-sounding CDs now available. Al-

though for the most part their dynamic range doesn't equal that of classical recordings, pop CDs have gained favor because of their cleanness, their clarity, and their punch. And it doesn't hurt to hear pop sound without the usual crackle of surface noise, either!

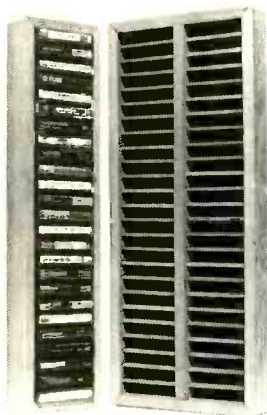
This RealTime recording draws on four jazz groups recorded digitally a few years ago—Don Menza's Big Band, John Dentz Reunion Band, Freddie Hubbard and friends, and Jack Sheldon's Late Show All-Stars. Most of the numbers selected are fairly unfamiliar originals, but there are such standards as "That Old Feelin'," "Sweet Georgia Brown" and "Star-eyes." In any case, this is a feast of swinging, punchy jazz, with plenty of hard-driving trumpets, 'bones and saxes, and solid percussion of great clarity and impact. Bass response is outstanding. Of course, this is multi-miking; but this is where it belongs! The only problem with this disc is that in handling material from four bands, it was not leveled; inadvertently raising playback level on a low-level number could mean trouble when the next number is several decibels louder!

Bert Whyte

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ROCK/POP RECORDINGS

MICHAEL TEARSON
JON & SALLY TIVEN

SHOWY BOWIE



Photographs: Greg Gorman/Syigma

Let's Dance: David Bowie
EMI-America SO-17093, \$8.98.

Sound: B+

Performance: B+

Nobody has accused David Bowie of making a fun album in years. His studio projects since 1977 include *Low*, "Heroes," and *Lodger*, all somewhat avant-garde collaborations with Brian Eno; 1980's very edgy *Scary Monsters*; an EP of songs from Bertholt Brecht's *Baal*; two albums with Iggy Pop, and the somber theme from the film *Cat People*. Serious projects all, none of them easy listening by any definition.

On the other hand, *Let's Dance* is fun. It is a direct and simple album in

the mold of 1975's Philadelphia album, *Young Americans*, recorded at the height of Gamble and Huff's success. The real difference between the two is the much fuller and punchier bass and drum sound on *Let's Dance*. Credit that at least in part to co-producer Nile Rodgers of Chic, who replaces Bowie's long-term associate Tony Visconti.

The first side is the lighter side, all love/dance songs at Bowie's highest energy level in years. There's nothing much more profound than "Modern love gets me to the church on time" and "Let's dance." The second side has equal energy but themes far darker. "Ricochet" asks "Who can bear to be forgotten?" "Criminal World," originally by Metro in '76, paints a violent,

sexually ambiguous scene of the streets. There is a remake of the *Cat People* theme, "Putting Out Fire (With Gasoline)," that is much more upbeat and nervous than the funereal original.

Most of all, *Let's Dance* is a New York album with the grit and danger of the city oozing from every groove. It is not an album for critics to dissect lyrically as much as it is a thumping good body album.

Some of David Bowie's records have worn particularly well over time—*Ziggy Stardust*, *Aladdin Sane*, *Young Americans*, "Heroes." Some have not—*Diamond Dogs*, *Lodger*. *Let's Dance* already feels like an album that is going to sound better and better as time goes by.

Michael Tearson

Cargo: Men At Work
Columbia QC 38660.

Sound: B+

Performance: B

Now this is a nice group, and let no one accuse us of criticizing what has become an institution. Men At Work came from nowhere, and sounded a little like The Police and a little like The Cars. It's hard to see their music or lyrics offending anyone. Truly a nice little band from Australia, and the fact that they've sold a few records doesn't hurt anyone.

Now that this group is selling records like hotcakes, as well as claiming a few Grammys, more than a few people are starting to go overboard and call them the next Beatles; the boys in the group are probably as uncomfortable with that claim as we are. When you get to the music, Men At Work are talented but moderately anonymous, and if they had any less of a style people would call them medio-



cre. They're not really New Wave, but they sport short haircuts so they get over with that crowd. They can play their instruments, so the arenarock fans don't mind them much. The dance-oriented drum beat and the sax bring them over to the people who buy records to groove to. By blurring the

distinctions, Men At Work have appealed to enough people in each different ballpark to fashion themselves a humongous following.

"Overkill" is a nice song, a nice major scale. But the new Beatles? Surely not. Maybe the next Chicago. Or, perhaps, Boston. *Jon & Sally Tiven*

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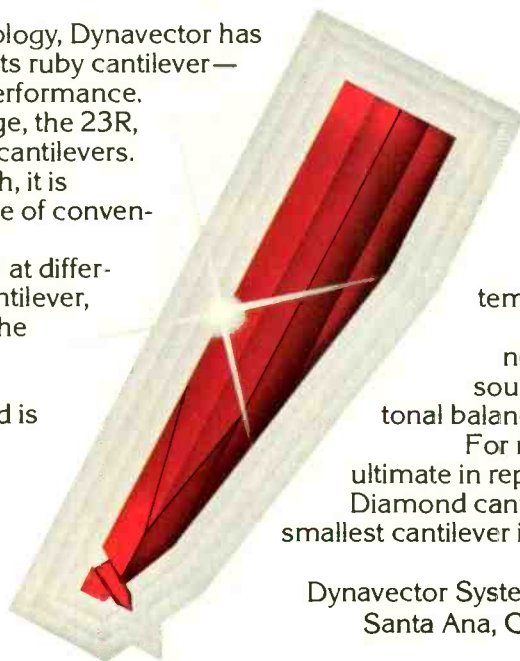
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Sound: B Performance: A

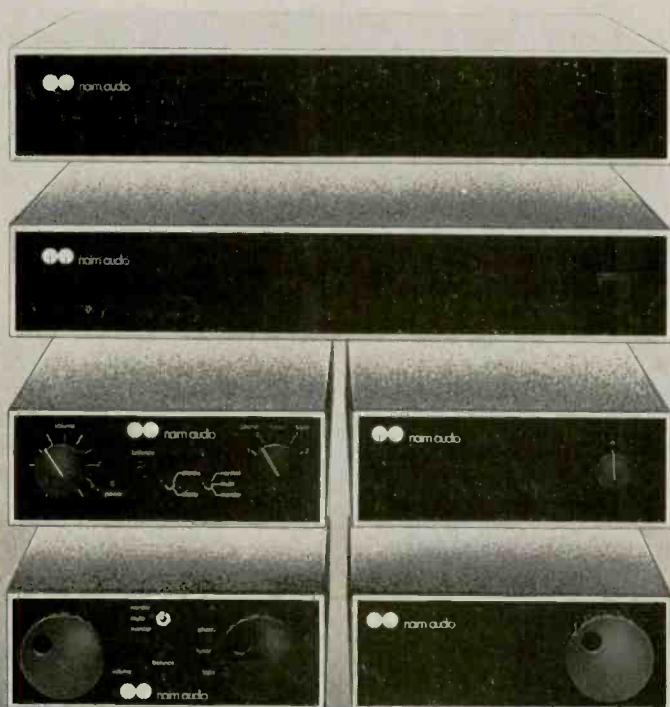
Sometimes it is really obvious that everything has fallen exactly into place for a band. *War* is just like that for U2.

After an acclaimed and promising debut and a rapid-fire but listless second album, their third is the album they've had in them and not quite gotten out.

The songs in their second album, *October*, needed tightening and focus. *War's* songs have it. This is something of a concept album inspired by the



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perpetual clashing in U2's native Ireland. The songs' tableaux may be grim, but there is a strong thread of underlying hope that unifies the album and energizes the record. "New Years Day" opens on a world in white and the thought "Nothing changes on New Years Day." The next thought is wistful, "I will be with you again." The band surveys the carnage and the headlines in "Sunday, Bloody Sunday" but closes with "the real battle just begun/ to claim the victory Jesus won/on a Sunday, bloody Sunday."

Crucial to the success of *War* is U2's charming sense of melody, apparent from their debut on. Here it has matured so that the songs, however grim the subject matter, are lilting.

Steve Lillywhite has produced all three U2 albums. His confidence and ability have obviously grown with the band and his other work with XTC, Joan Armatrading, and Peter Gabriel. For U2's *War*, he has designed a swirling sound with some nifty effects and touches, such as the stereo guitars on "Like a Song . . ." the fade into "Drowning Man" and "Sunday, Bloody Sunday's" electric violin part.

U2's *War* is one of 1983's essential albums. *Michael Tearson*

The Abominable Showman: Nick Lowe

Columbia FC 38589.

Sound: B Performance: A-

Information: Dave Edmunds

Columbia FC 38651.

Sound: B- Performance: B-

These two former Rockpile members have at last put out albums in approxi-



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Nick Lowe

mately the same time period, as if they don't care if they're in direct competition with one another. But the usually thrilling Dave Edmunds seems to be caught at a loss. He has fallen under the spell of ELO mentor Jeff Lynne and is using drum machine and synthesizers to a detrimental effect. Nick Lowe, who has been slagged off in this column on several occasions, has put out his best solo album since his first.

Both have bands of their own, but Edmunds' is far better. He has chosen not to use the finely honed chops of Billy Bremner (rhythm guitar) and Geraint Watkins (piano), so the whole band feel is not only interfered with but destroyed by Jeff Lynne, the DMX, and the poor choice of songs. Only the Rockpile-ish "Don't Call Me Tonight," "Don't You Double," and "Slippin' Away" are particularly memorable; on any other Edmunds album they'd be mere filler. Considering that Edmunds' consistency has always been one of his strong points, and his bands have always been an extremely solid and exciting attraction, *Information* will probably be remembered as one of the major disappointments of the year.

The Abominable Showman, on the other hand, shows Nick Lowe maturing as an artist. Even though he tries a bit too hard to be lyrically clever, his music is settling into a comfortable groove. He's somewhere in between silly pop and soul music, and on about half the album he's convincing. There are a couple of straight rock(pile) tunes, but this is not the focus of the record. With a hit single, Nick Lowe could easily rise from the ashes of Rockpile and become a powerful force in rock music—but not before. Still, this is a fine effort and deserves attention, and is as good-sounding a record as Nick Lowe has ever made.

Jon & Sally Tiven



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IVAN BERGER

DIGITAL TREASURE HUNT

Chasing Rainbow Discs

I and a batch of other audio journalists were in Holland late in April, visiting Polygram and Philips (more on that in a later column) and trying to buy Compact Discs at Amsterdam's record stores. The latter turned out to be a problem: The discs are still in short supply, and while most record stores had some titles on display, finding any particular title turned into a treasure hunt.

Amsterdam's CD dealers run the gamut from large and small record stores to department stores. (Few of the stores which sell the players also sell the discs, and those that do reserve those discs for customers who buy the players.) The stores that do sell discs show them in revolving or wall-hung display racks, but the jackets on display are usually empty. Sometimes they're dummies, for which the dealers have no discs (the nicer dealers mark these "out of stock" in Dutch); more often, the discs are piled in a cabinet behind the counter (a technique that wouldn't work with the more fragile LPs).

I started with a wish-list of about 24 records; I actually picked up about half that many, in trips to about seven stores—but my dozen included one or two impulse purchases not on my original list. A pamphlet handed out at all the record stores listed 209 presumably available offerings from the companies for whom Polygram presses CDs, including Decca (London, here), Erato, Deutsche Grammophon, Philips, Verve, RCA and others. I'd say that perhaps half of those titles were actually in the stores, though no one store had more than a small percentage of them. On the other hand, the stores also had some CBS-Sony discs; these had not been included in the printed list, as

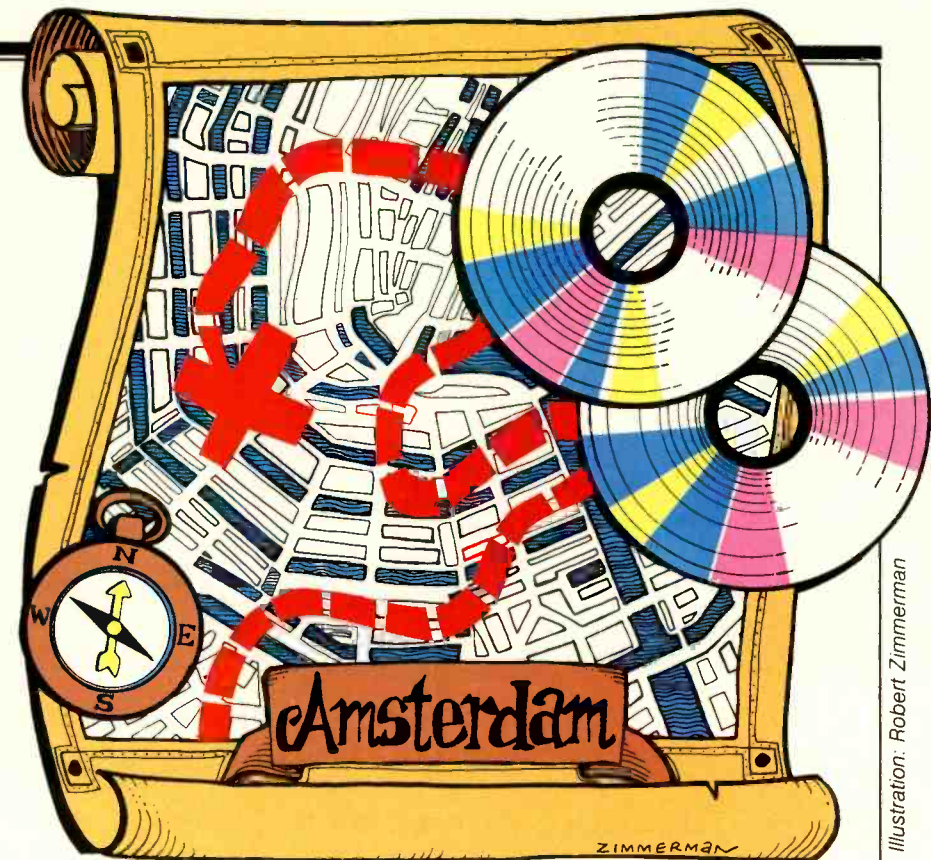


Illustration: Robert Zimmerman

Polygram doesn't press them, and the stores had no handouts listing these or other imports from Japan.

At the time of my visit, Polygram's Hannover plant was producing about 23,000 Compact Discs per day, compared to 70,000 music cassettes and 70,000 45-rpm singles daily. Their nearby LP factory presses 170,000 discs per day. By the end of this year, though, Polygram hopes to be making 35,000 to 40,000 CDs daily.

Even that may not be enough. Only a few European countries were receiving CDs when I visited. Between now and the year's end, all of Europe and the U.S. will start getting CDs. More plants are

opening, here and in Europe, but I suspect the discs may be in short supply well into next year and perhaps beyond.

One reason for the tight supply is that sales are running ahead of expectations. "At the Compact Disc marketing meeting," a record dealer told me, "they said their research showed that people who bought players would buy an average of seven discs apiece. A dealer asked, 'What about those who don't have players?' and the Polygram man said 'Get out of here!' But people without players are buying." He's right. I bought 12 discs, and I don't yet have a player, either.

Emergency Microphone

Ever need a microphone in an emergency? The odds are that a pair of headphones will work—not as frequency-flat or sensitive as real mikes, and with odd directional patterns, but still usable. Don't try the opposite, though: Mikes aren't built to handle the power levels fed to earphones, and are liable to burn out.

Tandy Abroad

The Radio Shack stores in this country have a counterpart in the Tandy stores abroad. I recently got my hands on Tandy's French and Dutch catalogs.

The stereo components looked about like Radio Shack's here. But there were some novelties: A quadrasonic synthesizer (39 francs

separately, 239 francs with a pair of speakers), some nicely styled speaker stands (195 francs per pair), an electronic rhythm generator (595 francs), and a gooseneck turntable lamp (149 francs). Figure about 6.8 francs per dollar (or 14¢ per franc) for rough price conversions. The Dutch catalog had only the rhythm generator; I didn't get the price.

7

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BERT WHYTE

FISCAL RESPONSE ABILITY

By the time you read this, the 1983 Summer Consumer Electronics Show will be history. After years of tantalizing us with mock-ups and one-off prototypes of assorted digital hardware, the audio industry will finally and officially enter the era of digital sound, and the 1983 Show will be remembered for that. There will be production models of compact digital audio disc players from virtually all of the major Japanese and European audio manufacturers. There will also be other digital audio equipment, such as digital processors and recorders, which could have a very profound effect on a large segment of the present audio market.

As you may know, members of the audio press attend manufacturers' press conferences several months before the Shows, where we are given previews of the new audio equipment that will be exhibited. This year, Technics held a preview conference, devoted entirely to digital audio, which I found of particular interest. I will detail most of this new equipment in my SCES product roundup. However, there is one fascinating new Technics product that I want to bring to your attention early, the SV-110 digital audio processor.

Using standard EIAJ PCM 14-bit linear quantization and decoding, with a 44.056k sampling rate, the SV-110 is designed to be used in conjunction with a videocassette deck to record PCM data.

A slim-line unit, the SV-110 measures approximately 17 in. W × 2½ in. H × 13½ in. D and weighs in at 13.7 pounds. Its frequency response is rated at 2 Hz to 20 kHz, ±0.5 dB, THD as less than 0.01%, and dynamic range as more than 86 dB. Record level indication is via a two-color fluorescent meter with a peak-hold capability. An unusual and useful feature is that the meter can be switched to indicate the highest peak level attained during the entire recording. The meter shows signal levels from -25 to +6 dB. The provision of the +6 dB indicator is a bit surprising, since PCM recording signals over the 0 dB point usually cause hard clipping and audibly nasty sound. Another helpful feature in setting recording level is that two separate level controls are provided along with a



Illustration: Philip Anderson

large, single master recording level potentiometer. A record mute switch is included, as is a playback mute cancel switch which permits cue and review monitoring with whatever VCR is being used. The SV-110 also has playback, record, copy and dubbing direction indicators. The input signals to the SV-110 can be monitored via a stereo headphone jack with separate level control.

Naturally, Technics favors the use of VHS decks with the SV-110, but Beta format decks can be used as well. Two VCRs can be connected to the SV-110 at the same time, permitting direct digital dubbing. The really unusual feature of the SV-110 is that it is capable of recording and retrieving PCM data in the SLP (super long play) mode of a VHS deck, thus affording up to six hours of digital recording on a T-120 videocassette!

The implications of this six-hour recording capability can be quite startling. Consider that (in the New York City area) a typical high grade T-120 videocassette can be purchased for a discounted price of a little more than \$10. Consider also that you would need four C-90 audio cassettes to achieve six hours of recording, and they are currently available for a dis-

counted price of around \$3 or \$4 each (assuming best quality cassettes, including metal particle). In other words, with the SV-110 it can actually be less expensive to digitally record equivalent amounts of music on videocassettes than on standard analog cassettes.

One must also consider the audio quality differential between the two recording mediums. The digital recording will provide unmeasurable wow and flutter (a parameter an audio cassette recorder cannot match), extremely wide dynamic range, noiseless recording, vanishingly low levels of distortion, and almost ruler-flat frequency response with significantly extended bass. High-end audio cassette decks equipped with Dolby C or dbx noise reduction can provide remarkably high quality sound, but even the very best of them cannot match the quality of the digital recording.

The most astonishing thing about the SV-110 is its price. Only a few years ago the first consumer-type digital processor, the Sony PCM-1, sold for a rather breathtaking \$4,400. The SV-110 has a retail list price of \$800! Of course, to this price must be added the cost of a VHS or Beta VCR, but currently good quality VCRs with long

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*Source: Ward's Automotive Reports, Specialty Subcompact Segment, October, 1982.

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“With the Technics SV-110, it can be less expensive to digitally record music on videocassettes than on analog audio cassettes.”

play capability can be purchased for \$600 to \$700.

Assuming a combined cost of SV-110 processor and VCR at \$1,500, this obviously places the system in direct competition with a number of high-end audio cassette decks. The question

naturally arises, what about software for a digital processor? Here one must concede that prerecorded PCM videocassettes are very few in number and cost \$45 to \$50 each. Until high-speed digital duplication is developed, there will be very little change in this situa-

tion. Clearly, the thousands of prerecorded audio cassettes offered by the major record companies are a major plus for the cassette format. The SV-110 has no microphone inputs, but a small mixer plugged into the line inputs can remedy this. However, there is still that ever-present question, what does one record? A few go-rounds with the local high school band, the church choir, and Junior's birthday party just about covers this subject.

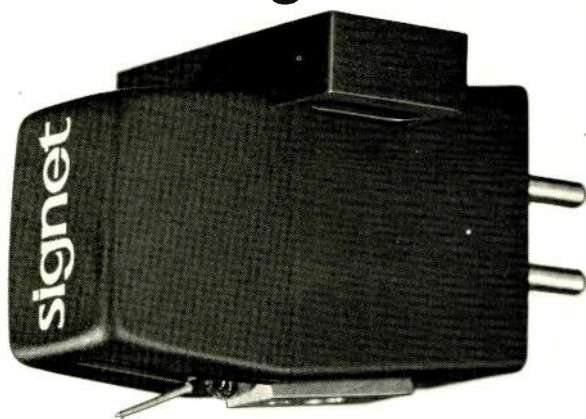
The obvious uses of the SV-110 parallel those of the compact cassette medium. A common practice of cassette owners is the preserving of sound quality by copying new (or slightly used) analog records onto tape. The SV-110 can be used for the same purpose, with the added advantage of longer continuity in music programming, such as full-length operas played back without interruption. For those addicted to background music, one could record six hours of favorite music on a T-120 videocassette. Imagine a party where the music greets the guests at 8 P.M. and ultimately speeds them on their departing ways at 2 A.M. The mind boggles!

Needless to say, if one has a digital Compact Disc player, these discs can be copied onto digital videocassette, although not on a digital-to-digital basis. There would be a D-to-A conversion out of the CD player, and a subsequent A-to-D conversion in the SV-110 processor. However, taping Compact Discs for preservation of sound quality would be an exercise in futility, since the tape would wear out while the laser-scanned disc would remain sonically pristine forever!

There would seem to be little doubt that inexpensive digital processors, such as the SV-110 with its long-play recording capabilities, could be highly competitive with high-end cassette decks. Perhaps the compact cassette forces can counter this with something like the Sharp CX-3 PCM digital cassette recorder I reported on in the April issue. We have noted previously that Sansui has their Tricode PCM digital processor which also affords six-hour recording capability, but at a much higher price.

Speaking of digital processors, the Sony PCM-F1 has become something of a cult item. The only consumer-type

The new Signet TK10ML



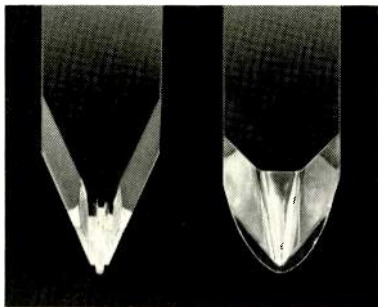
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"The combined cost of the SV-110 and a VCR places the system in competition with a number of high-end audio cassette decks."

PCM processor with 16-bit resolution, it is a really extraordinary device. In the opinion of some highly respected professional recording engineers, its performance surpasses that of Sony's earlier pure professional digital recorder models. I concur, having made many superb recordings with the PCM-F1, and the Sony PCM-F1 has received high praise almost universally. The only drawback has been its inability to edit recordings. Oh, there was a very circuitous and laborious way it could be done, but most felt it wasn't worth the effort. Such was the situation until March of this year, when the RTW Company of Cologne, Germany, introduced their Studio-Processor Set at the 73rd AES Convention in Eindhoven, The Netherlands.

The Studio-Processor Set consists of the RTW A + D Interface plus modifications to the Sony PCM-F1. This Interface unit, exactly the same size as the PCM-F1, essentially enables analog matching of the PCM-F1 processor inputs and outputs to balanced, floating, +6 dB lines. It also offers a digital interface for direct digital copying on the Sony 1610 professional processor system. There are error-correction and static displays, and a special headroom switch provides for optimum program-dependent utilization of dynamic range. Other switches are for 16/14 bit resolution, mute hold, copy prohibit, pre-emphasis (which can be defeated) and video copy.

With the RTW A + D Interface, digital recordings made with the PCM-F1 can be transferred to Sony U-Matic recorders and the professional Sony 1610 digital processor. Once in that format, the editing can proceed in the standard Sony electronic fashion with Sony's DAE 1100 editor. Obviously, since we are talking about more than \$100,000 for the Sony 1610 and DAE 1100 editing system, most owners of the PCM-F1 will have their transfers and editing done by specialist companies who have this professional Sony equipment and usually charge \$600 to \$700 a day for their services.

The cost of the RTW A + D Interface is \$2,000, which includes modifications to your own PCM-F1 processor. In this country, the RTW A + D Interface is handled by Auditronics of Memphis, Tennessee.

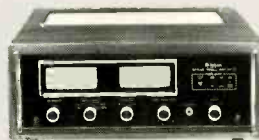
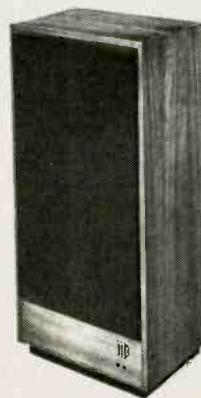


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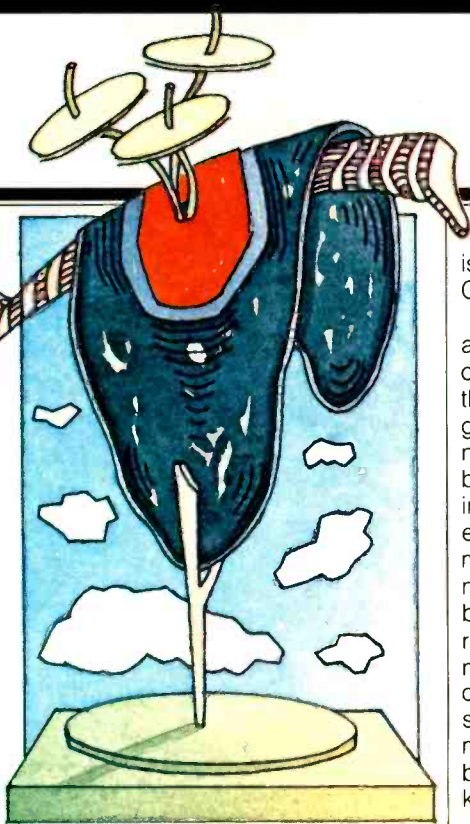
SYMBIOTIC SOFTGEAR

A successful softgear-hardware relationship such as the LP's (see last month) is like a well-matured marriage. It takes many years to perfect this sort of dynamic intimacy, and the result is therefore precious and irreplaceable, because it works. True, time passes and circumstances change, but the relationship adapts—it is too strong to break. Until at last death does it part. So with the LP.

Why else do you think this much-outdated disc still persists after 35 years, along with its enormous mass of softgear? We believe in our hearts that it cannot be replaced, that special symbiosis between the artistic softgear and the engineering hardware for which it remains the crucial link. What comes next will be a different animal, and a different relationship.

Death comes to all and it will come to the LP, if the rest of us last a little longer. Most of its special virtues remain but the flesh is weak. On the hardware side, as we all know, it is as far outpaced by the little CD, the Compact Disc, as the buggy was by the auto or, more accurately, the horse by the gas engine and the electric motor. And there is video, harassing from the side—the LP's successors, in one or another format, are easily picture-capable. Also surround-sound-capable in any old number of discrete channels in case we're interested—we may be. The LP can never enter these leagues. Nor, except by ingenious artifice, approach the dynamic range, the soundlessness of background, the absence of distortion—why go on? We know the story. But there it is, even so, still an immense and stable force in our entire business, a governing superflywheel to hold us together and in some sort of control of our destinies. That's what an enduring softgear-hardware marriage is all about.

Indeed it is an agony to try to see the future shapes that will prove symbiotically successful! Some people, as I suggested last month, have the gift. They are mostly the artists as such, not the engineers, but there is not really that much difference remaining between these categories. I would only say that the engineers do tend to be



quirky in a big way (having the goods to do so), seeing some things with true clairvoyance, intuition, genius, but missing others in the most obtuse fashion. And in this the captains of industry have all too big a hand. I can never get far from Thomas Edison in such thinking—he had the most peculiar mental oscillations, comb-filter style, seeing some things with absolute brilliance yet incurably blind to others. Not a very good softgear guide, this Tom. It was his younger assistants, his rivals, who saw the real means to put Edison's many syntheses (that's what they generally were) into softgear situations that would work.

When I look at some of today's hi-fi and TV I think of old Tom. With a difference. His was the approach of simplicity—not today! But simple or complex, any invention, any equipment, is only as good as the softgear that goes with it—say that again. If we are floundering today in a welter of marvelous technology and practically nothing new in the way of softgear except the video arcade, it is because in spite of the ads we can all sense the confusion, zany products all mixed up with useful ones, instant opportunism, overwhelming far-sightedness, and nobody really sure which is which.

Can I be more specific about the enduring aspects of the LP symbiosis? Yes, but only by looking back beyond, at the whole span of the disc, which

will soon be 100 years old. The LP is only its final form, short of the digital Compact Disc.

I'm not sure I really consider the CD a disc. It is far more closely related—in operation—to the audio cassette or, for that matter, the videocassette. In softgear terms it is barely a disc at all. The new CD is automated and can never be otherwise. Its "discness" is no more important to us than the "tapeness" of either type cassette, out of sight, out of mind, most of the time. Yes, the LP is now belatedly automated, perforce, but this is not really its nature and it responds clumsily in spite of the ingenious new mechanisms. The LP began on a par with the earlier disc and it is still, I think, a naturally hand-operated music source. It is as though we had belatedly automated the fork and the knife. The LP didn't really need that.

Look, then, how quirky has been the disc's success as it has evolved its symbiosis, the softgear and the hardware, over a century of sales, how quickly it has responded to varied changes, and how unpredictably. What size? What speed? These, in the beginning, were of course determined by the 19th century engineers, not the public. Speed: Very approximately 78 rpm or thereabouts. Size: Erratic, but there were 8-inch discs to start with, if I am right. Then, as the symbiosis began to take hold and the public to buy, in a remarkably short time the 10-inch disc became standard. It was the sellable, usable, popular form. Why? Did it fit the music and skits available for recording—or were these written to fit the three-minute format? Impossible to say; they happened together, give & take, tit for tat. All we know is that the 10-inch size and length worked so well that the entire modern corpus of recorded pop, from ragtime to jazz to rock and show tunes, has adapted itself ever since to that basic length—and even far beyond any engineering necessity, right up to the present. Could you have foreseen it? There's your symbiosis.

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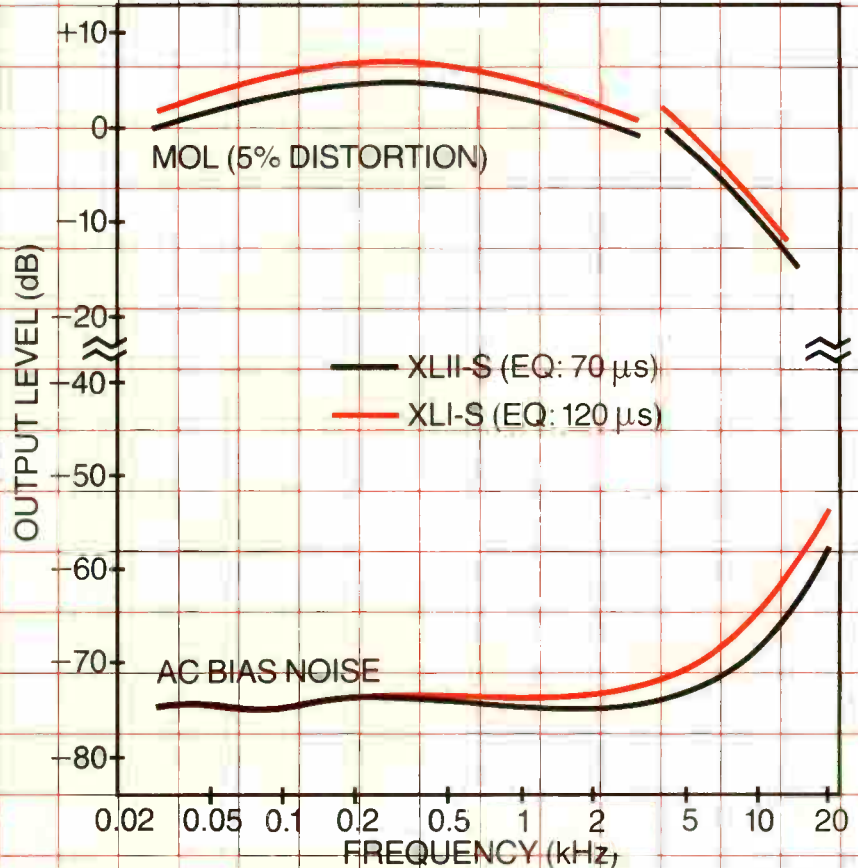
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"I'm not sure I really consider the CD a disc. It is far more closely related to the audio cassette or videocassette."

10-incher came the elegant 12-inch disc as recording began to go high-brow (classical)—mostly in opera excerpts. A different situation there, but it too worked. The longer span, maximum five minutes but much better four, combined with the length of most arias and the special qualities of the opera voice (high acoustic power and maximum intelligence at the narrow frequency band available) drew forth, one might say, a sub-symbiosis, the bigger disc alongside the smaller and compatible with its machinery. The pairing was immensely successful. The two aspects continue in essence to this very day, classical and pop, though the original engineering is all but vanished. Again, symbiosis.

When we come to a time of real change, we tend as I said last month to carry on with compatibility and all the old pre-existing softgear, just as far as we can. Necessary—at first—for business continuity. But also very good for any coming symbiosis, if the old traditions can persist into the new. When electricity hit the sound field and audio was born, we got the electrical recording and then, a bit later, the electric reproducer. (No, they did not appear together as a system! Compatibility allowed old and new discs to be played on either type of equipment.) And lo—once again there were the old 10- and 12-inch discs, as though nothing had happened. What else? We try for continuity, and this time it was easy.

Yet almost immediately big changes cropped up. First a matter of hardware, new equipment, the radio phonograph, the electric portable and, above all, the jukebox in prototype. But the new engineering sound parameters immediately began to change things too. Pop music in the home became mainly louder—a forecast of things to come—but the jukebox was really new (well, almost). It channeled the world of pop into new areas of recorded listening and, hence, record sales. The jukebox has never died. It evolved into our present disco, not to mention music for banks, airports and supermarkets.

In the classics, electricity brought more extensive softgear changes. Suddenly—albums! With the microphone and big orchestras in large halls, we could record anything, and we did, in multiple-disc sets. Straight

through the bottomless Depression, that early electrical recording spree was the most fertile and productive we in audio have ever experienced. The entire concert repertory of classical music and much beyond was put down on wax and onto 78s. Even the giant works, hours long with hundreds of performers, found their unlikely place, all chopped into four-minute segments, a dozen, 20 discs in enormous albums so heavy they could scarcely be lifted, horribly breakable, clumsy, impracticable! Yet viable. Here was one of the miracles of audio history and an example of what can happen, even in a Depression, when the symbiosis turns out right.

Even into electricity, then, the disc carried on and developed—there was no revolution. Albums, then art covers (mainly after WW II), in particular, program booklets, a vital new addition for those who listened. In the main the old standard worked again, the 10-inch for pop and the 12-inch for classical elegance. Good continuity. People went for the idea.

Twenty years—and again, revolution? Could have been. We had the LP and, a year later, the 45. But note how ingeniously, instead, the LP adopted the best of the earlier practice from the 78, already a half-century old. Immediately, LP took over the album aspect of 78 classical and applied it to the new single discs. We still call them albums (even in pop!). Good-looking covers (though the first Columbias had no more than undifferentiated paper covers—somebody soon caught that blooper). Extensive program notes, now even more convenient, both on the album itself and in big, readable, unfolded inserts. Thus the compatibility phase for the LP was superbly handled on the softgear side to preserve all that was good. Most important of all, the new disc was not even launched until it was possible to build up an impressive catalog of softgear via dubbing, both the 78 and LP versions copied from a common 16-inch lacquer master disc, this being shortly before tape. The original public demo of the LP (I was there) displayed a considerable stack of LP discs in the new form, alongside a mountain of 78s containing the identical music, enough to satisfy any doubter that the LP format

would lose us nothing in the way of music to play, our traditional wide choice, a true "library" of availabilities right from LP's beginning. Can we say as much about today's offerings of softgear in the new formats?

The 45 disc, a year later, must surely have been aimed at the jukebox, where it was a fantastic success. But at the beginning it came out, flatly literally, as successor to the 78 in all forms. There were fancy classical albums (the first things introduced) and players for the home. Too literal—for there were the same old four-minute sides we'd always had, merely smaller. It was classical prestige, I suppose; in any case, that particular classical symbiosis was a dead duck in no time at all. I have a few left, as museum pieces. But ah—the jukebox! The 45 took to pop like a duck to water. Thus do software and hardware interact.

Note, finally, a more subtle disappearance, that of the 10-inch LP. As I say, the symbiotic balance is always delicate. This disc followed very logically after the 10-inch 78, and the machinery to make it was available. In the classics it lasted quite awhile. It did have points. But the factors added up, or shall I say, subtracted, and in the end it was better to kill it—even in pop—and concentrate on the larger size disc. What will be the equivalent subtleties that show up on future CD offerings, the little laser disc? Obviously, nobody has the slightest idea, at least in public, at this point.

Note, to end, that the LP disc and its forerunner the 78 have *always* thrived on a very large backing of softgear. A lot more (by maybe 10,000 to 1) than some of our present promoters think is really necessary. They are wrong. *This is an inherent aspect of the entire disc history.* Even 78 catalogs were very large. Schwann's LP listings built into the many thousands in the earliest years. And the 30,000 or so titles of decades back have merely varied a bit, mostly upwards, right through to the present. The audio cassette is nowhere near catching up. *You think this can be ignored?* It's basic.

Next time you see the big ad announcing Fifty (50) titles now available for so-and-so digital player, just relax. When we get to 10,000, we'll be out of the woods. A

Achieve Mitsubishi in Cordia. The contemporary sports coupe.

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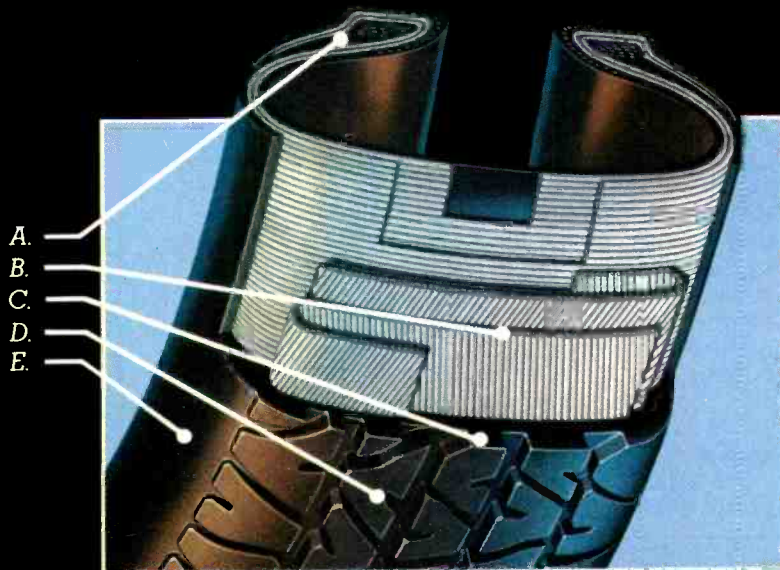
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DRIVE YOUR WALKMAN 'ROUND THE BLOCK

RICHARD BORYCZEWSKI

One reason those popular, lightweight cassette players are so light is that they use small batteries, usually lasting only 4 to 10 hours. One way to lengthen battery life is to use other power sources whenever possible. Power supplies to convert a.c. house current to low d.c. voltages are common; here's an easy-to-build supply for use in the car.

The power supply shown in the schematic diagram consists of an LM2931T adjustable regulator and a

R_2	Volts
39k	3
75k	4.5
110k	6

Resistor values (R_2) for popular cassette-player voltages.

few external components. The supply draws its power from the car's battery via a cigarette-lighter plug, and feeds the cassette player with an appropriate power plug. (Several types of power plug are used by these players; bring your player with you when shopping for a matching plug. If you use several players, with the same voltage requirements but different plugs, connect the power supply output to an in-line mini jack, then make short adaptor leads with mini plugs on one end and the appropriate power plugs on the other.)

The LM2931T is ideal for this application, since its output can be set to

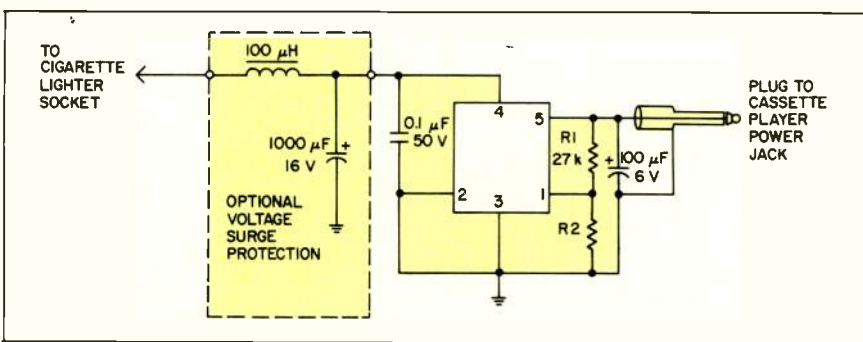
match most cassette players simply by selecting a single resistor value (see Table). The regulator also protects the player from inadvertent reversal of the input (battery) voltage and from the transient voltages that can appear in the electrical systems of typical cars. Even so, if possible voltage transients greater than 60 V are anticipated, add the protective circuit shown within the dashed lines.

The LM2931T can be obtained from Jameco Electronics, (1355 Shoreway Rd., Belmont, Cal. 94102), Circuit Specialists (Box 3047, Scottsdale, Ariz. 85057) or Digi-Key (Highway 32 South, Thief River Falls, Minn. 56701) if you can't find one locally.

Remember, though, that listening through headphones while driving is illegal in many places, and unsafe in all. Leave the phones for the use of passengers, or for when the car is at rest.

PARTS LIST

- LM2931T adjustable regulator.
- 0.1- μ F, 50-V capacitor.
- 100- μ F, 6-V capacitor.
- 27-kilohm resistor (R_1).
- Resistor (R_2 ; see Table for value).
- Cigarette-lighter plug.
- Plug to match cassette-player power jack.
- Perf-board (small piece).
- Mini case (sized to match perf-board).
- 100- μ H inductor (opt.).
- 1,000- μ F, 16-V capacitor (opt.).



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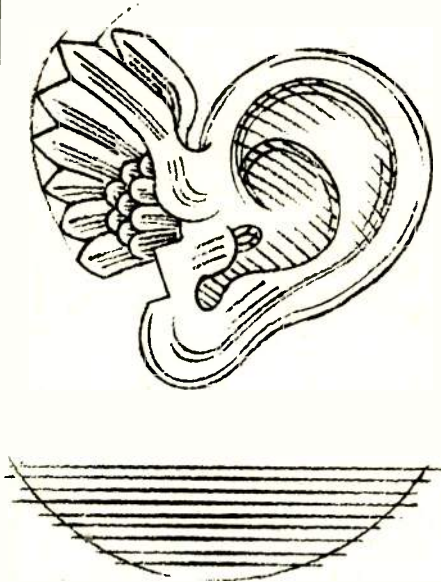
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A Sense of Loss

JOSEPH GIOVANELLI



We recently received a letter vastly different from those which usually appear in my "Audioclinic" column. I believe, however, that the material will be of general interest and that those who have similar problems should know that they are not alone. We hope readers knowledgeable in this area will find the time to share their information by writing me at *Audio*. Where applicable, I'll forward useful items either to the writer, Jane H. Johnson of Laurel, Maryland, or to all of you via my column. Her letter and my reply follow:

A member of our family has a serious hearing loss in the upper register. Her hearing is within normal limits (30% loss) up to 550 Hz. Above this frequency, her hearing declines precipitously so that by 600 Hz, she has lost 90% of her ability to hear.

Because her loss is within the conversational range of the human voice, she can hear vowels but no consonants. We find that she is unable to wear a hearing aid because no commercial aids can alter sound well enough to handle this acute loss.

We have noticed that whenever a man with an unusually low voice talks to her, she is able to understand him very well.

Is there any sound equipment on the market that will lower the pitch of a voice by one octave without otherwise distorting it? If such equipment is not

available commercially, can it be built? If so, by whom?

I have given a lot of thought to this problem, and I wonder if the right conclusion has been reached as to the reason this lady can understand some voices and not others. Certainly the frequencies she has lost are the very ones which convey information in the form of the consonant sounds. I simulated the conditions of her hearing by filtering out all the highs to see whether I could still get meaning in conversations by mainly hearing vowel sounds. I found that I could do so with great difficulty. I did not find that the pitch of the voice was a factor in my ability to understand what was said.

I am led to a different conclusion than was reached, but I definitely could be wrong. I wonder if those men, with their low-pitched voices, also have a particular vocal tract resonance which emphasizes some of the frequencies the lady has lost.

In any case, there may be a very simplistic way to check the correctness of the writer's conclusion. Using a 45-rpm recording of spoken words, play that disc and see how much is understood by the lady with the hearing loss. Now take that same recording and play it at 33 $\frac{1}{3}$ rpm. If the words are understood better, then the writer's conclusion seems correct. We are not just slowing the speech, but are also lowering the relative frequencies of the consonants. This might well put them within the range of her useful hearing. If a recording of speech made at 45 rpm isn't available, one made at 33 $\frac{1}{3}$ rpm could be played on an old turntable capable of play at 16 $\frac{2}{3}$ rpm. If so, perform the same experiment. Under these latter conditions, we will have just what was asked about, a lowering of the pitch of the voice by one octave, though, of course, the tempo characteristics of the voice will be changed.

If appropriate recordings or turntables aren't available, a two- or three-speed tape recorder can be used to perform this same experiment by recording on tape at a high speed, and then playing it back at half speed.

Assuming all this shows promise, and despite the dragginess of the speech, there are digital sampling techniques which can be applied to the problem. These were really designed to speed up or slow down the tempo of recorded speech without altering pitch, but they probably can be modified to lower the pitch of a voice while reasonably maintaining the speed at which speech is delivered. There may be many firms engaged in this work, but the one I am certain of is The Variable Speech Corp., 185 Berry St., San Francisco, Cal. 94107. While speech processed in this way is not rendered in perfect high fidelity, it may well prove beneficial. I do not see any convenient way of having this system produce stereo sound, which might also be helpful.

For the moment, assume my conclusions are correct, and if so, attempt some more conventional solutions. As a test, I recommend the following experiment which requires a microphone be connected in a stereo system. Because most systems do not have a means for doing this directly, the mike may have to be connected to the input of a cassette deck and the output of the recorder to the rest of the system. If the lady has hearing in both ears, then two mikes should be used, as though a stereo recording were being made. It is likely that the recorder must be set to the "record" mode in order for the mikes to be heard at the headphones, which must be plugged into the stereo system, not the tape deck. The usual precautions about level apply even though no recording is being done.

It is well known that listening to conversation stereophonically (or binaurally) via headphones renders the conversation more intelligible than does monophonic reproduction. This is likely to be very important where the speaking persons are off-mike and all speaking at once. The stereo enhancement can be of even greater help where room acoustics are live and bright.

With the phones in place, a normal conversation should be carried on and the stereo system's tone controls ad-

justed in various ways to see whether a particular combination will produce an improvement in the lady's ability to understand conversation. An equalizer can be of great help because it can boost narrow portions of the audio spectrum, hopefully making use of the lady's residual hearing at the highest possible frequency.


I claim no expertise in this area. I have, however, known deaf people, and certainly recognize that their affliction isolates them from much of what goes on around them. I have listened to hearing aids and found their sonic qualities unpleasantly harsh and strident. Asked about this, the wearers indicated that they are also annoyed by the reproduction.

Perhaps what I have suggested will be helpful, but whether these approaches will be beneficial or not, I hope to hear from those with experience in this area.

[I asked my father, who has a similar but less severe hearing loss, and who was once in the hearing-aid business, for his advice. He states: "Even with a less severe high-frequency loss, lower voices are much easier to understand; the high, piping voices of small children are almost incomprehensible. If you cannot hear high frequencies, then 'p,' 'ph,' 'th,' 's' and 't' all sound alike. If you mistake one for the other, you can lose the whole trend of a conversation.

"Hearing aids which emphasize high frequencies are on the market. However, I doubt if one would help with so severe a loss.

"A friend in the hearing-aid business reports that he has sometimes found that people with symmetrical hearing losses (the same in both ears) sometimes get asymmetrical benefits from hearing aids, gaining more low-frequency hearing when the aid is put in one ear, more high-frequency hearing when the same aid is put into the other. In such cases, separate aids for each ear help.

"This solution is expensive, but it should be possible to try it at a hearing-aid dealer's and determine if it works in this case."—I.B.] 

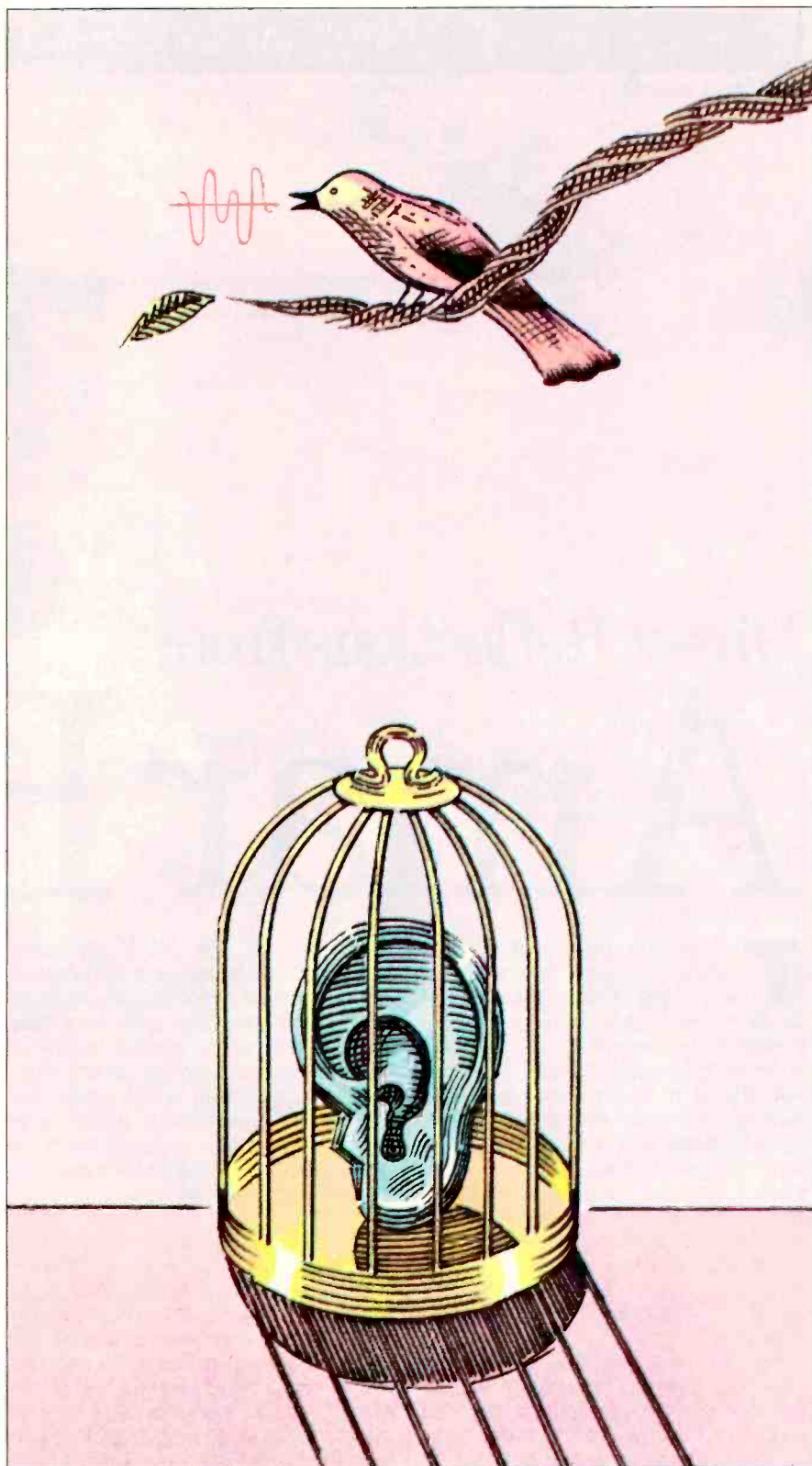


Illustration: Philip Anderson

“Is there any way to help a friend whose hearing allows her to understand only very low voices?”

DAVID LANDER



Direct Reflections from

Amar Bose

The driver's door of the 1983 Cadillac Seville swings open and Amar Bose steps out with all the swashbuckling assurance of a gunfighter dismounting on the main street of Dodge City, Kansas, a century ago. He is a lean six foot two, skin swarthy, hair wavy and graying handsomely. A few minutes late, he makes for the motel lobby where he is to meet visitors. Perhaps because of his build, perhaps because of his mind-set, the founder, chairman and technical director of Bose Corporation, probably the most successful U.S.-based audio company, tends to stride rather than simply walk.

But there is no swagger as he greets his dinner guests. Only warmth and an affable smile. By all means, a journalist should call him by his first name, pronounced Ah-Mahr, with more or less equal weight on each syllable.

Dinner, originally to have been in Boston, is now set for a spot in Framingham, the suburb that houses the corporation's headquarters. Already it is clear that its founder, who later admits to taking vacations only rarely, prefers to remain close to his work. At

the restaurant, the M.I.T. graduate, now a full professor at the institution where he spent nine years as a student (though his teaching load is a light one), takes neither alcohol before or with his meal nor coffee or tea afterward. He is content with a steak and animated conversation, which prepares his guests for a visit to the company's facilities the following morning and an afternoon interview.

In spite of his firm's dazzling track record, Dr. Bose seems an unlikely businessman. Aside from an expensive house which he helped design, he eschews emblems of luxury and perquisites most corporate chieftains relish. He normally drives a 10-year-old Buick (the Cadillac belongs to General Motors, which, along with its wholly-owned supplier of radios, Delco, collaborated with Bose on the first mass-produced auto sound systems acoustically designed for particular makes and models of cars; Dr. Bose did, however, confess he was taken with the Seville and might succumb). There are no executive parking spaces outside the hilltop plant, which was deliberately built with the cafeteria facing an Ar-

cadian New England view and the chairman's windows overlooking a busy expressway. And when lunchtime arrives, it is to the company cafeteria that Dr. Bose escorts his guests. Their meal is charged, while Bose Corporation's major stockholder pulls out his wallet and pays for his own.

Amar Gopal Bose, now 53 years old, was born in Philadelphia to a father who fled his native India to avoid persecution at the hands of the English and an American mother, a schoolteacher. Even in America, his father continued to publicly decry the injustice inflicted on his nation by an occupying one and raised funds to support his people's cause. The elder Bose's spirit may have been inherited by his only child because, when Consumer Reports ran what he considered a damaging review of his Model 901 loudspeaker in 1970, Dr. Bose did more than merely bristle. He filed suit against Consumers Union, the magazine's publisher, and pursued his cause for 11 years before a Federal Court in Boston ruled in his favor, making his the first company to defeat the powerful group in a courtroom. Shortly



"By 1959, I could show speaker design texts were incorrect, but I couldn't replace them."

after this interview took place, an appellate court overturned the decision and, at press time, Bose had heard that the U.S. Supreme Court will hear his appeal this fall. Because of this, and at the advice of Audio's attorneys as well as those of Bose Corporation, I have omitted those portions of the discussion bearing on the topic under litigation.—D.L.

Editor's Note: A decision to hold back interesting materials or discussion is always a difficult one, but libel is a strong argument not to publish. Whatever, when the case is decided, we intend to do a follow-up interview with Dr. Bose.—E.P.

When did you first get interested in electronics?

Electronics, as such, at 13. I think it originally started with some friends I had who were in the Boy Scouts who wanted to make some sort of a communications system that would work with rods that you stick in the ground a couple of hundred feet apart. So from that I learned how to read a schematic, and then I got very, very interested. By age 14 I had opened a radio repair shop. Since my father's business was an import business at that time and there was no shipping available, this provided the major income for our home. There was a big need for it because the people who were old enough to service radios generally were in the armed forces during the war, so I had an incredible business going while I was in high school.

How much of your time did this take?

It was every evening, every weekend and, as I remember, every Friday, since I managed to play hooky from school on Fridays on a regular basis.

Still, you must have had good grades to get into M.I.T.

Yes, my father made it a condition that I couldn't take off Fridays to work in the radio shop unless I maintained a good grade average.

When did you first get involved in the work that Bose Corp. is based on?

That started in the spring of 1956 when I finished the doctorate research and was in the process of writing. That tends to be not as exciting as the research, so I decided I would buy a

music system for some background music. And I bought it as engineers tend to buy things, on specification sheets. I really believed these numbers could tell me what was good and what wasn't, and I didn't even audition the equipment before purchasing it. I brought it home, set it up and bought some violin records because I had played violin. I turned it on and literally believed the unit was defective because the violins sounded anything but real. So I began finding that more and more of my time was being spent trying to resolve this apparent puzzle, that something that measured well sounded poor. And that's where the whole thing began.

But exactly how did you begin? Specifically, what were the first steps?

The first major effort took place in the summer of '56. I had been granted a position on the faculty when I graduated, but with a year's leave of absence to go on a Fulbright scholarship overseas. I asked M.I.T. if I could stay that summer without salary to use their facilities because I was interested in acoustics, whereas my formal field of research was more in the electronics side and communications theory. They agreed, and so I made an arrangement with the person who was then president of Radio Shack to borrow all these different brand-name speakers—brand-new ones—make measurements on them in an anechoic chamber at M.I.T., and then return them in good condition and give him the data if it was useful.

You've mentioned that this was a part-time preoccupation for the first few years. How long did it take before your research into acoustics took center stage?

In 1959 a very fortunate circumstance occurred. Namely, at that time Dr. Jerome Wiesner, who later became president of M.I.T. but at that time was director of the research laboratory of electronics there, which was the laboratory I did my research in, encountered me in the hallway. He commented that he had seen in my office this very strange octant of a sphere with 22 little loudspeakers on it, and he wondered what that had to do with statistical theory of communication [Dr. Bose's formal field of research at the time]. And so I said it didn't have much

to do with it, and in the process we wandered back into my office and talked for 10 or 20 minutes. It turned out that prior to coming to M.I.T. he was involved with the Library of Congress studying the processes of recording and reproduction of sound, so he was quite interested. And by 1959 I was able to show that what is in the textbooks as to how you should design loudspeakers is absolutely incorrect, and I could show why. But I couldn't replace it with anything. I could show the errors, but not give a solution.

What kind of errors?

There are many dimensions in which errors take place, but one very glaring one, that's easy to see, is that the textbooks tell you to take a loudspeaker in an anechoic chamber and put a microphone six feet on axis and design the speaker so that it has a flat frequency response measured by that microphone. Well, it turns out that the balance of tones that a loudspeaker radiates, the balance of energies at the different frequencies, is completely dependent on the surroundings of the loudspeaker because the impedance that it sees, looking out from the cone of the loudspeaker, is a function of its surroundings. That was just one problem. There are many, many others.

Let's go back to Jerome Wiesner and the "fortunate circumstance" you began telling us about.

We couldn't offer a solution at the time, but then Dr. Wiesner said our object at M.I.T. was not to produce products but to produce knowledge, and especially if that knowledge corrected incorrect notions of the past. So he said, I think we ought to make this an official project. His judgment on that had an enormous impact on the whole program. I don't think we would be where we are today without his decision, which opened the doors to having students and other faculty and facilities. Basically, as I see it, all those years of research couldn't have been done by any individual or even a company. There were no companies that would have put that kind of R & D money in, because a great deal of the research was not spent in any relation to a product but to try to understand the relationship between the things that are measured and perception, throwing out those things which don't have relationship, creating

"Many hobbyists do not know how to conduct a proper psychoacoustic experiment."

new measurements that did have. Also, I might say it was very lucky that conversation with Dr. Wiesner happened at that time, because the following year, 1960, saw the election of John Kennedy, and Kennedy promptly took Dr. Wiesner to Washington as his science advisor so he was gone for a couple of years. And had this conversation not happened, I think the project might never have gotten off the ground.

How long did the project take?

It was from 1956 until the first Model 901, which really embodied everything that we knew at the time—1956 to '68, 12 years.

Yet you formed your company in 1964.

The company was formed in '64, but at the time we formed it, we had patents in electronics and in acoustics, and the company really did all its early work with the government agencies in the electronics field—high-efficiency power amplification, audio amplification, power conversion. The original prospectus of the company stated that it would go into two areas. One was the electronics and the other was the acoustics. What we had from M.I.T. was a good knowledge of physics and a good knowledge of acoustics, but that's a long way from making a product that embodies those, and it took us four years, working nights, primarily, at the company to take that knowledge and put it into a practical embodiment that was the 901.

You had another speaker before the 901. The 2201, wasn't it? How many did you sell?

About 50 or 60 pairs. That was based on a research tool that we had been working with all these years at M.I.T., the octant of a sphere that I spoke of. *Isn't that what's been called the beehive speaker?*

I wasn't aware of that, but it certainly is an appropriate term for it.

Why did you sell so few?

Well, what happened was that the research into the spatial aspects of sound was going on very heavily between '65 and '68. By 1967 we realized that we could produce, at least at a research level, a 901 which outperformed this 2201 at a fraction of its cost.

What, specifically, was the 2201 like?

The 2201 was an octant of a sphere, 22 inches in radius, that sat in a corner,

and it had 22 small drivers on it that were equalized with a power amplifier inside the loudspeaker. We were able to show through some very interesting computer studies—the report on that exists in M.I.T.'s *Technology Review* if you ever want to see it—that that octant of a sphere with all those little loudspeakers on it would, in fact, sound identical to a perfect pulsating sphere, meaning a sphere whose radius just changes, with no resonances like cones have, no disturbances to the signal in any way. In a room, that perfect sphere and this partial one with all these little drivers would, in fact, sound identical. And that was the subject of a four-year experiment done at M.I.T. with the aid of the Lincoln Laboratory computer. With that very advanced computer we were able to prove it. And that is what led us to designs in which our most expensive products are always full range with a multiplicity of drivers, never woofers, midrange and tweeter. In fact, all our designs would be that way except for cost.

Regarding measurements, you've said in the past that loudspeaker manufacturers generally look at things that they know how to measure and are merely convenient from an engineering standpoint but aren't relevant to perception. You have distinct ideas about what should be measured. Do you want to talk about this a bit?

Not really. And the reason for that is, as you know, our company has reinvested 100% of its earnings, and a lot of it's gone into the R & D of determining exactly the kinds of things that one should measure. And we try to advance that every year. But that really is the stock in trade that we have. Namely, we have computer facilities now that I think are the best that exist—and I don't mean just hardware, but software—to make measurements which encompass those elements that we know about and can handle concerning how a human processes sound to make his final judgment on it. And that's highly proprietary. I mean that's really our stock in trade, and it's what enables us to go into an environment and hopefully be able to outperform the competition.

You use the word folklore, I gather in opposition to science, when discussing some of the common beliefs in high


fidelity. How much folklore persists in hi-fi? Is it mostly in the realm of speakers, which many people claim defy measurement, or does it exist elsewhere?

Oh, you find it everywhere. I think you were speaking to me about bricks on amplifiers allegedly making the sound better. I think a few good psychoacoustic tests will show, as Hans Christian Andersen's story of the emperor's new clothes showed, that the king is "nekkid."

To what phenomenon do you attribute this kind of thinking?

It exists primarily because of the way the industry grew up. It grew up with the hobbyists and people without formal training in either mathematics, physics or acoustics or psychoacoustics. They hypothesize all these interesting things and, I think, live in the world of imagination and really have not been sufficiently trained to know what it means to conduct a proper psychoacoustic experiment, which can prove or disprove many of these beliefs almost immediately.

How do these beliefs affect the products themselves? Do they, in fact?

Oh yes. You must remember, now, that the people who read hi-fi magazines comprise less than 0.5% of the nation, and then a lot of people who read those magazines don't read them for the technical aspects. Many of them are reading them for the information they have on music. So when you narrow it down to what percentage of the people are audiophiles, it becomes a very, very small percentage of the people. On the other hand, that area of the industry is responsible for producing better sound than the people who produced radio-phonograph combinations. And it's known for that, and it influences both the manufacturers and the retailer. And if the manufacturer feels that his product will be better received by the audio press and by the dealer-salesman if he makes a system with 0.01% distortion, and if people will pay more money for that, that's the trend. Also, the manufacturer's hunting for ways to make his product—"better than the competitor," and so "better" often takes the meaning of the specification sheet rather than the ultimate benefit to the consumer, which is simply performance. 

1

BOSTON ACOUSTICS A40 SPEAKER

Manufacturer's Specifications

Enclosure Type: Sealed.

Drivers: 6½-in. (170-mm) long-throw woofer; ¾-in. (19-mm) ferrofluid-cooled tweeter.

Frequency Response: 68 Hz to 20 kHz, ±3 dB.

Nominal Impedance: 8 ohms.

Crossover Frequency: 3.5 kHz.

Recommended Amplifier Power: 5 to 40 watts.

Cabinet Finish: Wood-grain vinyl.

Dimensions: 13½ in. (343 mm) × 8¼ in. (210 mm) × 7¾ in. (197 mm).

Weight: 9 pounds (4.1 kg).

Price: \$75.00 each.

Company Address: 130 Condor St., East Boston, Mass. 02128.
For literature, circle No. 90



The Boston Acoustics Model A40 is a diminutive loudspeaker system capable of high performance at a very low cost. A two-way system, the A40 uses a 170-mm (6½-inch) long-throw woofer and a 19-mm (¾-inch) Ferrofluid-cooled tweeter, packaged in a box whose longest dimension is only a bit over a foot, at 343 mm.

Weighing a mere 4.1 kg (9 pounds), the cabinet is finished on four sides in wood-grain vinyl. A snap-on grille protects the loudspeakers from inquisitive fingers, and electrical connections are made to spring-loaded clips mounted in a recessed cavity on the rear of the enclosure. Polarity is clearly indicated, both by color coding and symbols adjacent to the connectors. No difficulty should be experienced in hookup, since there are no equalizer controls on the loudspeaker and its small size makes experimentation for optimum location within a room much easier than with a larger system.

The sides of the enclosure are smooth, and, if placed on overhead shelves, care should be exercised so that inquisi-

tive toddlers do not harm themselves by pulling these lightweight boxes down. Boston supplies a set of adhesive-backed rubber feet or pads to prevent the speakers from sliding off the shelf, though (as with all small speakers) a lip on the shelf is advisable. Tipping is not a problem if the speakers are sandwiched closely between shelves; otherwise, a wire down the shelf back will help.

Measurements

The impedance which the Boston Acoustics A40 presents to a power amplifier is shown in Fig. 1. Although rated as a nominal 8-ohm system, the measurement indicates impedance dips as low as 5 ohms. Since this occurs in the octave around Middle C, I considered this system to be a 4-ohm load. This is borne out in the complex impedance plot, Fig. 2, in which a maximum lagging phase occurs at around 100 Hz with a magnitude of 9 ohms and angle of 23°. Treating the A40 as a 4-ohm system, and using larger size hookup wire in short runs from the amplifier, will also prevent the

impedance variations from modifying the frequency response due to line drop. With that in mind, the A40 presents no unusual impedance load to the power amplifier. The complex impedance plot is devoid of spurious terms, indicating a tight and well-constructed enclosure.

The anechoic frequency response is plotted in Figs. 3 and 4. Taken at one meter, directly on axis, these measurements are made using a drive voltage corresponding to one average watt into 4 ohms, or 2 V rms. Boston Acoustics rates the sensitivity as 88.5 dB at one meter and 2.83 V rms. On average, I measure 0.5 dB higher SPL, correcting for the difference in drive voltage. The A40 clearly meets specifications in this regard.

The frequency-amplitude response, Fig. 3, shows an unusually smooth on-axis response, commencing at a low-frequency cutoff of 75 Hz and progressing to 20 kHz. Boston Acoustics rates the response at 68 Hz to 20 kHz, ± 3 dB. Again, they are a bit conservative relative to my measurements, which put the range as 65 Hz to 20 kHz, ± 3 dB.

The frequency-phase response, Fig. 4, is corrected for two effective acoustic positions. The mean average delay, at a one-meter on-axis location, for the woofer is 3.1501 mS, while the delay for the tweeter is 2.9725 mS. The two drivers differ in arrival time by 0.1776 mS (that's the spirit), and the actual acoustic crossover occurs around 5 kHz. The woofer is polarized at 0° ; a positive-going voltage applied to the "+" terminal produces a positive increase in sound pressure (when the speed of sound is corrected from the measurement). The tweeter has a 90° phase shift (when corrected for time delay). The audibility of this phase shift has not yet been established, but the effect is to produce a sound pulse which, for the tweeter, is the Hilbert transform of that for a zero-phase reproducer. In this case, the first 0.15 mS of impulse arrival (corresponding to the response above 7 kHz) has a sine shape, as distinct from the raised cosine which a 0° phase tweeter might have.

The three-meter room test, Fig. 5, also indicates an extremely smooth response. In this case the A40 was mounted 790 mm (31 inches) above a carpeted floor and 75 mm (3 inches) in front of a hard wall. The microphone was positioned at normal listening distance, three meters away from the speaker and one meter above the floor (standard in this test). No articles of furniture, with the exception of the speaker stand, were placed nearer than one meter on either side of the A40. Figure 5 is the measured frequency spectrum of the first 13 mS of sound which arrives at the listening position. Two measurements were performed, and the plots displaced 10 dB on this scale in order to provide clarity of presentation.

Sitting right in front of the A40 produces the upper plot, while sitting 30° off axis, as if the system were the left channel of a stereo pair, produces the lower plot in Fig. 5. If the two curves had not been displaced 10 dB, they would virtually fall on top of each other. This speaker has an off-axis response that is almost the same as the on-axis response, decibel-for-decibel. The dips at 300 Hz, 900 Hz, 1.5 kHz, etc. are due to sound reflecting off the carpet and ceiling and arriving about 0.6 mS after the direct sound. These reflections disappear above 4 kHz, where the slightly higher-directivity tweeter carries the information. As a les-

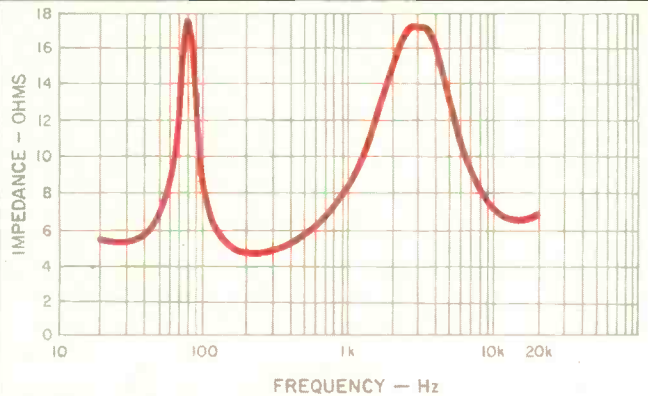


Fig. 1—Impedance.

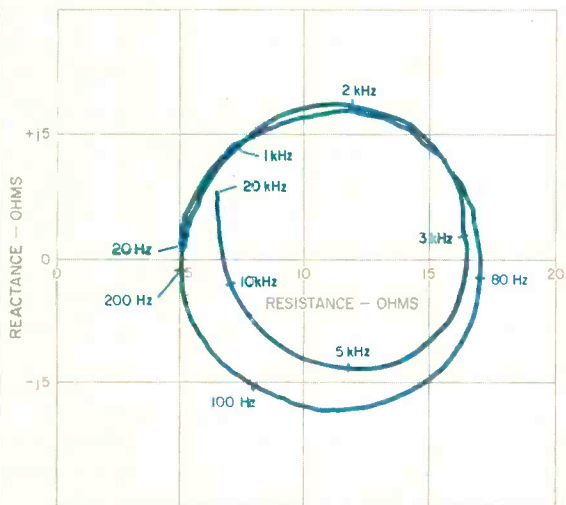


Fig. 2—Complex or polar impedance.

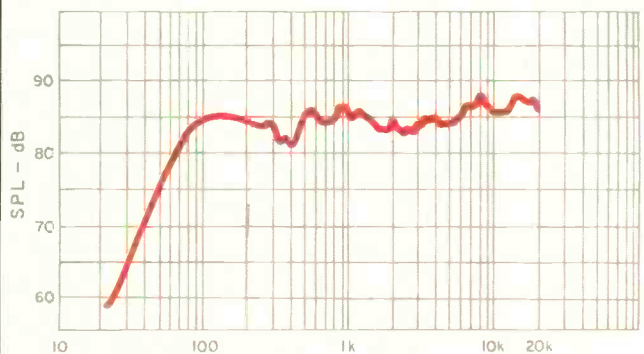


Fig. 3—Frequency-amplitude response measured at one meter directly on axis with a

constant drive voltage corresponding to one average watt into 4 ohms.

**"Boston Acoustics'
diminutive two-way
A40 speaker is capable
of high performance
for very low cost."**

son in physics, a perfect omnidirectional loudspeaker would reinforce at d.c., 600 Hz, and 1.2 kHz under this geometry and dip at 300 Hz, 900 Hz and 1.5 kHz. Taking this into account, the room response of the A40 is exceedingly good.

The horizontal and vertical polar energy responses for this speaker are plotted in Figs. 6 and 7. These are true energy responses in which the information plotted is the integral of the square of the amplitude of the impulse response for a perfect band-limited signal extending from 20 Hz to 20 kHz. The horizontal polar energy dispersion is uniform within

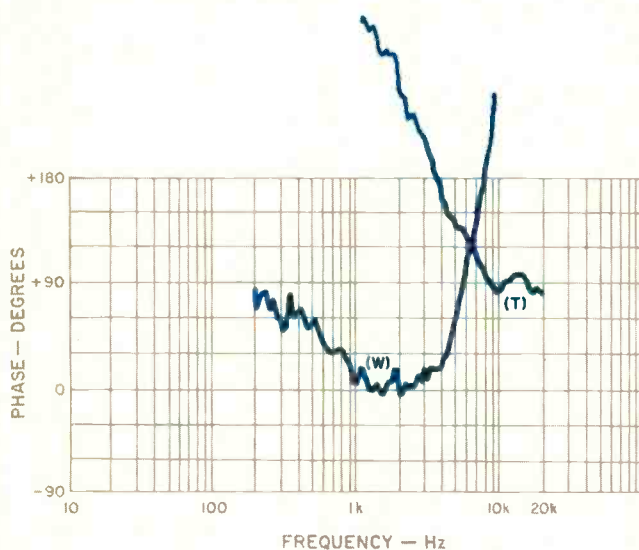


Fig. 4—Phase-frequency response, measured under the same conditions as Fig. 3, with the tweeter corrected for a time delay of 2.9725 mS and the woofer 3.1501 mS.

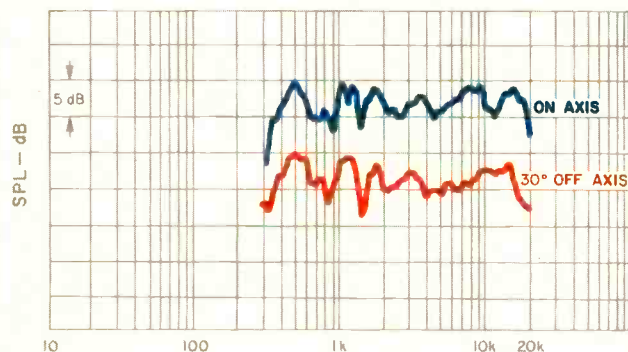


Fig. 5—Three-meter room response.

$\pm 30^\circ$ from the front axis position, and so is the vertical response, with the exception of the slight upward projection of sound energy which is characteristic of speakers with this frontal configuration of drivers. The wide lateral dispersion indicates excellent stereo imaging capability. The wide vertical dispersion, on the other hand, can be a mixed blessing. Being uniform in the vertical plane means that one gets the same sense of stereo illusion whether standing or sitting, an extremely good feature, but it does cause significant energy to be radiated toward the floor and ceiling. Thus the A40s should never be placed where any hard reflecting surface, such as an overhanging shelf, could cast early reflections back into the principal listening area. If that is not possible, then such surfaces should be covered with acoustically absorbent materials in order to preserve the excellent imaging properties of this speaker (even a doubled-up towel will do in a pinch).

Harmonic distortion measurements for the tones of E_1 (41 Hz), A_2 (110 Hz), and A_4 (440 Hz) are plotted in Fig. 8. Not surprisingly, E_1 , which lies an octave below cutoff, is difficult for the A40 but only at high drive levels. During the earlier listening test, I was struck by the fact that the A40 did an excellent job on wide-range material reproduced at brisk level. To be sure, the deep bass is not there, but when I began to drive it really hard, the A40 did not cave in where I knew deep bass to be present. The data of Fig. 8 show why. The distortion for E_1 rises uniformly with drive level, and the system does not show acoustic distress until levels of about 10 average watts (into the assumed 4 ohms). The combination of a uniform increase in distortion with drive level, and virtually the same ratio of second to third harmonic over most of the usable range, tends to prevent the system from becoming annoying in its harmonic structure. By all means, the cleanest reproduction will result when deep bass notes are kept away from the A40, but, as this measurement shows, the system does a creditable job of handling whatever you give it. Tones of A_2 and A_4 produce moderately low distortion, below 1.5%, up to an acoustic overload point of around 80 average watts. It must be remembered that the data of Fig. 8 are from a burst measurement technique intended to determine how the loudspeaker reproduces momentary bursts of high-energy signal. Any steady-state measurements at these levels would soon fry the driver.

The intermodulation distortion produced on a tone of A_4 (440 Hz) by a low E_1 (41.2 Hz), mixed one-to-one, is plotted in Fig. 9. Again, although the low-frequency cutoff is well above 41 Hz, the listening test indicated that low bass simply did not muddy up orchestral passages which were reproduced at high level. I would normally have expected a significant amount of mud due to low bass, which was moving the same cone that reproduces everything below about 5 kHz. It did not seem to happen, and, again, the measurement confirms the ears. The test signal has an equal mix of E_1 and A_4 , and the indicated power level is such that a peak drive voltage of 2.83 V corresponds to one average watt into the assumed 4-ohm load. The IM is computed as the combined energy in the sidebands around A_4 , caused by E_1 , and plotted as a percentage of the A_4 level. The values of IM produced by the A40 would be acceptable for some of the better and more-ambitious wide-range loud-

“For both sensitivity and anechoic response, the A40’s ratings are conservative relative to my measurements.”

speaker systems. Considering the fact that the A40 uses a 170-mm (6½-inch) woofer, the values are startlingly good. The nature of IM is principally phase modulation at lower levels, with only a small amount of amplitude modulation. This begins to change above 10 average watts. At 40 average watts, the IM consists of 8° peak-to-peak phase modulation of 440 Hz by 41 Hz and 3% peak-to-peak amplitude modulation. At 100 average watts (remember, this is a short-duration burst test), there is 9° peak-to-peak phase modulation and 8% peak-to-peak amplitude modulation.

There does exist a measurable effect which I did not pick up during the earlier listening test. As power level is increased, the mean average acoustic center of the A₄ tone moves toward the listener; this amounts to 4.5° phase shift of the A₄ tone at 100 average watts, or about 1 centimeter of spatial advance.

The test for acoustic transfer gain and the crescendo test both show the A40 to be an excellent performer. The indication is that the stereo illusion should remain stable under wide surges in orchestral dynamics. Up to 10 average watts, the tones of Middle C and A₄ remain within 0.05 dB of their proper level, while A₂ dropped 0.2 dB. Inner musical voices of A₂ and A₄ remained within 0.1 dB of their proper level when wideband noise of 20 dB higher energy level was superimposed, even up to peak levels corresponding to 60 watts.

The energy-time curve for the A40 is plotted in Fig. 10. The initial peak of energy, due to a Hamming-weighted 20 Hz to 20 kHz band-limited pulse, arrives at 2.97 mS. Following an initial reverberation decay at a rate of about 110 dB per millisecond, subsequent arrivals stay at least 30 dB below the main peak. All in all, this indicates an excellent impulse response, with the majority of energy arriving within 0.3 mS.

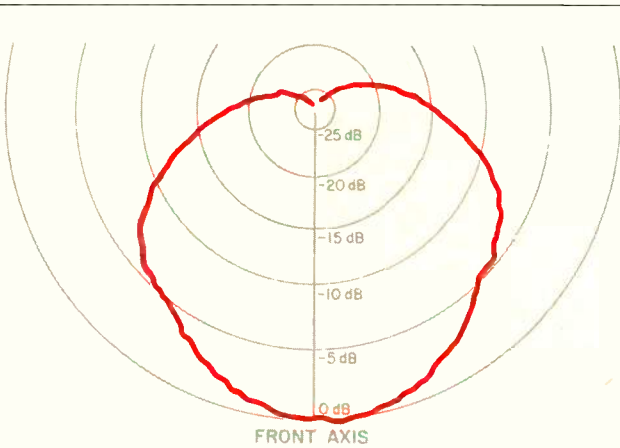


Fig. 6—Horizontal-plane polar-energy response.

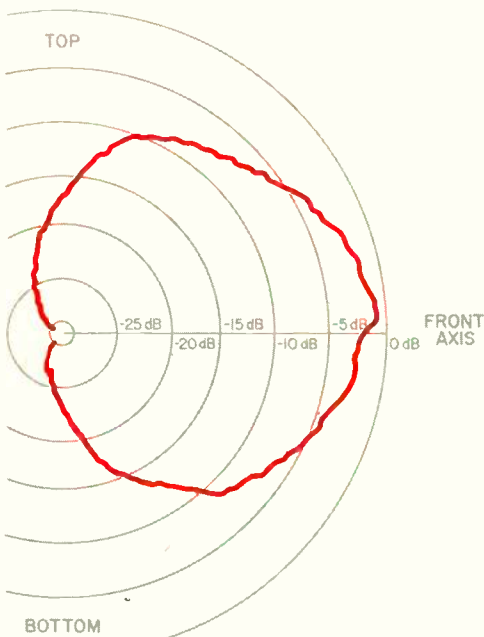


Fig. 7—Vertical-plane polar-energy response.

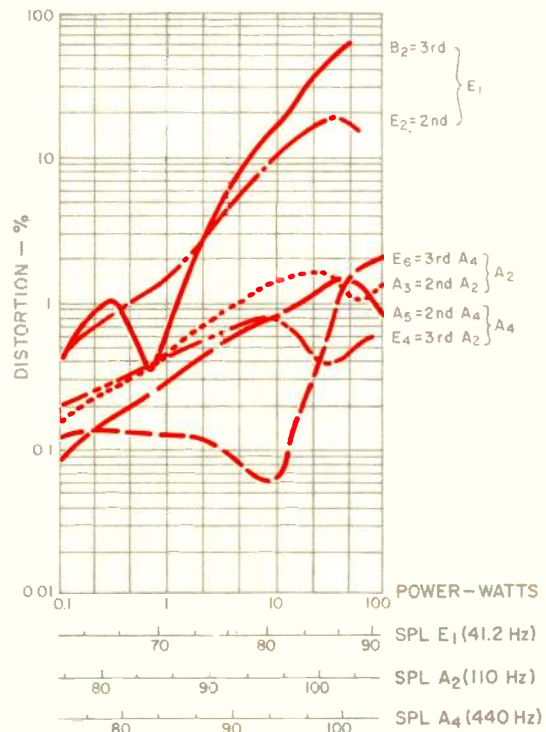


Fig. 8—Harmonic distortion for the tones E₁ (41.2 Hz), A₂ (110 Hz), and A₄ (440 Hz).

“Positioned properly, the A40’s sound is clear and remarkably wide in response for such a small enclosure.”

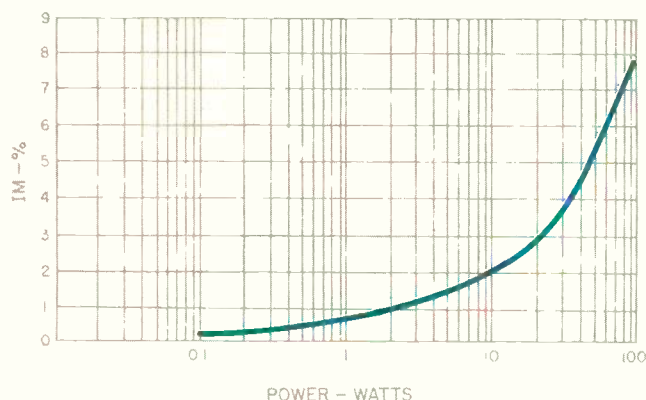


Fig. 9—Intermodulation distortion of A₄ (440 Hz) by E₁ (41.2 Hz) when mixed in one-to-one ratio.

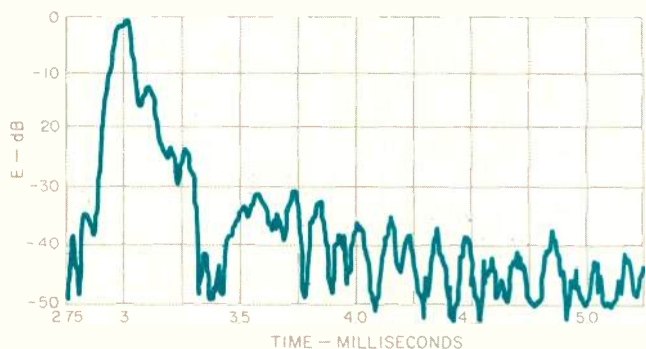


Fig. 10—Energy-time curve.

Use and Listening Tests

The information supplied with the Boston Acoustics A40 needs more recommendations for achieving optimum placement. As I soon found out, the A40 has a very wide dispersion of sound which produces unpleasant tonal notches and nasal properties when placed next to reflecting surfaces. When positioned away from such surfaces, the sound is clear and remarkably wide in frequency range for such a diminutive enclosure. Most of the listening tests were done with the A40s raised 780 mm (31 inches) above the floor, which placed the center of the enclosure at about ear level when seated.

As claimed, the dispersion is quite good, and there is no essential audible difference produced when the speakers are rotated directly toward the listening area or pointed forward, which places the stereo listening position about 30° off axis. All of the listening tests were done, however, with the speakers canted toward the listening area.

As might be expected, the super low bass is absent. But bass balance is such that response is uniform down to about two octaves below Middle C, then it drops smoothly with no obvious bumps or dips. This is not a loudspeaker whose low end should be brought up with tone controls. It

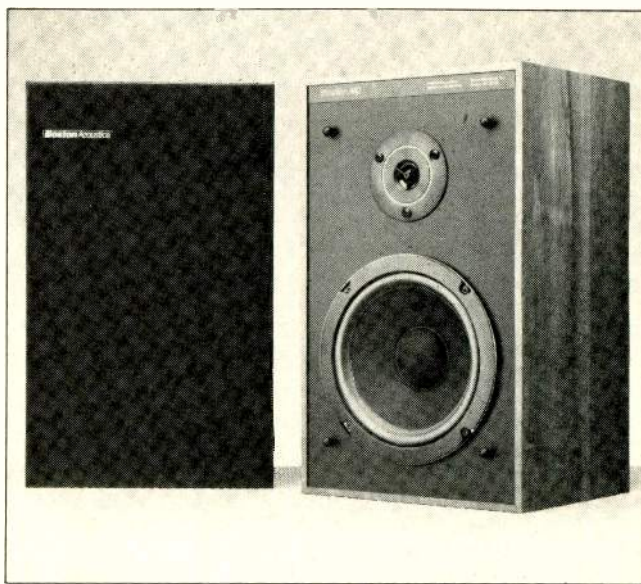
should be played flat. The midrange has a few dips (which the three-meter room test later showed to be due to interference reflections), and the top end is quite smooth and extended in its frequency range. I could not hear any difference with or without the grille assembly, so I left the grille in place. As far as wide-range tonal balance is concerned, this is a prime candidate for augmented bass using a sub-woofer. Because the top end goes right on out, the lack of low bass seemed, to me, to create a tonal imbalance on some wide-range material. This subjective effect was somewhat relieved by actually pulling down the extreme high end with equalization. Normally, I preferred the flat position for most material.

Stereo imaging is excellent. The illusions of both lateralization and depth are accurately conveyed, particularly at higher levels. I was pleasantly surprised to find that, although rated for a maximum of only 40 watts, the system can handle very brisk levels without stress or audible breakup. At higher SPLs, the A40’s ability to handle peaks gave the impression of a much wider frequency range than it was actually producing. In other words, after long periods of listening only to the A40s, I accommodated to the response and did not sense the lack of low frequencies on orchestral peaks. Only when I switched to a wider range system was the loss of bass apparent. This is a good example of Catastrophe Theory in action. That the A40 did not crunch or evidence other problems in the bass region under wide dynamic conditions allows this accommodation to occur.

Piano was moderately good, though not the very best I have heard from loudspeakers. And while the A40s do an excellent job of reproducing male voices, female voices, particularly choral groups, were not as realistically reproduced to my ears.

If this loudspeaker were to sell for a few hundred dollars, I would be tempted to say that it is a moderately good bargain; considering its actual price, I think it is an extraordinarily good one.

Richard C. Heyser



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EAGLE ST



White-letter perfect. Eagle ST.

We designed Eagle ST street radials with our Eagle race tires in mind.

Which explains the tread pattern that's a direct steal from our two-time IMSA RS champion radials. The racy low profile that puts more rubber on the road. And the Goodyear radial construction that will help keep it there for a long time to come.

As for the classic white-letter styling, it doesn't make Eagle ST go faster, but when you have a tire with this much of a competition heritage, why keep it a secret?

Best of all, even though Eagle ST may sound as if it belongs on a race car, it's built to work on your light truck or van, too.

Prove it to yourself. With a quick trip to the Eagles' Nest at your Goodyear retailer. The trip home will be even quicker.



GOODYEAR
QUALITY AND INNOVATION

2

ADS C2
CASSETTE
DECK**Manufacturer's Specifications**

Frequency Response: 30 Hz to 16 kHz, ± 1 dB; 30 Hz to 18 kHz, ± 1 dB, with metal tape.

Signal/Noise Ratio: 58 dBA, 74 dBA with Dolby C NR.

Separation: 35 dB.

Crosstalk: 70 dB.

Erasure: 65 dB.

Input Sensitivity: Mike, 0.2 mV; line, 30 mV.

Output Level: Line, 560 mV; headphone, 320 mV into 200 ohms.

Flutter: $\pm 0.06\%$ wtd. peak.

Wind Times: 80 seconds for C-60.

Dimensions: 17½ in. (440 mm) W \times 2¾ in. (70 mm) H \times 14¾ in. (375 mm) D.

Weight: 18.3 lbs. (8.3 kg).

Price: \$549.00.

Company Address: One Progress Way, Wilmington, Mass. 01887.

For literature, circle No. 91



The ADS C2 stereo cassette deck is a member of the recently introduced Atelier series of matching components. All of the units are of the same basic size and shape, ready for stacking—on an optional stand if desired—or side-by-side placement. The front of the C2 has a clean, uncluttered look which at first hides its relationship to the world of cassettes. A push of the button marked "Slider" causes a

good-sized drawer to move out from the left front panel of the deck, revealing a nicely illuminated horizontal well for the cassette. Loading is essentially a simple push-in-and-down operation, a quickly learned movement.

On the top of the drawer near the front are two sets of interlocked pushbutton switches. Three are for Dolby NR (off/B/C) and four for tape type (ferric/chrome/ferrichrome/

metal). There is also a multiplex filter on/off switch. These buttons are out of sight and mind when the drawer is closed, but they are very obvious and convenient when a tape is being inserted. On the front face of the drawer are light-touch bar switches for the six normal transport modes: Rewind, stop, play, fast forward, record and pause. Bright LED indicators for each function can easily be seen at a considerable distance. The logic allows shifting from any mode to any other, including flying-start recording from play or wind modes.

A seven-segment, three-digit counter display has large, bright digits which should be of aid to most users. There is the expected (and necessary) reset and also "Memo" which stops the deck at "000" in either direction of fast wind. Winding through zero is possible by just holding the appropriate wind button in. These are two useful characteristics of "Memo" which many decks do not have. With "Repeat" the C2 will automatically rewind from the end of the tape to the beginning and start play again. If "Memo" is set, rewind will stop at zero, and play will commence there. "Repeat" and "Memo" have the same light-touch switch bars and bright status lights as used for the transport modes.

The level meters consist of vertical, side-by-side LED-type bar-graphs. The 12 sets of double-bar segments in each meter are green up to zero and red above that. The zero of the meters is referenced to Dolby level, 200 nWb/m, though there is no double-D symbol on the scales to emphasize that fact. The separate dual concentric pots for both line and microphone inputs enable complete mixing of such inputs. The periphery of each knob is rubber covered to aid in rotating one section relative to the other for level balancing. The mike phone jacks are to the right of the pots: If a single mike is plugged into the left jack, it will be fed to both channels for an automatic mono effect. The green-colored "Power" on/off switch is at the opposite end of the front panel, right under the stereo phone jack for headphones.

The line in/out phono jacks are on the rear panel, along with an unswitched a.c. outlet, limited to 200 watts maximum. The ADS deck is supplied with a rear-panel cover which fits easily into place and conceals all of the back-unit cabling. This is perhaps a small convenience, but it could be quite appealing to those who like things neat.

The soldering of the p.c. boards was generally excellent with just a couple of spots having a little flux residue. The large, main circuit card had all adjustments labelled, and they were all completely accessible—not hidden under another card as happens with some decks. All parts were identified on all boards. There were two fuses in clips, and the power transformer was well shielded. The transport assembly was fairly rigid, and the drawer was well constructed, smooth in operation, and did not stop with a shock at its in and out positions. Close operation showed the drawer moves at two speeds, slowing towards the ends of its travel. The box chassis frame was made more rigid with the heavy-steel top cover, which had been removed for the internal examination.

Measurements

The playback responses were very good, with all points within ± 1.5 dB except for the lowest frequency on the 120-

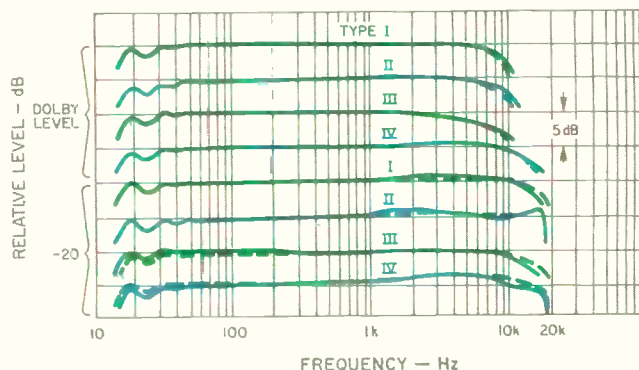


Fig. 1—Frequency responses with (solid line) and without (dashed line) Dolby C NR using Type I (Maxell UD XL-I),

Type II (Memorex HB II), Type III (BASF Professional III), and Type IV (Fuji FR-Metal) tapes.

μ S test tape. The indicated play level was about 0.5 dB low, and tape play speed was 0.35% fast, which is quite good. Many tape formulations were tried with the ADS deck, recording and playing back pink noise recorded at -20 dB in Dolby C mode. Many tapes gave what would be classified as very good performance with noise reduction, and more had flat responses, as expected, without NR. The tapes selected for further testing, Maxell UD-XL I, Memorex HB II, BASF Professional III, and Fuji FR-Metal, gave the flattest responses in the important 100 Hz to 10 kHz region. Other good performers were: Denon DX5; Fuji FR-I; Loran High Bias; Maxell XL II-S; Nakamichi EX II and SX; Sony UCX-S and FeCr; TDK AD, SA, SA-X and MA-R, and Yamaha CR and MR.

Figure 1 shows the swept-frequency response plots for the four tape types both at Dolby level and 20 dB below that, both with and without Dolby C NR. With the usual exception of Type III at Dolby level, the overall results are most notable for the flatness of the responses, particularly with Dolby C NR at -20 dB. The responses are also well extended at the low-frequency end, with minor head bumps. Most of the -20 dB responses are flat within ± 1.5 dB from 17 Hz to 15 kHz or more. (The hotter tapes, such as Sony UCX-S and TDK SA-X, had slightly higher levels above 2 kHz with some extension of the roll-off point.) The -3 dB points for the responses plotted are listed in Table I. Additional checks with pink noise showed that the ADS C2, with its sharp roll-off at 20 kHz, is one of the few decks not influenced by above-band energy—a definite plus for synthesizer users.

Playback of a recorded 10-kHz tone had 10° of phase discrepancy between tracks and just 20° of phase jitter, better than most decks. The multiplex filter response was not down 1 dB until 15.9 kHz, better than most units. The attenuation was a good 31.8 dB at 19.00 kHz. These and other characteristics are listed in Table II. The separation and crosstalk figures are both excellent. The erasure of 60 dB at 100 Hz was quite good for the metal tape used and for that low frequency.

Measurements were made of the third-order distortion of

“ADS supplies a cover for the C2's rear panel—a small thing perhaps, but symbolic of their attention to detail.”

Table I—Record/playback responses (–3 dB limits).

Tape Type	With Dolby C NR				Without Dolby NR			
	Dolby Lvl		–20 dB		Dolby Lvl		–20 dB	
	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell UD-XL I	16	10.0	15	16.1	16	9.3	15	18.3
Memorex HB II	16	10.8	15	18.6	16	9.5	15	18.6
BASF Professional III	16	9.2	15	14.8	16	8.3	16	17.3
Fuji FR-Metal	16	15.9	16	19.3	16	15.0	15	19.8

Table II—Miscellaneous record/playback characteristics.

Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
			Error	Jitter	
60 dB	49 dB	–80 dB	10°	20°	–31.8 dB

Table III—400-Hz HDL₃ (%) vs. record level (0 dB = 200 nWb/m).

Tape Type	NR	Record Level					HDL ₃ = 3%
		–10	–8	–4	0	+4	
Maxell UD-XL I	Dolby C	0.08	0.14	0.24	0.40	1.9	+5.2 dB
Memorex HB II	Dolby C	0.18	0.24	0.53	1.7		+2.4 dB
Fuji FR-Metal	Dolby C	0.11	0.15	0.29	0.75	2.1	+5.1 dB

Table IV—Signal/noise ratios with IEC A and CCIR/ARM weightings.

Tape Type	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby NR		Without NR		W/Dolby NR		Without NR	
	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Maxell UD-XL I	69.3	74.1	52.5	57.8	69.8	74.6	50.2	54.5
Memorex HB II	69.5	71.7	53.3	55.2	70.2	72.4	51.0	52.9
Fuji FR-Metal	72.0	76.6	55.5	59.3	72.5	77.1	53.4	57.2

Table V—HDL₃ (%) vs. frequency at 10 dB below Dolby level.

Tape Type	NR	Frequency (Hz)						
		50	100	400	1k	2k	4k	6k
Fuji FR-Metal	Dolby C	0.12	0.13	0.11	0.13	0.14	0.19	0.36

Table VI—Input and output characteristics at 1 kHz.

Input	Level		Imp., Kilohms	Output	Level		Imp., Ohms	Clip (Re: Meter 0)
	Sens.	Overload			Open Ckt.	Loaded		
Line	29 mV	6.5 V	197	Line	500 mV	380 mV	3.8k	+14.3 dB
Mike	0.16 mV	23 mV	2.24	Hdphn.	450 mV	47 mV	68	

a 400-Hz tone with the three tapes in Dolby C NR mode from –10 dB up to the point where HDL₃ reached 3%. Table III lists the results of those tests, and it shows that UD-XL I and FR-Metal had close to the same good performance. Signal-to-noise ratios were secured both with and without Dolby C NR, for IEC A and CCIR/ARM weightings. The excellent results for all combinations are reported in Table IV. The Fuji Type IV tape was also used for evaluating the distortion across the band at 10 dB below Dolby level; Table V presents the figures obtained for frequencies from 50 Hz to 6 kHz. The results are quite good, and those at the frequency extremes are better than many decks.

Various input and output characteristics were measured, and as Table VI shows they were all substantially to specification. That this is so for the headphone output might not be clear; the standard test loading for a headphone output is 8 ohms, while ADS specifies 320-mV output with a 200-ohm load. Using their specified load, the measured output was 366 mV. In the checks with various headphones, there was quite a range in the acoustic levels at zero meter level. As there is no output-level control, the user may find an advantage in selecting phones to match personal level preferences. Mike and line input-pot sections both tracked within a dB from maximum down to about –50 dB, which is quite good. The line-out polarity was reversed from the input's in record mode, but it was the same in playback.

The level meters were only 1 dB down with a tone burst of just 10 mS duration, meeting this criterion for peak-responding meters. The decay was on the fast side, just 520 mS for a 20 dB drop as compared to the standard of at least 1.4 S. The thresholds of the 12 meter segments were all acceptably accurate, and those between “–2” and “+2” were within 0.3 dB, which is just fine. Because the meters are fed after the record equalization, the responses are not flat. Relative to 400 Hz, they were up about 4 dB at 20 Hz, +3.6 dB at 2 kHz, and increasing to +7 dB at 8 kHz. This is a metering design that I prefer because the indicated levels are better correlated to the low- and high-frequency energy that can cause distortion.

A 3-kHz tone was recorded the entire length of a C-90 cassette. The flutter measured in playback was consistently low wherever it was checked: 0.033% wtd. rms and ±0.055% wtd. peak. The tape play speed changed less than 0.05% with the line power varied anywhere from 110 to 130 V. With time the speed wandered less than 0.02%, also an excellent figure. The wind times for a C-60 cassette were 72 S, average for a deck. The time required to change modes, such as from wind to play, was less than a second. Tape runout to transport stop mode took 2 S.

Use and Listening Tests

The instruction manual has very well written text, making things clear without excessive detail. There is just one set of figures showing panel layouts, but the arrangement of the pages of informative words obviates the need for illustrations to make points. I do disagree, however, with the comments on Type I tape to the effect that their use should be restricted to “utility” purposes. I also noted that the manual did not mention pressing the pause button and then play and record for record/pause mode, which would be the

“Frequency responses, as well as third-harmonic distortion and S/N ratios, were excellent with a variety of tapes.”

normal practice in order to set levels accurately before starting the recording process by again pressing pause.

After a little experience with the C2, pushing “Slider” to make the drawer move out seemed as natural as pushing an eject button. Putting the cassette in place did require more care, but little more time, than dropping it in a carrier. A bit of practice here gained the facility to insert the tape with the back down, pushing against the spring loading and snapping down the front—all in one motion. Maintenance of the heads was best performed with the deck in play, to make tape-path components more accessible. All switches and controls were completely reliable throughout the tests.

The length of the level displays had seemed somewhat short at first, but their fast response made adjustments quite easy. I found the friction between input-level pot sections to be rather high, which made channel balancing touchier than it might have been. At first I also made mistakes because there is no front-panel designation to remind the user that the front knob is for the right channel. The combination of white lettering on a black background, bright status lights and well-illuminated counter and meter displays did make for easy use under a wide range of lighting conditions. Even

with Dolby C NR, record and pause perturbations appeared to be nonexistent by ear or meter, and the stop “clunk” was barely detectable.

The listening tests with a pink-noise source demonstrated how well matched the Dolby C NR responses were, with no evidence of mistracking at any time. The playback of selected discs was most satisfying, aided I am quite certain by the exact level setting possible with the C2’s excellent metering. The extended low-end response contributed to the feeling of solidity with some of the discs.

The ADS C2 provides excellent responses, well-designed metering, low noise and distortion, mike/line mixing, and low flutter—all for a moderate price. The C2 does not have a host of convenience features or a third head for simultaneous playback, but it does do the essentials very well—and it is one of the simplest decks to use, with a minimum of confusion. Even if one isn’t interested in purchasing an entire system such as the Atelier series, the C2 will be of interest to those who are looking for a cassette deck with ease of operation, distinctive appearance, and excellent performance. The moderate-level price of the ADS C2 isn’t likely to hurt either.

Howard A. Roberson



Noise-reduction and tape selector switches become visible when the illuminated transport drawer is opened for loading—the only time they’re likely to need resetting.

3

SIE PUBLISHING

"CRITICAL LISTENING: AN AUDIO TRAINING COURSE"

Author: F. Alton Everest.

Course Materials: Five cassettes or open-reel tapes and 108-page manual.

Price: With cassettes, \$129.95; with open-reel tapes, \$199.95.

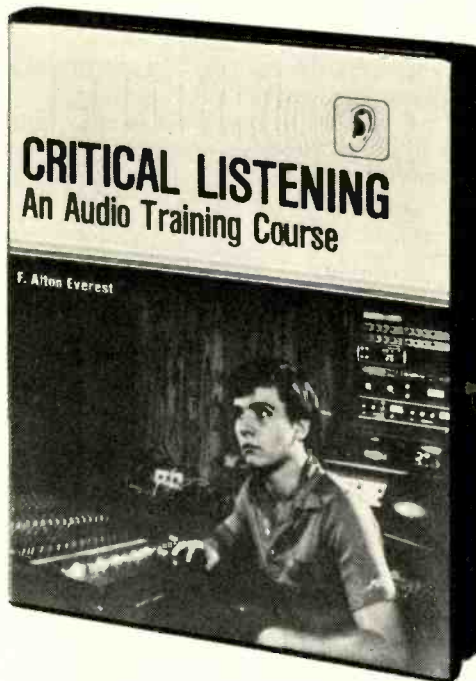
Company Address: 31121 Via Colinas, West Lake Village, Cal. 91362. For literature, circle No. 92

Critical Listening is a training course aimed at those considering music-studio careers, but its potential usefulness to audiophiles is obvious. The version I reviewed consists of a 108-page manual and five cassettes, with one "chapter" or lesson on each cassette side.

The course's level is quite basic, and the treatment appropriately diagnostic, concentrating not on "good" or "bad" sound but on the ability to analyze what one actually hears. As the manual puts it, the course is "based upon the premise that . . . discriminating listening ability, which appears so remarkable and complex when viewed casually, can be subdivided into a number of simpler parts which are teachable."

I listened to the cassettes with a female colleague whose hearing is probably better than mine but perhaps not so critical. We heard the same things in all cases. She was surprised at the emphasis on values she considered musical rather than technical, but for someone who will have to equalize tapes to the satisfaction of musicians, the emphasis is right.

Cassette side one ("Estimating the Frequency of Sound") deals with the



audio spectrum, and teaches the association of pitch with actual frequency for single tones and narrow-band noise signals. The object is not to determine whether you can hear 22,000 Hz, but to see if you can confidently select the right equalizer band to make a desired change. Side two ("Estimation of Sound Level Changes") does the same thing for perceived loudness versus actual sound levels, with the manual providing very basic notes on the logarithmic derivation of the decibel. Side three ("Estimating Frequency Band Limitations") presents deliberately band-limited program material and general instruction on detecting frequency-response limitations. All these sides, and the ones that follow, conclude with little quizzes.

Side four ("Frequency Response Irregularities") progresses into multiple peaks and dips in frequency response, finishing with some valuable tutorial on the behavior of lavalier microphones. Side five ("Judgement of Sound Quality") discusses the audible differences between simple and complex waveforms, the contribution of the fundamental frequency to the perceived sound, and the effect of depriving musical instruments of their overtone structures. Side six ("Detecting Distortion")

treates harmonic distortion, wow, and flutter.

Side seven ("Reverberation Effects") takes on the meaty subject of reverberation time and its influence on music and speech intelligibility. The reverberation is artificially generated, but the conclusions arrived at are generally valid. Side eight ("Signal versus Noise") defines signal-to-noise ratio and acceptable noise levels, and demonstrates some often-encountered noises of electrical and mechanical origin. Alas, some of the noises, such as a touch of hum here and there, have been introduced unintentionally.

Side nine ("Voice Colorations") delves pretty deeply into good microphone practice, and contains excellent information that many working professionals seem to ignore. The recorded examples are of speech only, but the problems translate directly to music recording. Use of acoustical absorbers to eliminate local sound reflections to the microphone is not touched on at all, but at least the student gets a clear idea of what havoc such reflections can raise, and is taught some of the reasons why multi-miking has been falling out of fashion.

Side 10 ("Listening with Discernment"), described as a review, is an

exam that asks the listener to identify flaws which have been deliberately introduced into 10 musical excerpts.

Critique

The principal problem I find with *Critical Listening* is that while it is a splendid guide to making or understanding a good recording, it is not *itself* a good recording. Chromium-dioxide tape is used, but without noise reduction. As it happens, noise—except for modulation noise—never becomes a significant fault, but this is probably because compression and riskily high levels are employed throughout. There is print-through (most blatant on the frequency sweep of side one) and a fair amount of high-frequency overload and other distortions. There is also a distressing tendency for some of the purposefully flawed examples to sound better, or at least more accurate, than the properly executed reference (as when the cardioid microphone, placed at the "correct" distance from the narrator,

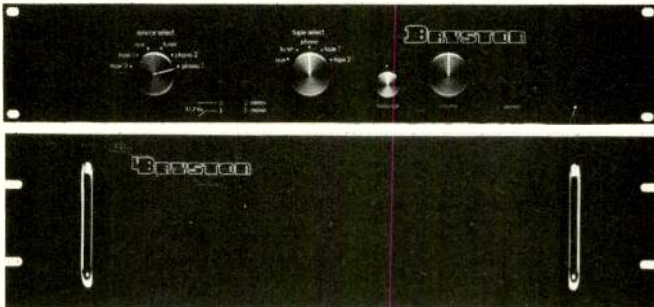
comes through with far more proximity effect than I like to hear). This mystery sent me and my cassette deck to the test bench several times, to make sure that all was well with the machinery. It seemed to be.

The most annoying part was the brief snatch of TV-commercial music that is used throughout the course to demonstrate good and impaired sound. Evidently it is a stock item from a tape library (rights to original material for projects like this are hard to come by), and whatever it sounded like when it was rented, it comes to us on these cassettes with something like 10% distortion in its "clean" version. This doesn't mean you can't hear the deliberate distortion increases of side six; the added increments of THD are substantial. But it does mean that a reference to good sound is lacking, and this can become a distraction when you're listening for flaws other than distortion in other sections of the course. (Incidentally, Mr. Everest, the author,

tells me that distortion levels for side six were established by raising the recording level until a steady tone achieved the desired amount of distortion, and then recording the music with the VU meters peaking at that level.)

Aside from a few other quibbles (for example, the violin and piano of side five are not precisely in tune), I'm inclined to award *Critical Listening* full points for value and validity of concept. I can see this course, or something like it, doing good service for a technical library or an audio club, its somewhat high cost notwithstanding. Does it adequately define what critical listening is really all about? It certainly puts its finger on many things that make listening unpleasant, and by implication suggests what can be done to improve matters. Also, I would have to say that if you can't hear the points that this course is trying to make, any hopes you might have of becoming a critical listener are fanciful indeed.

Ralph W. Hodges



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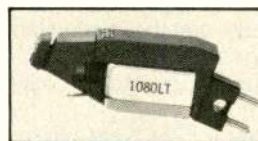
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4

GRACE F-9E RUBY PHONO CARTRIDGE

Manufacturer's Specifications

Type: Fixed coil (moving magnet).

Frequency Response: 10 Hz to 50 kHz, ± 2 dB.

Output: 2.6 mV at 5 cm/S at 1 kHz.

Impedance: 1.7 kilohms at 1 kHz.

Recommended Load Resistance: 47 kilohms.

Recommended Load Capacitance: 220 pF.

Separation: 30 dB at 1 kHz.

Stylus: Elliptical type/extended range, nude-mounted on a ruby cantilever.

Stylus Pressure Range: 0.5 to 2 grams.

Standard Pressure: 1.2 grams.

Compliance: 25×10^{-6} cm/dyne.

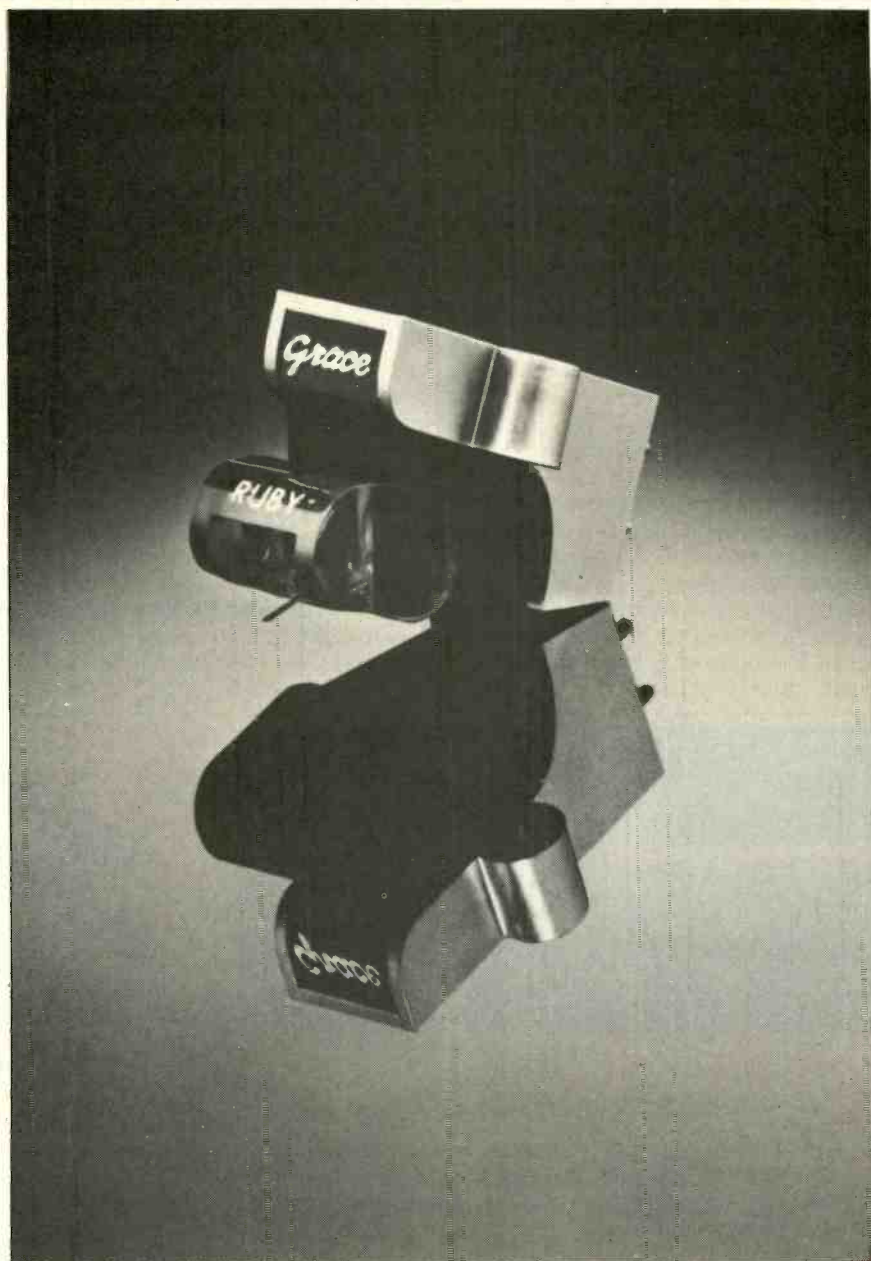
Tip Mass: 0.35 mg.

Square-Wave Rise-Time: 10 μ S.

Price: \$300.00.

Company Address: c/o Sumiko, P.O. Box 5046, Berkeley, Cal. 94705.

For literature, circle No. 93



I am amazed at the number of good phono cartridges that are currently available in the U.S.A. As most cartridges originate in Japan, I am inclined to believe that the Japanese enjoy nearly a world-wide monopoly in the manufacturing of "state-of-the-art" phono cartridges, both fixed- and moving-coil types. Among these are the well-established Grace F-9 series of moving-magnet phono cartridges manufactured by the Shinagawa Musen Co., Ltd. of Tokyo and sold in the U.S.A. by Sumiko, Inc.

Among the advances the Grace F-9s have utilized over the years is their Omni-Axial[®] Pivot, which frees the stylus from aberrations caused by nonlinearities in the suspension

system—longitudinal drag distortion. In most cartridges, the damper and pivot point coincide, causing hysteresis effects at the exact point where the system should be linear. In the F-9 a tension wire keeps the cantilever poised while the damper keeps it centered. This setup is akin to that of the finest moving-coil cartridges.

The Grace F-9E and the F-9E Ruby are quite similar, with the bodies and styli relatively identical. The styli are made from Ogura's best "Vital" diamonds, which means that each is shaped from a diamond block of rectangular cross-section having one-half the mass of conventional square-shank diamonds, thereby allowing a significant reduction in effec-

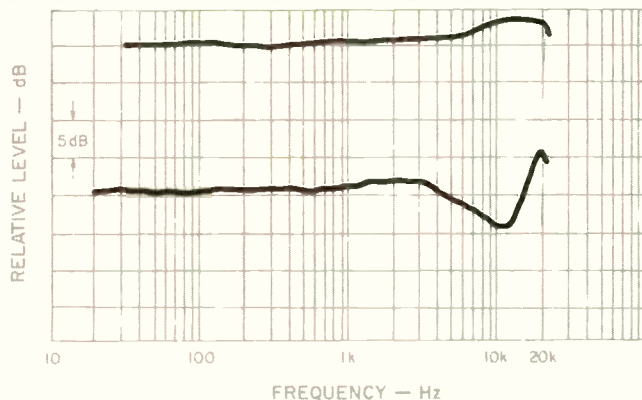


Fig. 1—Frequency response and separation.

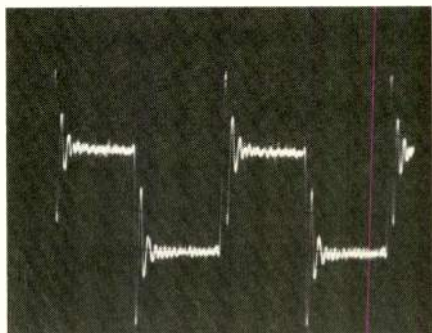


Fig. 2—Response to a 1-kHz square wave.

tive tip mass. With a lower effective tip mass, the stylus can respond much more quickly and precisely as it is pushed from side to side in a moving record groove.

The stylus of the F-9E Ruby phono cartridge, with its precisely elongated elliptical contact area (0.2 x 0.7 mil or 5 x 18 μ), is polished to a mirror-like smoothness and nude-mounted on a ruby cantilever. This cantilever is made from a ruby rod; ruby is second in hardness only to diamond. Since ruby also exhibits much less resonance and flexing than any metal cantilever, it allows a virtually perfect one-to-one energy transfer from stylus to generating element. This, in turn, provides both an improved resolution of detail and an improved transient response.

Measurements

The Grace F-9E Ruby phono cartridge was mounted in an Audio-Technica AT-S headshell and used with the Technics EPA-A250 (S-shaped) interchangeable tonearm unit attached to the Technics EPA-500 tonearm base, which was mounted on a Technics SP-10 Mk II turntable. The cartridge was oriented in the headshell and tonearm with the Dennessen Geometric Soundtracktor.

Laboratory tests were conducted at an ambient temperature of 67° F (19.44° C) and a relative humidity of 58%, \pm 3%. The manufacturer's recommended stylus force of 1.2 grams was most unsatisfactory in my tonearm. The optimum

tracking force was determined to be 1.7 grams, with an anti-skating force of 2.2 grams. The load resistance was 47 kilohms, and the load capacitance was 410 pF. Because of the large difference in the tracking force as well as in the load capacitance from that recommended, I called Sumiko's David Fletcher for a possible explanation. He said the 1.2-gram tracking force given in their literature was an error and that they measured the Grace F-9E Ruby parameters at a tracking force of 1.5 grams. He was, however, unable to explain my finding that the optimum cartridge load capacitance was almost double the recommended figure. My measurements and listening tests were performed under the conditions stated above.

At this point, a brief discussion relative to the problem of fixed-coil phono cartridge loading capacitance is in order. There are some cartridges of the moving-magnet or moving-iron type (but not moving coil) that are sensitive to variations in capacitance loading, while others of the same type are not affected. As much as 5 dB variation in frequency response has been seen in improperly terminated phono cartridges. However, cartridges sensitive to capacitance loading may tolerate as much as a 20% mismatch without appreciably affecting the frequency response. Reduced cartridge terminating capacitance can cause a peak at the 10 to 20-kHz region as well as a depressed treble response from 2.5 to 10 kHz. Conversely, a very high capacitive load can depress the high-end response. One of the factors contributing to incorrect capacitive loading has been the interconnecting cable used between the tonearm-cartridge output and the phono input of the preamplifier. I have found that dual phono cables supplied by various manufacturers do not have reasonably identical capacitances in each half of the dual cable. Not infrequently, more than a 65% difference in cable capacitance has been measured in many dual cables, thus adversely affecting the load in one channel. The result is an appreciable difference in interchannel response, and the reproduced music is quite unnatural.

As is my practice, measurements are made on both channels, but only the left channel is reported (unless there is a significant difference between the two channels, in which case both channels are reported).

The following test records were used in making the reported measurements: Columbia STR-100 and STR-112; Shure TTR-103, TTR-109, TTR-110, TTR-115, TTR-117; Deutsches HiFi No. 2; Nippon Columbia Audio Technical Record (PCM) XL-7004; B & K QR-2010, and Ortofon 0002.

Frequency response, using the Columbia STR-100 test record (Fig. 1), was +2.5, -0.25 dB from 40 Hz to 20 kHz; with a gradual rise commencing at 4 kHz, +1 dB at 8 kHz, +2 dB at 12 kHz, +2.5 dB at 15 kHz, and dropping to +1.75 dB at 20 kHz. Separation was 19.3 dB at 1 kHz, 26.75 dB at 10 kHz, 28 dB at 12 kHz, 22.75 dB at 15 kHz, and 17 dB at 20 kHz. From these data it is quite evident that the Grace F-9E Ruby has an excellent frequency response and a good high-frequency separation. The 1-kHz square-wave response is consistent with the wide frequency response of the F-9E Ruby. The square-wave photo, Fig. 2, shows that there is a large overshoot (not unlike moving-coil cartridges'), the full amplitude of the square wave, followed by low-level ringing that decays rapidly. This is apparently

"From the data, it is quite evident that the Grace F-9E Ruby has an excellent frequency response and good high-frequency separation."

due to a relatively undamped stylus resonance that takes place at about 32 kHz. The arm-cartridge low-frequency resonance was almost impossible to measure with the EPA-A250 "S" arm unit. After disabling the arm's anti-resonance unit, the arm-cartridge low-frequency, lateral resonance point for the left channel was 8 Hz with a 2.5 dB rise, while for the right channel it was also 8 Hz, with a 3.5 dB rise. Vertical resonance was at 7 Hz. Neither the lateral nor the vertical low-frequency resonance was measurable when the arm's anti-resonance unit was used. The high-frequency resonance point was at 32 kHz.

Using the Dynamic Sound Devices DMA-1 Dynamic Mass Analyzer, the arm-cartridge dynamic mass was measured as 20 grams, and the dynamic vertical compliance as 25×10^{-6} cm/dyne at the vertical resonance frequency of 7 Hz. The anti-resonance unit on the arm was defeated for this test, since no resonance is measurable when the device is functioning.

The harmonic distortion components of the 1-kHz, 3.54-cm/S rms 45° velocity signal from the Columbia STR-100 were 2.8% second harmonic and 0.45% third harmonic, with less than 0.25% higher order terms.

The vertical stylus angle measured 31.5° using the Vertical Tracking Angle Meter (Inclination Meter), Model 3002, developed by the CBS Technology Center. This is one of the highest vertical stylus angles I have ever measured. Other measured data are:

Wt., 6.0 g; d.c. res., 626 ohms; opt. tracking force, 1.7 g; opt. anti-skating force, 2.2 g; output, 1.1 mV/cm/S; IM distortion (4:1), +9 dB lateral, 200/4000 Hz, 1.7%; +6 dB vertical, 200/4000 Hz, 6.4%; crosstalk (using Shure TTR-109), left: -24 dB, right: -26.4 dB; channel balance, 1.8 dB; trackability: high freq. (10.8 kHz, pulsed), 30 cm/S, mid-freq. (1000 and 1500 Hz, lat. cut), 31.5 cm/S, low freq. (400 and 4000 Hz, lat. cut), 24 cm/S; Deutsches HiFi No. 2, 300-Hz test band was tracked cleanly to 77 microns (0.0077 cm)

lateral at 14.50 cm/S at +8.70 dB and 55.4 microns (0.00554 cm) vertical at 10.32 cm/S at +5.86 dB.

The Grace F-9E Ruby phono cartridge played all test bands cleanly on the Shure Obstacle Course Era III musical test record. On the Shure Obstacle Course Era IV test record, the cartridge experienced some difficulty playing level 5 of the orchestral bells, harp and flute, and flute and bells test bands. Needless to say, the cartridge played very well, inasmuch as peak recorded velocities on level 5 for the combined instruments exceed 45 and 50 cm/S, respectively. The peak recorded velocity of commercial records averages about 15 cm/S.

Use and Listening Tests

As usual, I performed many hours of listening tests, both before and after measurement. Equipment used in the evaluation included a Crown IC-150 preamp, an Audire DM-700 power amp, and a pair of Pentagram P-10 loudspeakers in addition to the aforementioned Technics arm and turntable and an Audio-Technica AT666EX vacuum disc stabilizer.

The Grace F-9E Ruby was able to cleanly reproduce the many string instruments on the Eglise St. Medard Concert recording (Dominus Records, Elizabeth, N.J. 07201) and, in particular, the Moeran *Symphony in G minor* (Mobile Fidelity MFSL 1-524), which can also be used as a musical test record to aurally evaluate the entire audio system. In the course of the listening evaluation, the Grace F-9E Ruby was found to be neutral, neither imparting sound nor coloration of its own to the music. There was excellent sonic clarity as well as a well-defined bass. Applause definition, transient response, transparency of sound, and tracking ability were very good. Although there is a slight rise in frequency response at the high end, I did not find the cartridge to be bright. The overall musical response of the Grace F-9E Ruby is very pleasing to the ear and certainly merits serious consideration by all music lovers.

B. V. Pisha



THE IMF ELECTRONICS HPCM

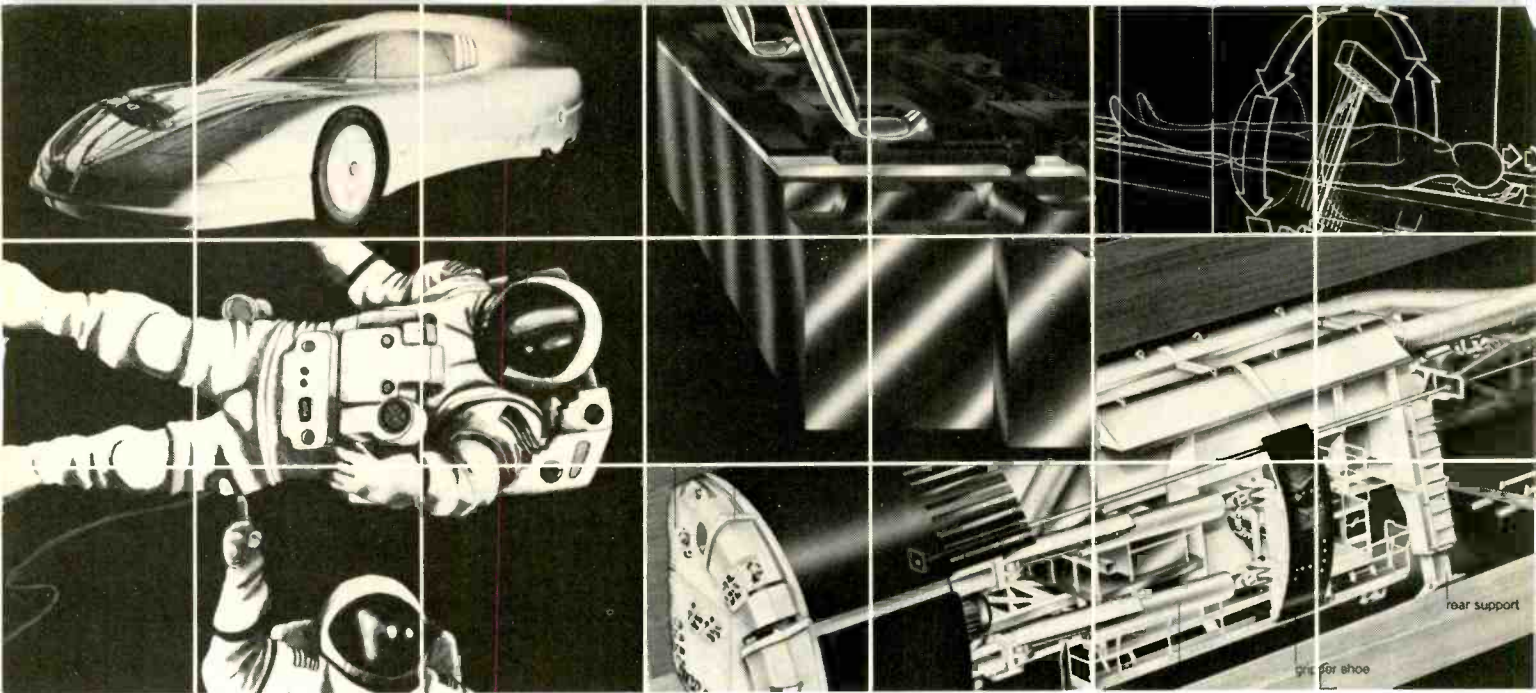
The IMF Electronics HPCM does not refer to some exotic new type of Pulse Code Modulation, but designates our new High Performance Control Monitor loudspeaker. However, the allusion to PCM is entirely appropriate since digital sound was a vital tool in the development of our HPCM loudspeaker.

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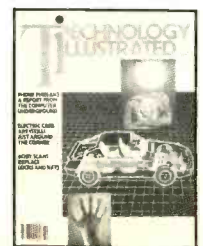
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5

REALISTIC 33-1080 BACK-ELECTRET CONDENSER MIKE

Manufacturer's Specifications

Frequency Response: 20 Hz to 20 kHz.

Impedance: 600 ohms.

Sensitivity: -72 dB (0 dB = 1 V/ microbar, 1 kHz).

Maximum Input SPL: 130 dB with AA cell; with PX 28 cells, more than 140 dB.

Directional Pattern: Cardioid.

S/N Ratio: Greater than 45 dB.

Operating Voltage: 1 to 12 V.

Battery: One AA penlight cell, more than 3,000 hours continuous life; two PX 28 cells optional.

Connector Type: Detachable XLR.

Cable and Plug: 3/16 in. (5 mm) dia. x 15 ft. (5 m) long cable with 1/4 in. (6.35 mm) plug.

Dimensions: 1 in. (26 mm) dia. x 7 1/4 in. (184 mm) long.

Weight: 4.42 oz. (125 g) with battery.
Supplied Accessories: Microphone holder, windscreen, leatherette case.

Price: \$49.95.

Company Address: Radio Shack, One Tandy Center, Fort Worth, Tex. 76102.

For literature, circle No. 94



The Realistic 33-1080 microphone is intended for use with consumer tape recorders or sound systems. It is self-powered by a built-in AA cell, and the cable supplied has a 1/4-inch phone plug which fits most consumer tape recorders. However, by using cables with 3-pin connectors (Switchcraft A3M/F), a balanced output is obtained so that the microphone can be used with professional-type mixers and recorders. The nickel-finished microphone head and handle are all metal and appear to be machined (rather than cast), making the appearance comparable to that of high-grade professional condenser microphones.

An unusual feature is the lack of a power switch. The battery life (with an AA cell) is rated at 3,000 hours, so if the microphone is used regularly, the battery may be left in the mike. The manufacturer recommends that the battery be removed if the microphone is to be idle for a few weeks or months. The absence of a switch would appear to improve reliability by eliminating the possibility of switch troubles, but this is not so because a low-cut "M-V" (Music-Voice) equalizer switch is included. It is hidden, but accessible by unscrewing the barrel, which also gives access to the battery. The "M-V" switch is intended to eliminate proximity effect or boominess when the mike is used for close-up speech. This is a desirable feature, but as received, the switch was noisy and had to be cleaned with contact spray prior to my laboratory tests.

The accessories include a quick-release microphone holder for mounting on standard microphone stands having a 5/8 x 27 thread and a foam windscreen. The windscreen includes a plastic frame which supports the foam. This is a small but well-thought-out detail. By using a frame to space the foam from the microphone, thinner material can be used, and effective pop and wind protection obtained with less roll-off of extreme high frequencies.

Measurements

I would like to remind the reader that the measurements were conducted in accordance with my articles on microphone testing in the April 1977 and September 1978 issues of *Audio*.

All tests were conducted using the AA cell as supplied. The optional PX-28 batteries were not tried, since the output clipping level with the 1.5-V cell was adequate for my purposes.

I was dubious, at first, about the maximum audio output obtainable with 1.5-V power, and the first test was to measure the clipping level as seen on an oscilloscope with high-level speech input. The clipping level was ± 0.5 V, corresponding to an input level of 138 dB SPL (peak) or 135 dB SPL (rms). This is adequate for many of the very loud pop music and vocal applications, and, I think, one would rarely have to use the optional higher voltage batteries. This performance is outstanding, because the SPL limits of self-powered electret microphones (see prior reviews) have been observed to vary from 125 dB with 1.5 V to 135 dB with 6-V d.c. power.

The EMT 160 polarity tester showed standard phasing of the output (pin #2 positive with positive sound pressure). Being wary of strange output circuit configurations sometimes found in remotely powered electret microphones, I

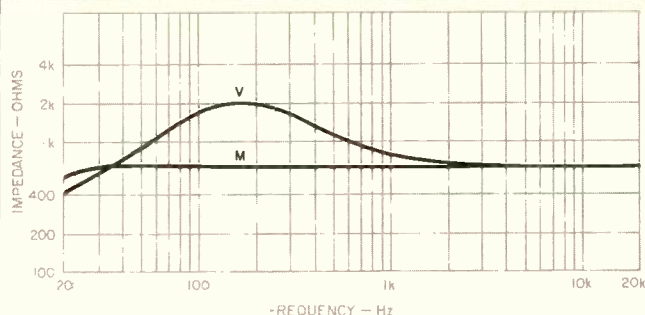


Fig. 1—Impedance vs. frequency for "V" and "M" switch settings.

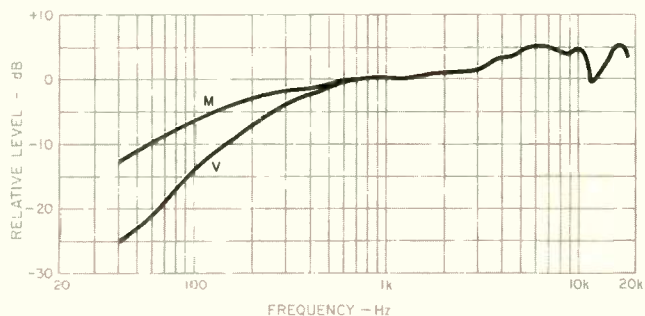


Fig. 2—Frequency response to plane waves, for "V" and "M" settings.

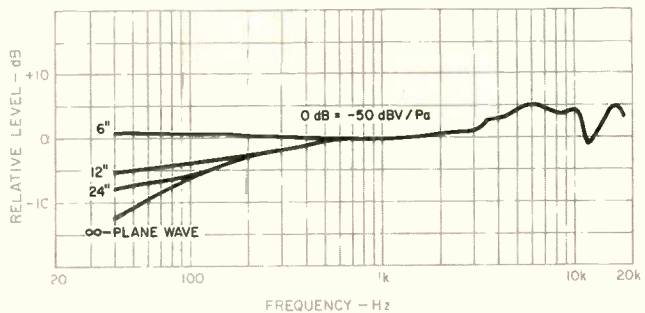


Fig. 3—Frequency response at four distances, with "M" setting.

"The Realistic had much less sensitivity to vibration or handling noise than my reference microphone."

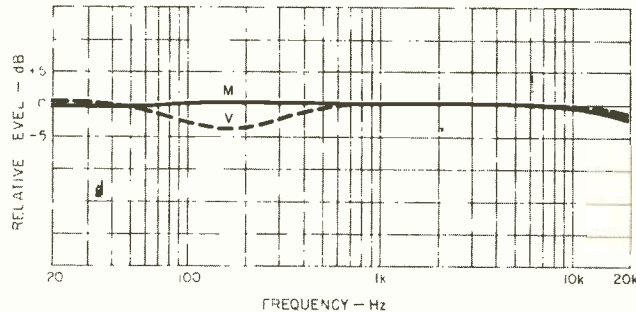


Fig. 4—Loading loss vs. frequency for 150-ohm preamp.

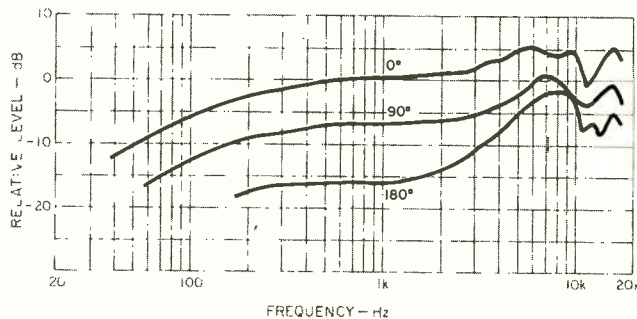


Fig. 5—Frequency response vs. angle for plane wave.

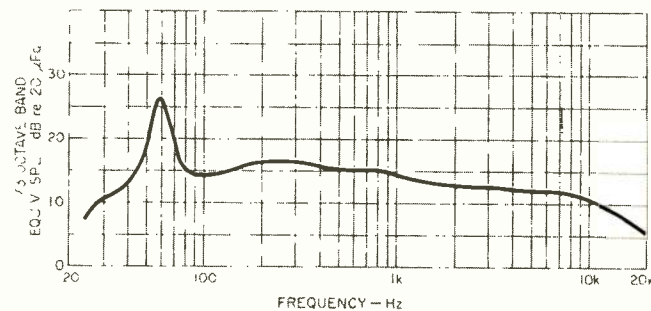


Fig. 6—Noise spectrum (1/3-octave bands), "M" switch setting. Overall noise levels for 15-kHz

bandwidth are 29 dB equivalent SPL (unweighted), 24 dB SPL (A-weighted).

checked d.c. resistance from each output pin to ground (pin #1). It was in the gigaohm range, with no indication of substantial capacitance to ground. Thus, the output is well isolated from the ground by an integral transformer, and therefore the microphone can be used with balanced or unbalanced (one line grounded) audio inputs. Unbalanced microphone circuits are subject to radio frequency interference, but the cable supplied is short enough so that r.f.i. should rarely be encountered. If a longer cable is required, a standard microphone cable with 3-pin plugs should be used, and a balanced input transformer provided at the recorder or mixer input.

The impedance curves are shown in Fig. 1. The value with the "M" switch setting is nominally 600 ohms, similar to most other microphones manufactured in Japan. This could result in slightly higher noise levels and frequency response variations, due to loading by audio equipment which is designed for 150/200-ohm microphones. In practice, I have found that 600-ohm microphones can be used with most 150/200-ohm inputs with impunity. Most audiophile recorders will perform well with microphones of 150 to 600 ohm impedance, but I recently discovered a late model open-reel machine which gave poor S/N with 150-ohm microphones, and line transformers were needed to increase the microphone impedance to about 2.5 kilohms to suit the recorder specifications.

Note in Fig. 4 that with the "M" setting there was negligible frequency response variation due to loading by the "150-ohm" input of my broadcast-grade preamp, but with the "V" setting, there was significant loss of bass response. However, this loading effect served in a positive fashion to reduce boominess with close talking.

This shows that the audiophile should ensure either that his microphone's impedance falls within the specified impedance range of the mixer or recorder or, if not, that a proper line-matching transformer is used.

Figure 2 shows the measured frequency response with a distant source of sound (plane wave). For plane waves, a response rating of 60 Hz to 18 kHz seems to be more appropriate with the "M" setting. The bass roll-off on the "V" setting seems to be much more drastic than on "M." However, the results of previous reviews show that linear bass response to very low frequencies is undesirable for on-location recordings with cardioid microphones because of room noise or rumble. This is likely to be more of a problem with audiophile recordings made under adverse room acoustics conditions. Plane waves probably do not exist in these circumstances, so the microphone bass response is likely to follow the curves for finite distances to a source (Fig. 3), which are flatter. With voice or a musical instrument at 6 inches, the microphone has linear response, ± 0.5 dB, from 40 Hz to 3 kHz. This is very remarkable performance for a microphone of such relatively low cost. The high-frequency response (Figs. 2 and 3) is extremely smooth to 10 kHz. The 3 to 5 dB rise from 1 to 10 kHz is, I think, desirable for audiophile (as well as for professional) applications, adding clarity to vocals and brightness to bass, woodwinds and other instruments.

The directional frequency response curves (Fig. 5) show a pattern which is slightly sharper than a cardioid. The response of a cardioid at 90° is 6 dB below the 0° response,

"The Realistic 33-1080 microphone has excellent performance at a relatively low cost, superior to comparably priced mikes."

whereas the Realistic microphone response is about 7 dB down throughout the midrange. The 180° response shows greater than 15 dB rejection in the midrange, which is acceptable for a cardioid, and the response is quite uniform with frequency up to 2.5 kHz. Above 2.5 or 3 kHz, the pattern tends towards omnidirectional, probably due to diffraction effects.

Note that the "sharper-than-cardioid" pattern of the Realistic microphone is similar to that of the Uniaxial ribbon microphone patented by Olson in the '50s. The Uniaxial (RCA BK-5A) was used for many years as a boom mike for television, and served as my reference microphone for subjective comparison tests until recently (*Audio*, April 1977). The response curves of the Realistic (Fig. 5) are very close to those of the BK-5A, with the latter on V1 response. This moderate bass roll-off characteristic was found to be desirable in TV to reduce low-frequency noises on the set.

To summarize, the test results of frequency response and directional properties show the Realistic microphone to have performance highly suited to audiophile recording applications, and suitable for many professional audio applications as well. However, the frequency response could be too flat for specific applications in sound reinforcement (PA) or rock music vocals. In these cases, more bass roll-off and/or greater treble rise might be needed.

The output noise spectrum (Fig. 6) shows a 60-Hz peak which was correlated to the power line but was not reduced by changing the orientation of the mike and the soundproof test box. However, this did not greatly influence the overall A-weighted noise level, which measured 24 dB. My calculation of signal-to-noise ratio or dynamic range differs greatly from the specification value of 45 dB (probably based on 1 microbar or 74 dB SPL: $74 - 45 = 29$ dB noise level). Subtracting the noise level from the clipping level, we obtain a range of $135 - 24 = 111$ dB, which is outstanding for a microphone in this or any price range for that matter. Therefore, from a standpoint of dynamic range, the Realistic microphone should perform excellently with all sorts of tape recorders, with or without noise-reduction circuits.

Use and Listening Tests

The reference comparison microphone for these tests was the Nakamichi CM-700 mike with cardioid capsule. As explained in previous reviews, the reference microphone was selected primarily for its uniform frequency response and directional properties, and not because it is an ideal microphone for applications being discussed.

For the tests involving music, I did not have the opportunity to record a live concert, but had to resort to pickup of full-range orchestral sound reproduced from my archive of live concert master tapes in my studio. A controlled laboratory test with recorded music can often yield better results than a field recording made under adverse acoustical conditions. To test noise rejection, I turned on an air conditioner to add some noise to the otherwise quiet studio.

The Realistic microphone, while picking up both speech at more than one foot and music from a greater distance, showed much greater rejection of room noise and sounded a little brighter and more crisp than the reference. For this test, the Realistic was set at "M" and the reference at "Flat"

response. The Realistic exhibited no noticeable coloration of sound quality from 0° to ±90° off axis, reflecting the very uniform directional responses as measured. When the Realistic and reference microphones were set on "V" and "Lo-Cut" respectively, and spoken into at about 6 inches, the Realistic had a slightly brighter, cleaner sound (more highs) and just a little more bass. Both microphones showed good rejection of room noise with these settings.

The Realistic had 5 to 10 dB greater pickup of 60-Hz magnetic fields (hum pickup) than the reference, when set on "M" and "Flat" response respectively. It is not surprising that the Realistic (which costs only about one-fourth as much as the Nakamichi) does not have an expensive, shielded transformer. This deficiency will not cause a problem in practice if the user is careful to orient the microphone away from power transformers of amplifiers and other electrical equipment.

The Realistic and the reference were equally immune to "pop" sounds when spoken into at very close range. For this test, the "V" and "Lo-Cut" settings were used respectively, and each microphone was used with its accessory windscreen. Each microphone showed a small degree of "pop" or breath-blast sound. As a second reference, I tried an old RCA 44BX ribbon velocity microphone at close range with the "V" setting. This microphone had absolutely zero sensitivity to "pop" sounds, probably because of its mammoth cloth-lined screens. This shows that windscreen size is the prime factor in determining wind or "pop" sensitivity, and the kind of element (electret condenser, ribbon, or dynamic) is relatively unimportant, as long as each has similar electroacoustic sensitivity.

The Realistic had much less (about -20 dB) sensitivity to vibration or handling noise than the Nakamichi when both were set for maximum low-frequency response. This is a definite plus factor for hand-held vocal use.

As a final check, I tested the Realistic with an unbalanced input circuit versus the balanced circuit that had been used for frequency response measurements. There was no change in audio level or quality between the two circuit conditions, and no change in hum or noise level. Thus, the microphone will probably exhibit the measured performance when used with a wide variety of audio recorders and mixers.

I think that the Realistic 33-1080 microphone has excellent performance at a relatively low cost. The electret element offers performance that is much superior to comparably priced microphones, which generally employ moving-coil transducers.

By spending \$150 more, one can buy a microphone that offers more bass response and less magnetic hum pickup, but these features are not needed for many audiophile recording applications. The linear high-frequency response and directional characteristics of the Realistic are equal or superior to the acoustical performance of microphones costing from \$100 to \$300. The 33-1080 is, in my opinion, a "best buy" for audiophiles, particularly those having cassette recorders of medium or high quality. For professionals who require a large quantity of microphones for a recording setup, the Realistic offers excellent quality while keeping total cost reasonable.

Jon R. Sank

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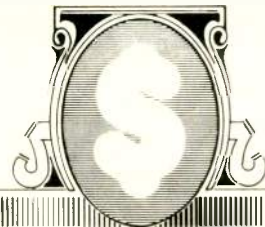
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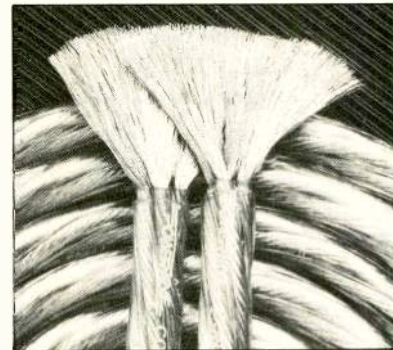


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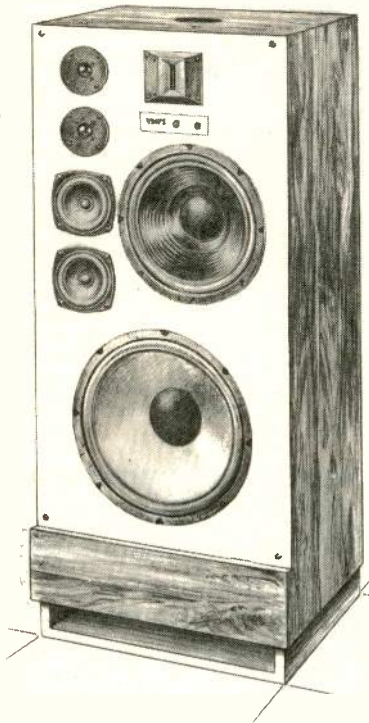
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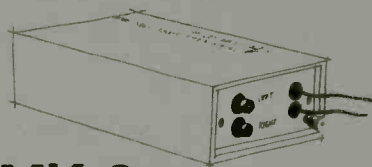
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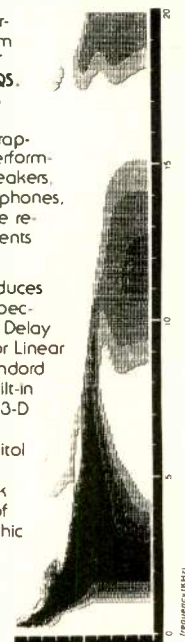
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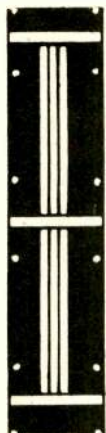
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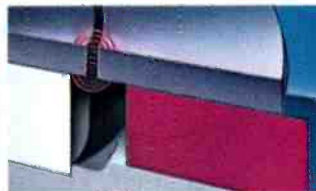
When you understand how well they're put together, the argument for buying anything else simply falls apart.



A unique flat-wire voice coil (Patent applied for) helps JBL Automotive Loudspeakers achieve both high efficiency and high power capacity.



Each speaker features a die-cast aluminum frame to ensure complete freedom from warping or corrosion.



The loudspeaker's magnetic structure produces a symmetrical magnetic field around the voice coil gap of the low frequency driver. This design provides a dramatic reduction in distortion.

You're looking at the inner workings of a remarkable automotive product. It's manufactured to tolerances so precise that they actually rival those found in critical engine components. It incorporates some of today's most advanced metalworking and chemical engineering techniques. And its performance is unsurpassed.

The product is JBL's T545, 3-way automotive loudspeaker. Part of a full line of new JBL speakers designed with innovative features you can see as well as hear. Each model, for example, utilizes a rugged die-cast aluminum frame to ensure tight tolerances and complete freedom from warping and corrosion. The loudspeakers also feature large, long-excursion, flat-wire voice coils. This design uses the magnetic field in the voice coil gap more efficiently so the speakers need less power to operate.

And that's only part of the story. Through the use of large-diameter, high-temperature voice coil formers and the latest in high-temperature adhesive technology, power capacity has also been improved. Combined with the loudspeakers' high efficiency, this provides outstanding dynamic range and significantly higher maximum sound output.

Other features include a massive, barium ferrite magnetic structure, powerful high frequency and ultra-high frequency drivers, and bi-amplification capability on 6 x 9-inch models.

Of course, the best way to appreciate their advanced engineering is to audition them for yourself. So ask the audio specialists at your JBL dealer for a complete demonstration of JBL Automotive Loud-

speakers. Once you hear them, the argument for buying anything else will simply fall apart.



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