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Audio

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MUSIC REVIEWS

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America, The Dream Goes On Boston Pops/Williams. *America The Beautiful*, more. Philips *DIGITAL* 115134

Dire Straits: Brothers In Arms Money For Nothing, Walk Of Life, One World, others. Warner Bros. *DIGITAL* 114734

Brahms, 21 Hungarian Dances Vienna Philharmonic Orchestra/Abbado. DG *DIGITAL* 115408

Pointer Sisters: Contact • Dare Me, Bodies And Souls, Hey You, Pound Pound Pound, more. RCA 124611

Mozart, Piano Concertos Nos. 12 & 20 • Rudolf Serkin; London Sym. Abbado. DG *DIGITAL* 115062

Rachmaninov, Symphonic Dances; Vocalise; more • Berlin Philharmonic/Maazel. DG *DIGITAL* 115113

Bach, Brandenburg Concertos Nos. 1-3 • The English Concert/Pinnock. Archiv *DIGITAL* 115541

John Cougar Mellencamp: Scarecrow • Lonely Ol' Night, Small Town, Rain On The Scarecrow, more. Riva 144512

Dave Grusin & Lee Ritenour: Harlequin • Title song, Early A.M. Attitude, San Ysidro, etc. GRP *DIGITAL* 154203

Vivaldi, The Four Seasons Standage, violin. English Concert/Pinnock. Archiv *DIGITAL* 115356

Hall & Oates: Live At The Apollo Apollo Medley, Everytime You Go Away, I Can't Go For That, etc. RCA 140625

Eurythmics: Be Yourself Tonight Would I Lie To You?, Sisters Are Doin' It For Themselves, etc. RCA 153394

James Galway & Henry Mancini: In The Pink • *The Pink Panther*, more. RCA *DIGITAL* 151758

Pat Benatar: 7 The Hard Way Sex As A Weapon, Invincible, many more. Chrysalis 144101

Pavarotti: Mamma • Title song, *Vieni sul mar*, more. Henry Mancini conducts. London *DIGITAL* 115310

Prince: Around The World In A Day • Paisley Park, Raspberry Beret, Amenca, Pop Life, etc. Warner Bros. 124370

Richard Strauss, An Alpine Symphony • Berlin Philharmonic Orchestra/Karajan. DG *DIGITAL* 105528

Sting: The Dream Of The Blue Turtles • If You Love Somebody Set Them Free, Fortress Around Your Heart, others. A&M 150266

Dvořák, Symphony No. 9 (New World) • Chicago Symphony Orchestra/Solti. London *DIGITAL* 115168

Kenny Rogers: The Heart Of The Matter • Morning Desire, People In Love, title song, others. RCA 153995

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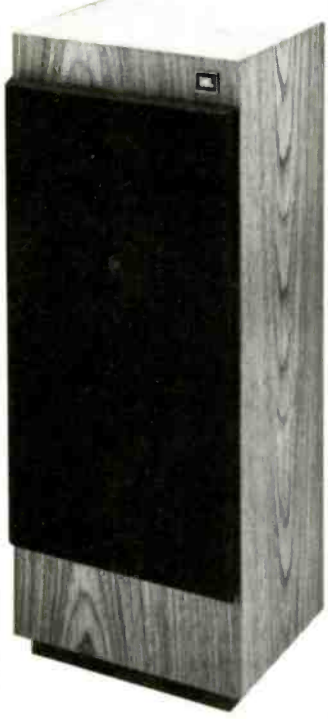
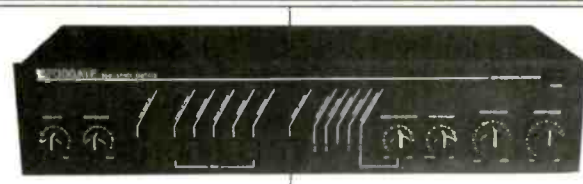
VAS55 ZQ

JBL Speaker

The L60T falls in the middle of JBL's new L series, which, like the Ti series, uses titanium ribbed-dome tweeters. The speaker's other driver is an 8-inch, laminated high-polymer midrange/woofer. The cabinet is wood veneer, with five-way binding posts at the rear. Price: $265 each.
For literature, circle No. 110



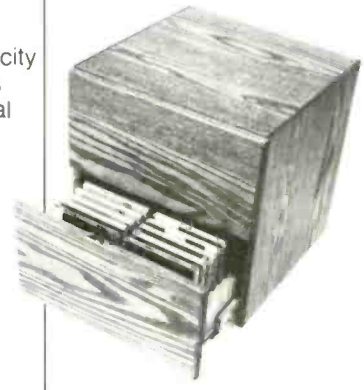


Fosgate Directional Processor

The Fosgate 3601 directional processor requires only the addition of two speakers to convert a stereo system to surround sound. It has three surround modes (including Dolby Surround, for videos and movies) plus stereo (bypass) and mono settings. Built-in, rear-channel amplifiers deliver 40 watts per channel, and a switchable, center-front channel output is also included. Price: $549.95; optional wireless remote control, $75.
For literature, circle No. 113

A & B CD File

The SC-1200 Compact Disc storage cabinet from A & B Enterprises holds 28 CDs in each of two drawers, for a total capacity of 56 discs. The drawers slide on heavy-duty metal guides. The cabinet is stained in light oak and finished in lacquer. Price: $119.95.
For literature, circle No. 111



Yamaha Headphones

Designed for portable use as well as for use at home, Yamaha's YHD-1 headphones have ear pads which fold inward when not being used, to save space. The open-air drivers are orthodynamic types, with flat diaphragms sandwiched between magnets. The YHD-1 has a 3.5-mm mini plug, with a mini-to-standard plug converter. Frequency response is rated at 20 Hz to 20 kHz, and sensitivity is 100 dB/mW or 109 dB/V. Impedance is 125 ohms, and weight is 5.1 oz. without cord (5.9 oz. with cord). Price: $70.
For literature, circle No. 114

Kyocera Receiver

With its control flap closed, Kyocera's R-861 receiver looks deceptively simple. But behind that door are such unusual controls as a three-band, semi-parametric tone control with variable turnover frequencies (100 to 500 Hz for bass, 500 Hz to 2 kHz for midrange, 2 to 10 kHz for treble). Other features include switchable de-emphasis for Dolby FM, a tuner with 80-dBA S/N, switchable i.f. bandwidth, and a fluorescent display whose non-switching power supply can't interfere with low-level circuits. Power is rated at 100 watts per channel. An optional remote control can be used with the R-861 and Kyocera's latest cassette decks and CD player. Price: $975; remote system, $250.
For literature, circle No. 112

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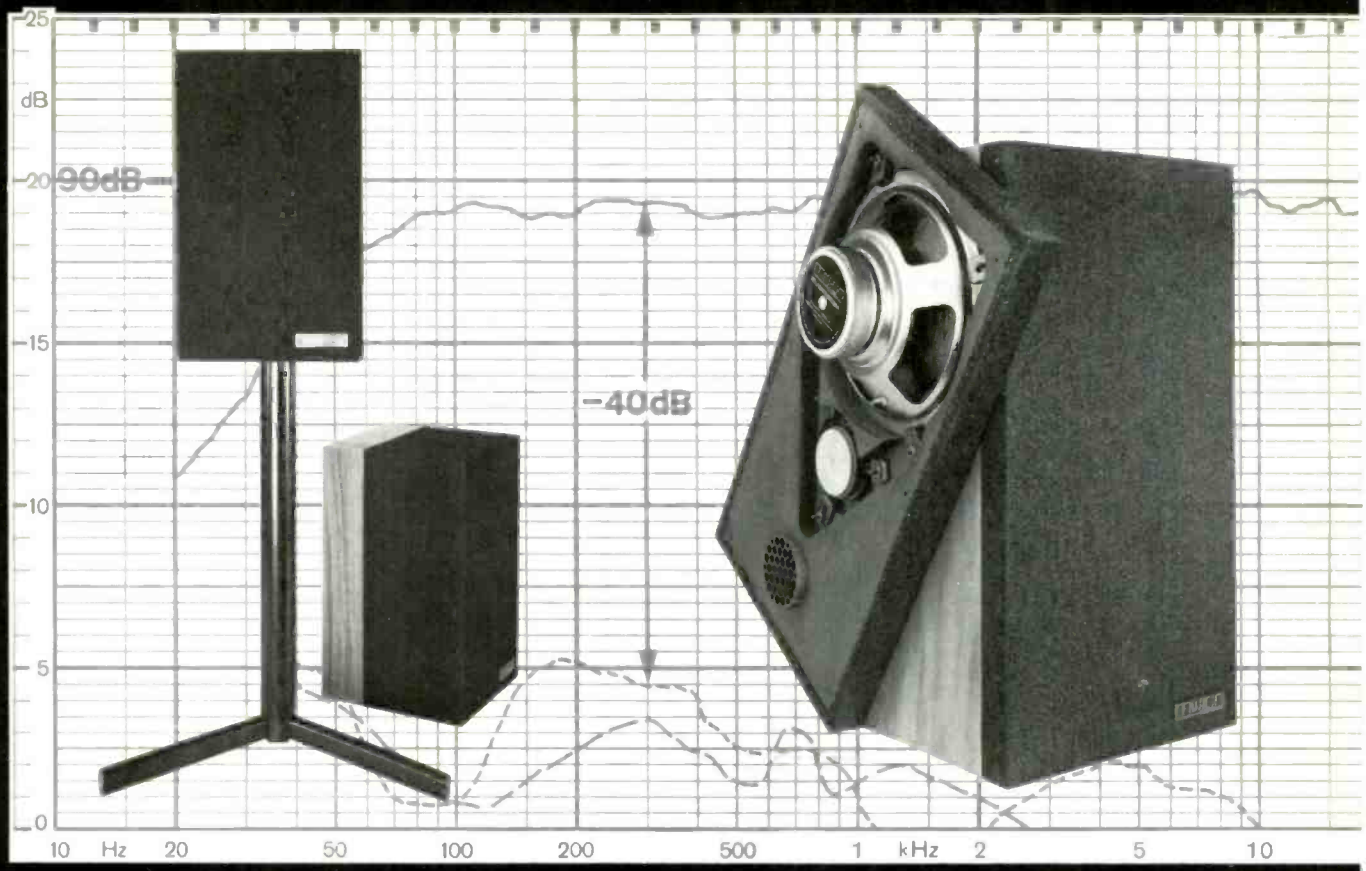
MISSION 70 MISSION 700.2



Mission 70

1984's "Loudspeaker of the Year" in Britain; HI FI CHOICE "Best Buy"; winner of "Decibel d'Honneur" in France; acclaimed "Wunderkind" in Austria, the Magnificent 70 is an extraordinary state-of-the-art product.

The design objective was to manufacture the most compact loudspeaker system which was nevertheless capable of reproducing the extremities of the audible frequency range. This resulted in a true hi-fidelity speaker system capable of handling musical materials with exceptional dynamic range, including digital master tapes, and remaining linear at all listening levels. Here we should point out that many loudspeakers can only create the excitement and dynamics of music when played at loud levels. In fact, it is a tragedy for the consumer that most hi-fi systems sound no better than a transistor radio when played at low levels. Indeed, this is why cheap amplifiers offer a "loudness" control to artificially compensate for these inherent weaknesses, and it requires dedicated manufacturers to avoid such complex pitfalls.

The 70 is manufactured of sandwiched construction to dampen and distribute enclosure resonances and uses sculptured MDF for the baffle board. The bass unit is a high quality 7" Mission product with a unique cone design and a quality 19mm ferrofluid damped dome tweeter. The filter is a full multi-component design incorporating Mission's own electrolytic capacitors and low saturation inductors. The driver geometry is inverted in the novel Mission style resulting in superb three dimensional stereo stage. The total design is carefully integrated to result in a wide bandwidth system free of unwanted resonances, distortions, frequency response anomalies and colorations.

As far as measurements are concerned we would briefly touch on the objective performance of the 70. Whereas the competition for the 70 has an irregular frequency response often as poor as ± 5dB, the 70 measures flat to within ± 2dB! When measured off axis it exhibits no mid band cancellations and at 30° off axis the response is still ruler flat. The modulus of impedance is very smooth, does not drop below 6 ohms and does not suffer difficult phase angles, which in turn makes the loudspeakers very easy for any amplifier to drive. Measured at 90dB, 2nd, 3rd and all other harmonic distortions remain below 0.5% – approaching amplifier specifications! and some 10 times better than most other loudspeakers on the market! The efficiency is 89dB.

The 70s are recommended for use on bookshelves or stands and with amplifiers ranging from 20W to 75W per channel.

Mission 700.2

The 700.2 is an updated version of Mission's famous 700 model – acclaimed as the world's finest compact speaker system by the technical press throughout Europe and America.

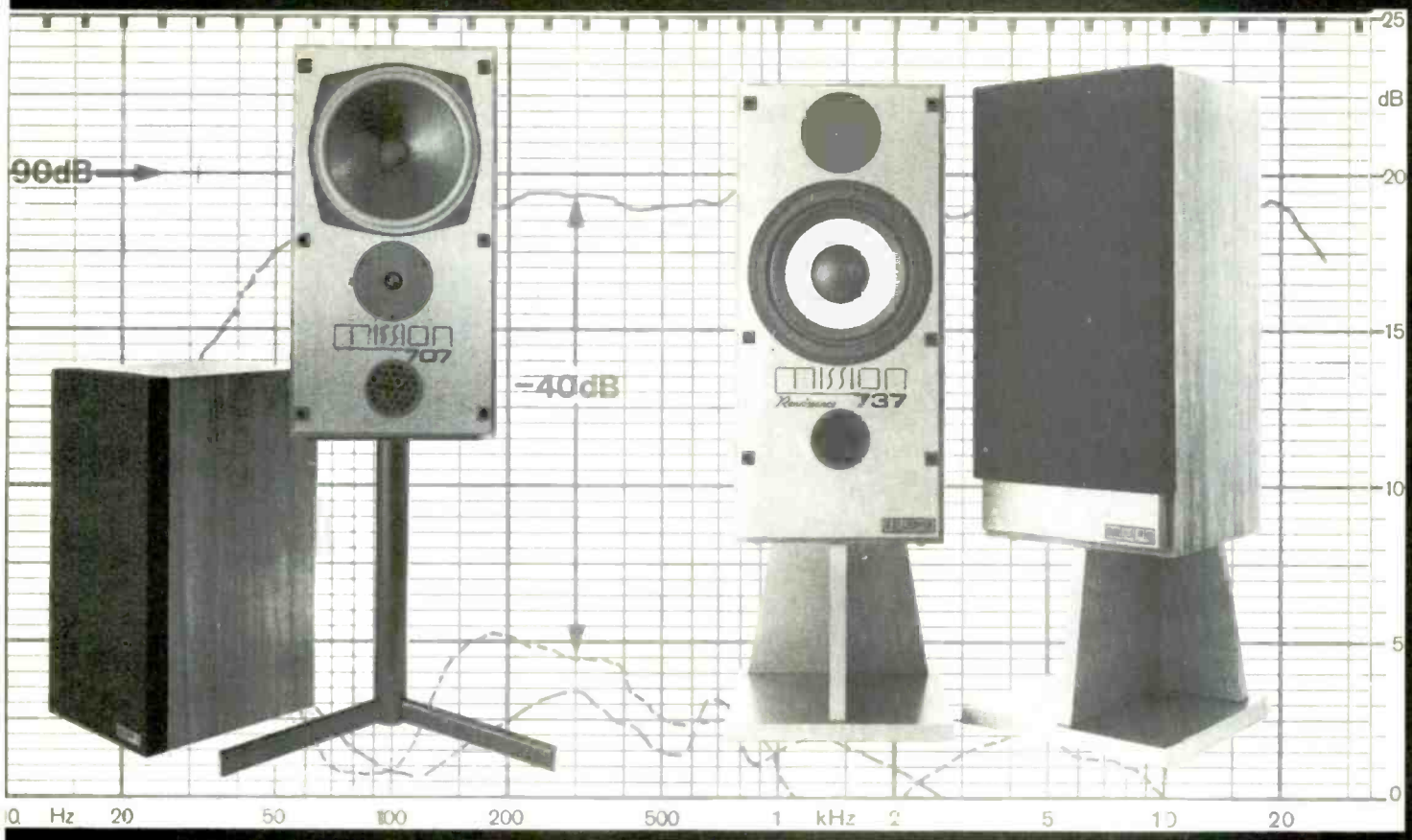
The unusual drive unit geometry first designed by Henry Azima in the Mission 700 ensures equal "path lengths" to the ear when the speakers are conventionally positioned. This is an ingenious engineering principle which makes time aligned and phase-arrayed geometries unnecessary. The effect of such a design is that at the crossover frequency point the radiation lobe is directed towards the listener rather than down to the floor. The proven 700 bass drive unit has been further refined incorporating a much more powerful motor system to ensure improved power handling and sensitivity. The frequency response is now even more linear at different power levels and the highly refined ferrofluid dome tweeter offers greater headroom before saturation than the old 700. The drivers are carefully aligned and mounted in a 32mm thick front baffle board. The direct and rigid coupling of the drive unit chassis to such a baffle board design minimises relative accelerations and displacements between the two structures ensuring exceptional transient response. The cabinet itself now offers the unique Mission construction method of multi-folding, which ensures exceptional rigidity without increasing fundamental wall stiffness. The objective here is to lower the resonant frequency of the cabinet so that it is not set off in the important mid band region.

The 700.2 is a very high performance system offering a rare combination of accuracy, low coloration, extended dynamic range and a high power handling. It is recommended for use on bookshelf or stands and with amplifiers ranging from 20W to 100W per channel.

SPECIFICATIONS	MISSION 70	MISSION 700.2	MISSION
FREQUENCY RANGE:	35Hz–20KHz	35Hz–20KHz	30Hz–20KH
FREQUENCY RESPONSE:	60Hz–20KHz ± 3dB	55Hz–20KHz ± 3dB	50Hz–20KH
IMPEDANCE NOMINAL:	8 ohms	8 ohms	8 ohms
RECOMMENDED AMPLIFIERS:	20W–75Watts/Channel	20W–100 Watts/Channel	20W–100 W
SENSITIVITY, SPL at 1M, 1W:	89dB	91dB	92dB
TWEETER:	19mm Polymer Dome – Ferrofluid	19mm Polymer Dome – Ferrofluid	19mm Poly
WOOFER:	175mm Plastiflex Cone	200mm Carbon/Paper Cone	210mm Pla
CROSSOVER FREQUENCY:	2.2KHz	2.1KHz	2.2KHz
GRILLES	Fixed	Fixed	Removable
TERMINAL CONNECTIONS:	4mm plug or wire	4mm plug or wire	4mm plug o
EFFECTIVE VOLUME:	12 litres	24 litres	25 litres
CABINET DIMENSIONS: (H x W x D)	350 x 210 x 210 mm	470 x 250 x 270 mm	470 x 250 x
FINISH:	Walnut/Black	Walnut/Black	Walnut/Bla

MISSION 707

MISSION 737 *Renaissance*



Mission 707

The 707 is a brand new addition to the Mission range. It offers the inverted drive unit arrangement first used in the 700 (for reasons see 700.2). The 707 incorporates Mission's unique multi-folded cabinet construction and sophisticated injection moulded baffle board manufactured from polypropylene and natural minerals – the formula not being made public by Mission. This configuration offers optimum rigidity for accurate transient bass response with controlled and minimal resonances in the mid band region. The tweeter is our proven ferrofluid 19mm polymer dome and the overall results are optimum integration and excellent off axis performance, resulting in quite exceptional stereo stage.

Here we must point out that there is a fundamental design conflict between the efficiency and low frequency performance of a loudspeaker. In the majority of cases efficiency is achieved at the direct expense of bass extension, and frequently high efficiency systems suffer very high coloration. Not so with the new generation of Mission designs. The exceptional motor systems combined with high quality cone materials and precision manufacturing processes have enabled us to offer extraordinary sensitivity and bass extension whilst preserving the mid band magic of classical Mission speakers. Our speakers have always been acclaimed for low coloration, neutrality and transparency in the mid band. This is now coupled to bass extension, with control and articulation. Careful attention is paid to the linearity of both frequency response and distortion at different power levels. Consequently the dynamic headroom is so great that the loudspeaker system will not suffer "saturation" and "compression" at high listening levels.

The 707 offers 92dB efficiency for 1W input measured at 1 metre and can be used with amplifiers ranging from 20W to 100W per channel. Rigid, sand-filled metal Mission stands are available for use with this model, or under special circumstances the 707 may be bookshelf mounted.

Mission 737 Renaissance

In 1978 when polypropylene as a cone material was in its development stages at the research laboratories of the British Broadcasting Corporation, and other manufacturers were carrying on with conventional materials, Mission were negotiating the patent rights for the coming technical revolution. Around the same time Mission became the first licencees in the world for this British patent. Mission's pioneering research in this area resulted in one of the most advanced loudspeakers – the 770. Since then most other manufacturers have attempted to copy the Mission design with varying degrees of success.

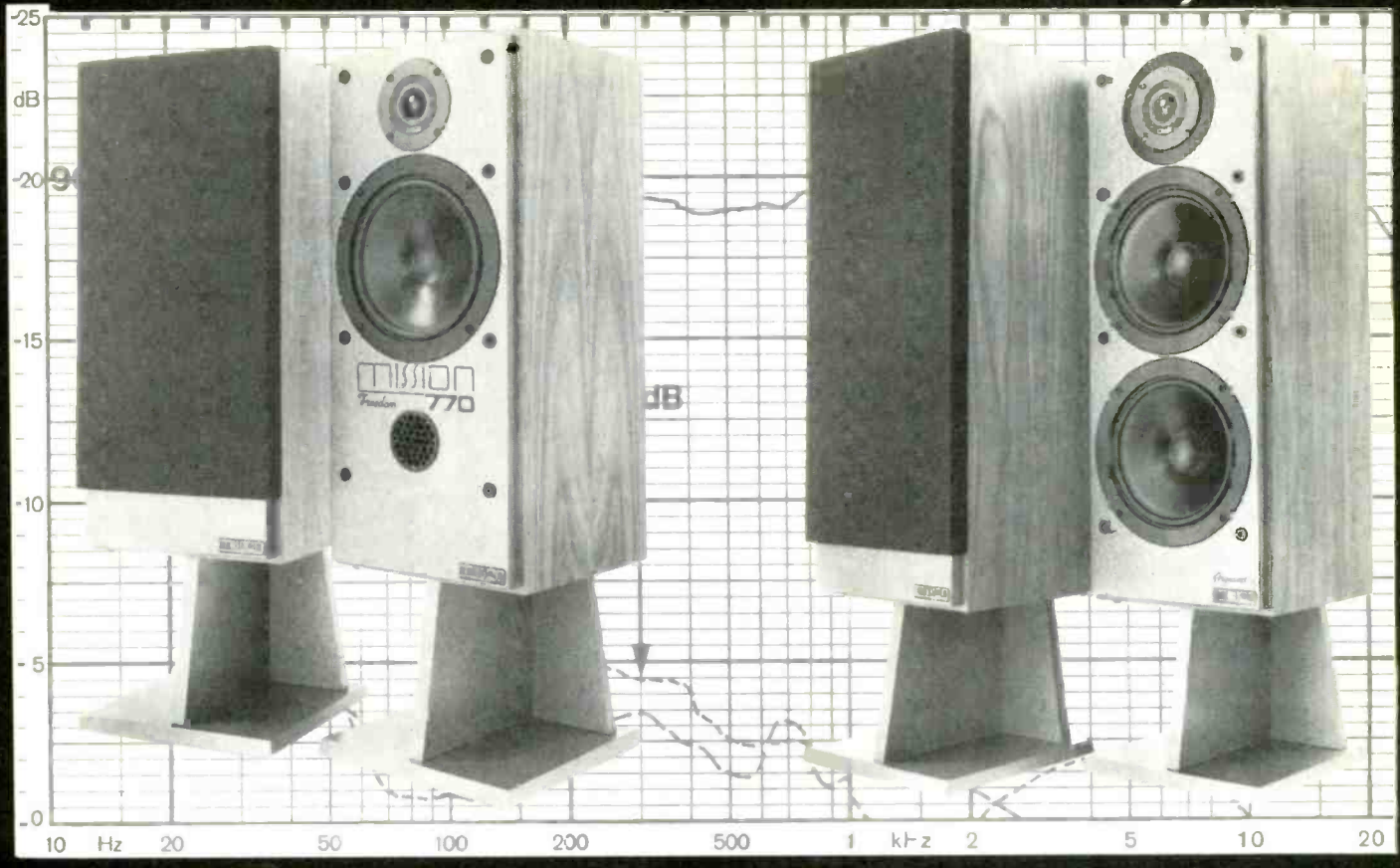
At Mission we have continued to move on. After many years of evolutionary refinements the most advanced version of the 770 drive unit is now designed into our new model 737 Renaissance. The cone membrane for this model offers a unique combination of rigidity, lightness and acoustic opaqueness. The drive unit is manufactured into an esoteric die-cast magnesium chassis to improve rigid coupling. The acoustic properties of the cone are such that they do not allow for internal reflection and standing waves to come out of the cabinet and reach the listener out of phase. Furthermore, a solid block of Mission acoustic foam is built into the inside of the cabinet to attenuate such standing waves. The Renaissance cabinet is of precision multi-folded construction, visco-elastically damped and incorporates our special MDF baffle board. The total system is reflexed using the Mission resistive port and resulting in extended low frequency and power handling performance. The Renaissance now possesses many attributes of its predecessor but at substantially lower cost.

For this model, as well as the 770 Freedom and the 780 Argonaut, special Mission stands are available which lock into the loudspeaker and are offered as an optional extra. The Renaissance is recommended for use with amplifiers ranging from 30W to 120W per channel.

	MISSION 737 RENAISSANCE	MISSION 770 FREEDOM	MISSION 780 ARGONAUT
	30Hz–20KHz	20Hz–25KHz	20Hz–25KHz
	40Hz–20KHz ± 3dB	35Hz–20KHz ± 3dB	30Hz–20KHz ± 3dB
	8 ohms	8 ohms	4 ohms
nnel	30W–120 Watts/Channel	30W–150 Watts/Channel	50W–200 Watts/Channel
	90dB	92dB	94dB
e – Ferrofluid	19mm Polymer Dome – Ferrofluid	25mm Polymer Dome – Ferrofluid	25mm Polymer Dome – Ferrofluid
ne	215mm Polypropylene Cone	215mm Homopolymer Cone	2 x 215mm Homopolymer Reinforced Cones
	2.4KHz	2.0KHz	1.8KHz
	Removable	Removable	Removable
	4mm plug or wire	4mm plug or wire	4mm plug or wire
	30 litres	40 litres	50 litres
	540 x 250 x 270 mm	610 x 270 x 300 mm	710 x 270 x 300mm
	Walnut/Black	Walnut/Black	Walnut/Black

MISSION 770 *Freedom*

MISSION 780 *Argonaut*



Mission 770 Freedom

We are confident that the 770 Freedom is a worthy successor to our legendary 770. Our objective in replacing the 770 was to improve on that model in certain specific areas. Firstly, we wanted to ensure that the frequency range was even more extended. Secondly, our design team felt that the bass response could be tighter and with greater transient attack. Thirdly, we wanted to increase the available headroom so that at high power levels the system did not go into saturation. Finally, we wanted to increase efficiency for the era of digital master tapes.

For the mid/bass drive unit a brand new cone was developed made of an advanced homopolymer material impregnated with certain minerals (the formula not being made public by Mission) to offer optimum mass, rigicity, Q and sonic opaqueness – a further advance on polypropylene. The voice coil is manufactured using high temperature aluminium former and is carefully ventilated to increase power handling. The motor system is exceptionally powerful for the amount of magnet we have used and this has been achieved by careful geometric design of the pole piece which in turn is brass plated. This arrangement results in minimal magnetic flux wastages into stray fields. The driver is assembled into a sophisticated rigid magnesium die-cast chassis. The high frequency unit is carefully designed for extreme power and exhibits exceptional power/frequency response linearity and no major saturation at high levels. It is further oil cooled to avoid temperature related performance aberrations and for increased saturation thresholds. The cabinet construction is based on Mission's unique multi-folded geometry ensuring rigidity for low frequency transient attack without coloring the very open and transparent mid band. The cabinet walls are visco elastically damped to control and attenuate resonances and minimise stray acoustic output to ensure minimal acoustic phase distortion. The Freedom's low frequency behaviour is totally unusual for a reflex loudspeaker and this has been achieved by careful integration of the drive unit Qs in relation to the 37 litres of internal volume and the use of the Mission resistive reflex port.

On measurement the Freedoms are capable of exceptionally smooth, highly integrated off axis frequency response as well as the least amount of distortion we have measured in any other loudspeaker. Indeed, driven at 90dB mid band distortion is close to 0.1%!

The Freedom is a powerful expression of Mission's experience and technology. Subjectively and when used in conjunction with good quality ancillary equipment, the results are exhilarating and most realistic. The Freedom has optional stands as pictured above and is recommended for use with amplifiers ranging from 30W to 150W per channel.

Mission 780 Argonaut

The 780 Argonaut is a brand new Mission product. It is important to point out at this stage that by the nature of its design the Argonaut presents amplifiers with both complex and difficult loads. That is to say, the characteristic impedance at certain frequencies can drop to around 3.5 ohms and even though the phase shift angles are kept to a minimum and for the most part the impedance is purely resistive, nevertheless this can present problems for ordinary amplifiers. This means that only exceptionally well designed amplifiers should be used to drive the Argonauts otherwise the sound quality will be poor and the amplifier could suffer damage. Many good British and American amplifiers, however, are designed to deal with such loads and all Mission designed amplifiers, including the little Cyrus I, are perfectly capable of driving the Argonauts.

The Argonauts are truly exceptional speakers unmatched by any other model at any price. Firstly, for 2.83V of input a single Argonaut produces approximately 94dB of output measured at 1 metre. Secondly, whereas speakers of such sensitivity always lack deep bass, the Argonauts are extremely well extended in low frequencies. Thirdly whereas nearly all ultra high efficiency speakers use lightpaper for their cone material and suffer the associated colorations, the Argonaut uses modern polymer based engineering materials and has no significant audible or measured colorations or distortions. The whole speaker is manufactured from MDF rather than conventional chipboard and the walls are visco elastically damped.

The Argonaut has many common features with the 770 Freedom. It parallels up two of its 8" drive units (see 770 Freedom) for mid/bass frequencies and the tweeter takes over at 1.8 KHz to handle the high frequencies. Such low crossover frequency combined with excellent dispersion characteristics of the tweeter result in breathtaking stereo stage such that when the speakers are correctly positioned there is no audible evidence of point source left and right channels. Rather, the system achieves the true definition of stereo – a solid three dimensional stage with tremendous front to back imaging (without any tunnel effect) and no interrupted left to right sound stage. When this happens the speakers effectively "disappear". Such 3-D musical stage is then combined with the Argonaut's awesome dynamic range to produce what Mission designers call Magic!

Special optional stands are available from your dealer which fix into the 780 and we would recommend these speakers for use only with very high quality British and American amplifiers.

Cyrus Electronics

Design Philosophy

The design of a good amplifier remains more obscure and more complex than the design of any other component in the high fidelity chain. In recent years the requirements for the operation of a good amplifier have been the subject of extensive research by academics and manufacturers alike, resulting in a new understanding of some of the more important parameters. The problem is somewhat compounded by the substantial improvements made to front-end inputs such as advanced 'turntable–arm–cartridge' combinations, digitally synthesised FM tuners and, of course, the advent of quality compact disc players such as the Mission 7000. Additionally, modern loudspeakers have become far more complex in terms of load factor than their predecessors making the job of the amplifier increasingly more difficult. Hardly any amplifier designed in the 1970s is capable of driving such sophisticated loudspeakers as the Mission Argonauts. Indeed, you will find that the small Cyrus One drives complex speaker loads better than many amplifiers with ten times the power output and sometimes costing ten times as much! The secret lies in appreciation of fundamental design parameters, as well as intuitive, somewhat inspirational application of 'black art'.

You see, there are serious differences between live music and hi-fi. At first people thought these could be dealt with by improving 20 or 30 simple specifications, but as these improved many listeners became more aware of the shortcomings and less satisfied with hi-fi. Indeed, improvements made to certain specifications have ironically turned out to be detrimental to the ability of the amplifier to reproduce music. A prime example of this is the power output specification. For the last 20 years Japanese companies and other commercial designers have been obsessed with giving you more 'Watts' for less money – and always at the expense of the current capability of the amplifier! That is to say, for any given power supply you have a 'see-saw' relationship between power output and current drive. For example, we could at no extra cost to you or ourselves, have designed the Cyrus One with power output in excess of 100 Watts per channel, and of course at the expense of the current capability of the amplifier. In fact, this is exactly how commercial manufacturers satisfy the irrelevant and superficial specifications drawn up by their marketing departments – who have little or no interest in the sonic excellence of their products. Amplifiers with poor current delivery are simply not capable of driving the modern loudspeaker, and unfortunately the problem doesn't just stop there.

Whereas years ago, using poor front-end inputs and highly distorted loudspeakers, people could not hear the subtle and, at the same time, important differences between equipment, today such differences are being noticed by a great many. Whereas years ago we were obsessed with such superficial problems as distortion, colouration and power output; today we have the sophistication to research into musical notes themselves. The coherent reproduction of music is a function of such subtle and ethereal qualities that many listeners find hi-fi gives a different, somewhat disembodied interpretation of the original live performance.

For example, music may sound detailed and 'open' but nevertheless sterile and lacking in feeling. At the first encounter with such ideas the less knowledgeable reader may find the phenomena non-scientific and even absurd. However, through careful research carried out by the designers of Cyrus Electronics we can demonstrate both scientifically and musically the validity of these phenomena. For instance the above mentioned problem of amplifier 'sterility' is associated with, among other causes, amplifier hysteresis due to poor circuit design, incompetent topology, or the use of low-grade components. Take a musical note with a given decay characteristic. One high fidelity system would shorten the decay, cutting the continuity of the note, whilst another would overdecay to such a degree that it would cause transient response delay to the leading edge of the next note. The net effect of either aberration would be music which although not muddied, coloured and distorted, nevertheless may sound uncommunicative, incoherent and disembodied. You see, whereas in the 1970s we placed great emphasis on detail and information retrieval, today we have moved on beyond such simplistic concepts and are investigating the true art of the reproduction of music.

If we review another area of subjective performance our explanation will become more lucid. Take two amplifiers, one with uncontrolled, overblown, rather boomy bass and the second with over-damped, rather restricted bass. The subjective difference between these two amplifiers is that the first sounds rather slow and sluggish whilst the second initially sounds fast and impressive. However, both of them, in the long run, will sound quite boring and non-musical. The subjective reason here is simply that neither amplifier is capable of reproducing the musical time correctly. The first slows down the subjective beat and tempo in the music resulting in a tired and sluggish performance, whilst the second hastens the subjective musical time to such a degree that the reproduction loses elegance and majesty.

The important issue here is that music in itself is abstract, intangible and immeasurable, and the high fidelity chain extremely complex. The fundamentals of processing music signals through such a cumbersome series of components, materials, interfaces, conversion of energies etc. are not clearly understood. Laboratory designs, mathematical models and conventional measurements appear to be totally inadequate. To design on subjective grounds alone would also be dangerous. Therefore what is needed is a design that satisfies both criteria, and more importantly introduces the musical dimension.

The genius of Cyrus designs lies in their ability to transcend the classical pedestrian ideas of dealing in simplistic specifications, meet the stringent requirements of the musical community, and incorporate music's spiritual and emotional dimension. In a tired world dominated by commercialism, consumerism, designed obsolescence and so much mediocrity your Cyrus amplifier will touch your mind and bring you breathtaking musical experience for many years to come.

Cyrus I

A British critic wrote "... the stunned look on the face of people who first heard the Cyrus One amplifier ..." a leading Dutch reviewer went on to say: Cyrus One is probably the best amplifier at any price; a most respected American reviewer added: the more subtle qualities of Cyrus One can only be matched by the finest of American tube amplifiers, and the French critics simply awarded Cyrus with 'Decibel D'Honneur'. Since then we have continued to read extraordinary independent test-reports from critics all over the world on this genius of a product. We have learned of astonished music critics replacing their costly 'super-amps' with the little Cyrus One. One can therefore only conclude that in its short history, since its introduction, the Cyrus One has become both a Reference and a living legend.

The Cyrus One is based on a revolutionary circuit design philosophy, details of which are beyond the scope of this brochure and in any case well guarded secrets. The design is then implemented with careful attention to circuit topology in order to minimise the number of components in the signal path and reduce their harmful effects. This 'straight-line' design is then manufactured to the very highest standards using components and materials beyond the reach of most competition. The power transistors, for example, are military grade, ultra-fast and very linear devices especially manufactured for Cyrus Electronics. The driver transistors are equally products of a British military semiconductor manufacturer. World class German produced passive components have been selected including extravagant polypropylene capacitors, polystyrene capacitors, and metal film resistors. The casing for the amplifier is precision injection moulded from a 'non-magnetic', non-electroconductive' metal substitute produced by Space Division of American General Electric.

All spurious and harmful stages, such as tone-controls and filters, headphone and loudspeaker switching, protection circuits and balance controls have been eliminated to make the amplifier a 'straight line', no compromise, state-of-the-art design. The quality control standards are amongst the highest in the industry where every amplifier is tested along nearly 100 parameters on the most sophisticated Hewlett-Packard CAD-CAM systems available. The result is an extraordinary achievement called the Cyrus One integrated amplifier, elegant in appearance, without gimmicks, and capable of producing a breathtaking and spectacular sound stage when used with quality ancillary equipment.

Cyrus Two

The Cyrus Two is an even more sophisticated amplifier with a similar philosophy to that of the Cyrus One. The major differences between the two amplifiers are in the area of greater power output and even more importantly, superior current delivery capabilities. Furthermore, Cyrus Two incorporates one truly exceptional moving coil stage with emphasis on noise and hysteresis factors. Indeed, the MC stage is designed to work with esoteric cartridges often costing many times the price of Cyrus Two. Another unique feature of Cyrus Two is its ability to accept the PSX optional outboard power supply (not available for use with Cyrus One) and, when configured with the PSX, Cyrus Two is capable of competing directly with the finest and most esoteric American 'super-amps'. Independent test reports have frequently suggested that the only problem with Cyrus Two is its modest price tag, which may prejudice the most discerning of audiophiles who tend to look only at very expensive equipment. We suggest that you audition the Cyrus Two, possibly combined with the PSX, against the world's most esoteric equipment before you make your final decision.

Cyrus PSX

Given that the circuit philosophy is capable of reproducing magic and that really is what music is all about, and given what we have already stated, Cyrus Two uses state-of-the-art components and manufacturing techniques throughout, there is only one other area of potential improvement – and that is in enhanced power supply capabilities.

Whereas the Cyrus Two has a superb internal power supply of its own, capable of unbelievable current delivery of 60 amps peak-to-peak, nevertheless the addition of the PSX can only improve things further. The PSX is manufactured in a similar case to the Cyrus Two, and plugs into the back of the Cyrus Two via an umbilical cord terminated with an XLR connector. The PSX transformer has been the subject of two years research and development and is the ultimate in toroidal transformer technology. The power supply reservoir capacitance is substantial and again the finest available components have been used. We are confident that the discerning music lover will not be able to better the performance of the Cyrus Two, using optional PSX outboard power supply, at any price.

Cyrus Tuner

The advent of digitally synthesised tuners has substantially improved the reception quality of FM broadcasts. A few problems however continue to persist in the design of most FM tuners. The most serious of these problems we consider to be sibilance in high frequencies and poor low-frequency performance. It is common knowledge that the low-frequency performance of tuners lacks authority, control, definition, and articulation – especially when compared to the latest generation CD players.

The objectives of Cyrus Electronics have been to produce an outstanding tuner where the FM section does not suffer the nagging problem of 'spitting' sibilance, and to give bass notes their rightful and necessary musical weight, tempo, and authority. The Cyrus Tuner is manufactured in a case of identical dimensions and appearance to the rest of the Cyrus range, and will suit the requirements of the perfectionist audiophile who owns either a Cyrus One or a Cyrus Two.

The design is based on microprocessor controlled digital frequency synthesised tuning, and provides 19 FM and 9 MW presets with C-MOS memory back-up. The unit provides variable speed up/down scanning, automatic search, as well as manual tuning. Automatic FM mute is provided to eliminate irritating interstation noise. Quartz-locked tuning system is adopted for ultimate tuning accuracy and minimal frequency drift. An informative Flucrescent Tube Display electronically generates digital frequency readout, 'Tuning' indication, 'Stereo' reception and, when selected, preset channel number. For finest reception quality under adverse signal conditions the Cyrus Tuner has FET front-ends (dual-gate with automatic gain control for FM). The FM mixer oscillator is buffered to ensure high immunity to interference, and Ceramic filters are incorporated for high selectivity on both AM and FM wavebands. The Cyrus Tuner offers Sliding Stereo decoder maintaining full channel separation on strong signals, and changing gradually to mono for fullest noise suppression on weak signals. PLL decoder circuitry produces a stable audio signal with optimum channel separation, and an SSF filter cuts out interference on stereo broadcasts.

Note: As mentioned earlier the products of Cyrus Electronics exclude harmful protection circuitry to ensure maximum signal integrity. Please be extremely careful not to short the speaker outputs on installation.

Note: Combinations of any two Cyrus products produce the standard rack width of 430mm to match your other equipment.

MISSION ELECTRONICS

The Mission DAD 7000 is an advancec third generation compact disc player and the first of its kind from a quality specialist manufacturer. In the light of great controversy concerning both the absolute standard of reproduction from CD players as well as tremendous variations between the machines from different manufacturers, Mission Electronics hung fire until the fundamentals of the technology had settled and until their own extensive research programme had resulted in what promises to be the world's most advanced CD player.

The Mission DAD 7000 is a 4 times over sampling machine with 16 bit resolution. The machine offers full facilities including motorised front loading tray with anti-jamming protection, studio class access time of average 2.5 seconds, full programmability of up to 99 tracks and in any sequence with repeat capability, queuing to within one second accuracy, automatic disc read after loading the CD, high speed forward or backward music search plus fine step adjustments. The Mission DAD 7000 also offers user-friendly ergonomics and full infra-red remote control.

Other technical features of the Mission DAD 7000 include two separate digital to analogue converters for true stereo reproduction, the unique Philips digital transversal pre-DAC filter as well as Mission's own patented post-DAC filtering. This sophisticated two stage filtering system combined with high sampling frequency results in a perfect audio band frequency response without phase shifts and other aberrations and with mathematically near-perfect impulse response and the associated transient performance. Here it must be noted that most machines on the market suffer from severe inter channel phase shifts or absolute phase shift, and in most cases both. The laser read system is a single focus design eliminating the dangers of manufacturing alignments or subsequent field disturbances. Unlike most inexpensive designs the Mission DAD 7000 is manufactured into a most sophisticated set of pressure die-cast chassis and structures to ensure total stability and integrity of the fragile transport system and a subsequent reduction in reproduced errors. The machine is precision manufactured to the highest standards using high grade components to offer the best sound quality and long term user satisfaction.

Above all, Mission has a worldwide reputation for state-of-the-art in high fidelity and our design team are confident that the DAD 7000 meets Mission's stringent requirements for the ultimate in sonic performance.

Call Mission North America: Tel: (416) 673 3777

EDWARD TATNALL CANBY

THE GREAT BROADCAST OF 1938

Illustration: Kim Wilson Eversz

Orson Welles—dead at 70. Sad news, but interesting in what it recalls, especially for this writer. The Great New England Hurricane. The very young Welles, one of the pioneers of audio's impact on people. *Citizen Kane*, of course—his great early film in which, like Charlie Chaplin, he was his own star. Thereafter, a lifetime of actorism around the edges of Hollywood, but again, like Chaplin, never really at the center. Both were too much "originals" for that.

The "Mercury Theatre" was an innovative theatrical drama on big-time network AM radio. Welles, barely out of his teens, was the first real genius of radio dramatics in a serious format, after a generation of radio comics from the Two Black Crows and Amos 'n' Andy to Will Rogers. Before we had TV, the unique medium of spoken drama without visuals (like the silent film without sound) developed remarkable properties through the sheer power of suggestion. Boundless imagination took over for the missing pictures and, like the silent films, the all-audio drama became a very potent force.

In particular I remember one special "Mercury Theatre" production—the famous Panic Broadcast, as it has come to be known, the supposed invasion of the Earth by Martians who had landed, we were told, only a few miles from Princeton, New Jersey. That incredible occasion, the evening of October 30, 1938, when Orson Welles was all of 23 years old, marked a terrifying milestone in audio history. For the first time we discovered our awesome power *via the electronic signal alone* to create mass hysteria—indeed, a sort of temporary mass insanity. Astonishingly, I myself did not panic. Like Little Audrey (remember her?), I just laffed and laffed. But hundreds of thousands did indeed panic.

True, this was not the earliest demonstration of mass persuasion via the loudspeaker. Hitler was on hand. His rantings used sound and film to their utmost, but they were nevertheless basically live performances staged before vast audiences. Hitler seldom *created* mass hysteria through electronics; the hysteria, so to speak, was prebaked. The mikes merely took down the evidence. Franklin D. Roosevelt was also on the air. But his Fireside Chats were again different; they changed the politics of government but were broadcast as individual messages to each of us, to the American and his family—hence the title. And so Welles, even though quite unintentionally was the man who proved the power which audio, on its own, exercised over the mass mind.

I have just realized that the two events which, in my mind (if not in public), entitle me to undying fame both occurred at this time, within a few short days of each other. I heard the Panic Broadcast on my own, not even knowing, and *I did not panic*—when all around me were going berserk. That was one. And a few days before, on the Connecticut shore, I had muttered the immortal words, *"This must be that hurricane,"* noticed by nobody around me. Not one in a million people in the destructive path of the Great New England Hurricane said the same. They didn't know, but I did. I also happened to know exactly what the Orson Welles broadcast was all about, because I recognized its source immediately—*The War of the Worlds*, by that good old sci-fi writer, H. G. Wells, no relative of Orson's and minus the extra "e." It was written in 1898, and the locale of the story was not Princeton but somewhere in England. The "Mercury Theatre" radio version was skillfully modernized by 40 years and transplanted to America; even more, it was so brilliantly adapted to radio itself, and to the familiar techniques of 1938 broadcasting, that everyone, in the millions, took it for real. And that in the face of a hundred deliberate falsities—reports, for instance, from a nonexistent broadcast service. Worse, people actually saw the Martians, saw the glow of the fires of destruction, and passed on the hysteria to hundreds more. But as soon as I recognized my childhood favorite, H. G. himself, I just enjoyed a good show without a thought of the world's impending end.

In Connecticut, I was less than 10 miles from the eye of the Great New England Hurricane, and on the dangerous side. In Princeton, a few days later, I was less than 10 miles from the "eye" of the Orson Welles drama, the farm at Grover's Mill, just the other side of the Pennsylvania railroad tracks, beyond Princeton Junction.

If I had been part of a crowd that evening, or even a family at home, I'll

Absolutely not. There are certain areas in life where you can't skimp on quality.

That's why there's Maxell XLS tape. It's engineered to achieve a lower distortion and wider dynamic range. XLS frequency response extends to the widest possible limits, with greater sensitivity throughout the tonal range.

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maxell

THE TAPE FOR SOPHISTICATED EQUIPMENT.

WOULD YOU BUY CHEAP PERFUME FOR YOUR GIRLFRIEND?

Do people notice glaring falsehoods as they listen to the radio? Sometimes. But in panic they forget everything—the wise and the foolish together.

have to admit things might have been different. I was simply relaxing, by myself, in my lodgings near the Princeton campus. I had idly turned on the radio to see what might be going on, as we all do today. I stumbled on the Panic Broadcast by sheer chance, as did most people, and a bit beyond the opening, which added authenticity to the "news" broadcasts.

Within a minute or so, I began to be suspicious. What *was* this? That's ridiculous. Totally improbable! How can they get away with such stuff? It's a hoax. Then, even as I heard that I was only a few miles from the Martian landing, I recognized H. G. Wells.

Well, the classic antidote for panic and hysteria, we are told, is to Be Informed. To know. I did know, you see. I loved H. G. Wells. I also was a "weather freak," and I had been following that big hurricane on weather maps, never thinking, of course, that it would hit *us*. But when it did, I was mentally prepared. Not an Expert—just Informed.

What they do not tell us, a thing that Orson Welles already knew, is that to be informed does not necessarily mean a mere piling-up of facts, knowledge by sheer accumulation. In the broadcast, Welles himself played the Absent-minded Perfesser, the Princeton astronomer who first saw the Martian blastoff through his telescope at the University. His long-worded ineptitudes, leaving practically everything hanging, must have been a joy for Welles, the master of verbal communication, to act!

I suspect that every few listeners got to hear the unexpected conclusion, in which the Martians are killed off by terrestrial germs. (In 1898 this was a hot topic, the older Wells knew, equivalent to DNA and genes and such today.) Most of us in 1938, after 10 seconds or five minutes of the awful news, had alredy taken to the hills—jumped into cars and vamoosed, departed at furious speed for *somewhere*. Anywhere but where we were, be it Princeton, Dallas or San Francisco! Sheer insanity. Not hard to explain at the time: There was Munich, and we knew the big war was inevitable. Any day. Anxiety, turned into hysteria. That surely is what set it all off.

For those increasing numbers of people today who are not even aware of this historic occasion, as the phrase goes, I can only say that you'd better believe what you read. It was a shaking thing. Do people notice glaring discrepancies, falsehoods, impossibilities, gaps a mile wide, as they listen? Sometimes. But in a panic they forget everything. Intelligence is useless. We simply fly apart in the upper story, the wise and the foolish together.

No space here to go into much more of the gory and wonderful details of that evening; it would take me a dozen columns. In any event, a man named Howard Koch has long since done it for me in *The Panic Broadcast*, an awesome and delightful book (which includes the radio play itself), published in 1970, 32 years after the event. Mr. Koch was the man who actually wrote the script, Orson Welles' radio ghost. Suffice it for me to say that though, strangely, there was absolutely no visible damage from the great Invasion anywhere in the country—and so nothing at all to gawk at the next day—for a few hours total chaos reigned from coast to coast. As the Martians (supposedly) landed more of their deadly cylinders around the country, the highways—especially around New York City and in New Jersey, but also elsewhere—were reduced to utter confusion and what we now call gridlock, a hideous gridlock inflamed by panic.

It must have been really terrible, for out of those crashing cylinders—if you believed—rose enormous steel towers with squat tops on them, which "walked" over the land, pushing down buildings and bridges, spraying forth deadly heat rays which set cities afire in seconds, and a lethal black gas that killed instantly, wiping out whole armies at a time. *If you believed!* Can you imagine it? Public switchboards—police, radio stations, whatever—were swamped, church-loads of people stampeded outdoors in the middle of services and fled in terror, apartment houses were roused into frenzy as the inhabitants got out, carrying useless things like chicken legs with them. Mr. Koch cites one anticlimax in which a couple touring the redwoods in Northern California heard the Martians had landed and set off posthaste to get their children in L.A. before the End came. They forgot about gas—and ran out of fuel in the middle of the forest. So they just sat, holding hands, waiting for doom to arrive. It must have been a rather long wait.

Then, in New York, the Koch book quotes: "I drove like crazy up Sixth Avenue. I don't know how fast—fifty, maybe sixty miles an hour. The traffic cops at the street crossings just stared at us, they couldn't believe their eyes, whizzing right past them, going through the red lights. I didn't care if I got a ticket. It was all over anyway."

Afterwards, as you might guess, there were voluminous repercussions, once people got back home, shamefaced or angry (they thought they had been taken in unfairly). There was commentary by everybody with a big name, pompous newspaper editorials, batches of hilarious cartoons, takeoffs, and, last but never least, studies by the usual qualified Experts and scholars, notably at Princeton University (where else?); there was also the taking of much valuable information via interviews (though not, I should remark, on tape recorders). After a few months this ran its course and we began to forget. Soon we had a grimmer reality on hand—war.

It was the new spate of Mars news and probably also the 30th anniversary of the Welles broadcast that prompted Howard Koch to put together his book about the famous event, though he missed the anniversary deadline by a bit. *The Panic Broadcast* was published by Little Brown and should still be around. Mr. Koch is far from a scholarly drudge—no one around Orson Welles could have been that—and it was he who wrote the film script for *Casablanca*, which should place him in a proper niche. He does a superb job here, I think, reminiscing, interpreting, interviewing, collecting masses of data—the newspaper reports, the columns, editorials, cartoons, personal accounts. And there's the play itself, remarkably old-fashioned as we read it now. Radio has changed much more than you think. The broadcast wouldn't fool anybody, nowadays.

So Orson Welles is dead—and there may be a new edition of Koch. As a book-sized monument to the historical audio event, you should own it, decidedly. And it will do wonders for your coffee table. A

BERT WHYTE

OUR AES REPORTER

The world of professional audio is flourishing, as evidenced by the more than 10,000 people from 46 countries who attended the 79th convention of the Audio Engineering Society during its October run at the New York Hilton. Record-breaking crowds jammed into the exhibits, and the many interesting papers and informative seminars and workshops drew heavy attendance.

While analog audio is still very much alive and well, there was no doubt at the convention that digital audio has become the predominant technology and the wave of the future. The tremendous success of CD has had much to do with this; today, virtually all of the new digital audio equipment and technology is interlocked with that of the CD medium. Most recording engineers now regard the CD, not the vinyl LP, as the end product of their efforts, and many have modified their recording techniques to take advantage of the superior sonic qualities of the format.

Many engineers feel that the full potential of digital audio will not be realized until all elements in the recording chain—especially the input console—are digital. Although there are a number of digital recorders on the market, there is currently just one digital console available, the Neve DSP, though Neve's archrival, Solid State Logic, plans to build one too.

Big analog consoles, with their intimidating myriads of knobs and controls (which necessitate some control automation), have price tags of several hundred thousand dollars. The Neve DSP costs between $600,000 and $800,000, depending on its configuration, and there is every reason to expect the Solid State Logic digital unit will be in the same elevated range.

If you would like to hear what a truly all-digital recording sounds like, the great New Zealand soprano Kiri Te Kanawa has made one, in her first foray into popular music. On a London CD entitled *Blue Skies*, the late Nelson Riddle and his orchestra accompany her in a group of well-known ballads. The recording was made on a 24-track Sony 3324 digital recorder, through the Neve DSP digital console. The resulting sound is utterly quiet and extremely clean, without the faintest tinge of distortion. This type of recording does not have great dynamic range, but one can imagine how spectacular an all-digital recording of a full symphony orchestra would be.

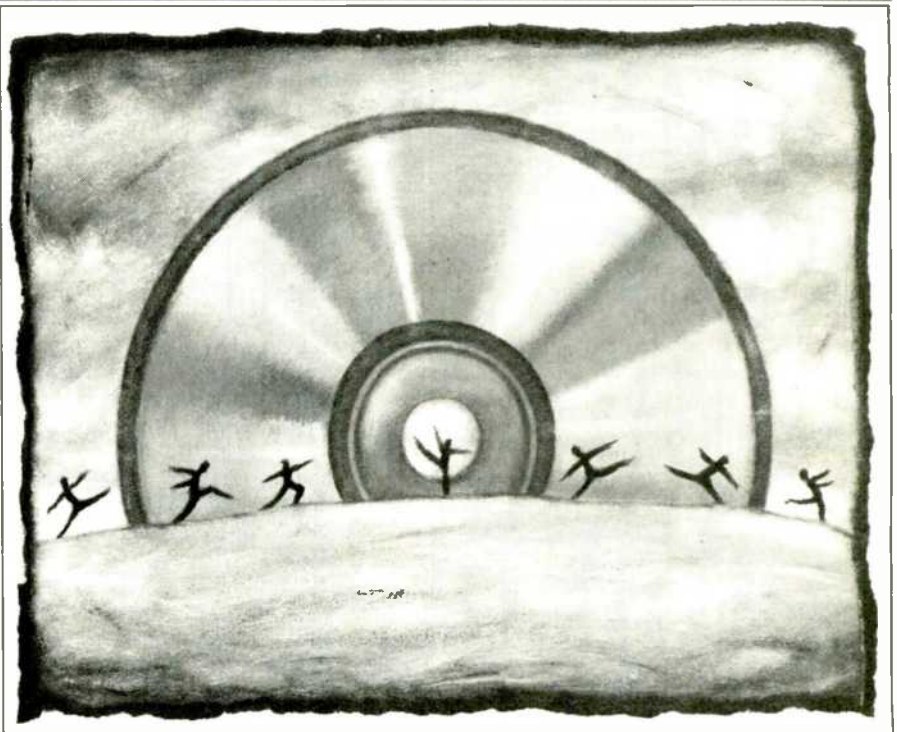

Illustration: Warren Gebert

I have commented before on the desirability of digital-input consoles, and have noted that the Neve DSP is hardly suitable for portable use in location recording. You may recall my wishing that someone would make a fairly simple, straightforward, portable digital mixer for use in "purist" symphonic recording. Lo and behold, the first thing that caught my eye at the JVC exhibit was a portable digital mixer! This unit is approximately 12 inches wide and 18 inches long, with an angled panel 10 inches high at the rear and about 3 inches high in front. There are four inputs, controlled by slide-type faders, and two outputs. There is equalization for each channel (which I wouldn't normally use, but it is useful in some situations). There is also a digital port to interface with a computer. The unit is expected to cost around $30,000. Not too far down the line, I expect to do some recording with this device.

You may recall that a consortium of Matsushita, Sony, and Studer proposed a standard for digital recorders known as the DASH (Digital Audio Stationary Head) format. (See "Behind the Scenes," January 1984.) At this 79th AES convention, no DASH recorders were forthcoming from Matsushita, but Sony and Studer had their first models on display.

Sony's DASH recorders, the PCM-3000 series, are built in Sony's MCI plant in Fort Lauderdale, Florida. The PCM-3102 operates at 7½ ips and provides two digital audio channels on quarter-inch tape. The PCM-3202 operates at 15 ips and has the same track configuration as the PCM-3102. The higher, 15-ips speed of the PCM-3202 permits easier razor-blade editing from the analog cue track. All DASH digital recorders use 48- and 44.1-kHz sampling rates. The first 15 PCM-3102 recorders have already been delivered to the NHK studios in Japan; U.S. deliveries of this model and the PCM-3202 are scheduled to begin in January 1986.

Studer's DASH digital recorder, the D820X, is a two-channel unit that operates at 15 ips and utilizes the DASH standard track configurations on quarter-inch tape. The transport uses three direct-drive d.c. motors, and can accommodate reels up to 14 inches in diameter, affording two hours of re-

CLASSICS ON CASSETTES

ALSO AVAILABLE ON STEREO RECORDS

331488-391482. Bach: Brandenburg Concertos, 1 to 6 (complete)—Kapp, cond (Counts as 2—*Digital*—CBS Masterworks)

326983. Bach: Organ Masterpieces—*Toccata & Fugue in D Minor*, etc A. Newman (Sine Qua Non)

317081. Bach: Goldberg Variations—Glenn Gould (*Digital*—CBS Masterworks)

330647. Bach: Unaccompanied Cello Suites 1, 2—performed by Yo-Yo Ma (*Digital*—CBS Masterworks)

336578-396572. Bach: Flute Sonatas—Rampal, flute, Pinnock, harpsichord, etc. (Counts as 2—*Digital*—CBS Masterworks)

338178. A Bach Celebration. Christopher Parkening plays music from Bach cantatas arr for guitar and orch. (*Digital*—Angel)

329714. Bartok: Concerto for Orchestra; Dance Suite—Solti conducts Chicago Sym (*Digital*—London)

338004-398008. Beethoven Piano Sonatas—Moonlight, Appassionata, Tempest, 3 more A. Brendel (Counts as 2—Vox Cum Laude)

335075. Beethoven: Overtures—Coriolan, Egmont, Fidelio, Lenore, etc Tennstedt, London Phil (*Digital*—Angel)

232496. Beethoven: Symphony No. 3 (Eroica)—Bernstein and New York Philharmonic (Columbia)

321570. Beethoven: Symphony No. 5; Schubert: Symph. No. 8 (Unfinished)—Maazel, Vienna Philhar (*Digital*—CBS Masterworks)

252874. Beethoven: Symphony No. 9 (Choral)—Ormandy and the Philadelphia Orch (Columbia)

331595. Bizet: Carmen Suite; L'Arlesienne Suites 1, 2—Ozawa, Orch National (*Digital*—Angel)

263293. Bolling: Suite For Flute and Jazz Piano—Rampal, Bolling (Columbia)

332668. Brahms: Symphony No. 1—Tennstedt cond London Philharmonic Orch (*Digital*—Angel)

334243. Brahms: Piano Concerto No. 1—Weissenberg; Muti, Philadelphia Orch (*Digital*—Angel)

328039. Brahms: Symphony No. 3; Haydn Variations—Mehta, New York Phil (CBS Masterworks)

333518. Bruckner: Symphony No. 7—Chailly, RSO Berlin (*Digital*—London)

325183. Dvorak: Symphony No. 9 (New World)—Solti, Chicago Symph. Orch (*Digital*—London)

333575. Elgar: Enigma Variations; Pomp And Circumstance Marches—A. Davis, Philharmonia Or. (*Digital*—CBS Masterworks)

331314. Gershwin: An American In Paris—plus Grainger's *Fantasy on Porgy & Bess*—Labeque sisters (*Digital*—Angel)

323543. Handel: Royal Fireworks Music; Oboe Concertos 1-3—Karl Munchinger, Stuttgart Chamber Orch (*Digital*—London)

332569. Haydn: Symphony No. 94 (Surprise), **No. 100** (Military)—Solti London Phil (*Digital*—London)

321190. Liszt: Hungarian Rhapsodies 1 & 4; more—Baskovsky cond (Angel)

330613. Mozart: Greatest Hits—Gould, Previn, Szell, others (CBS Masterworks)

321224. Mozart: Overtures—Don Giovanni, Cosi fan tutte; Marriage of Figaro, etc Marriner, Academy of St Martin (*Digital*—Angel)

338228. Offenbach: Gaite Parisienne; Gounod: "Faust" Ballet Music—Dutoit, Orch symphonique Montreal (*Digital*—London)

318691. Prokofiev: Love For Three Oranges Suite; Lt. Kije Suite—Michael Tilson Thomas, Los Angeles Phil. (CBS Masterworks)

245043. Rachmaninoff: Piano Concertos Nos. 1 & 2—Ashkenazy, Previn, London Sym (London)

334565. Rachmaninoff: Symphony No. 2 (complete version)—Rattle and L.A. Phil (*Digital*—Angel)

321729. Schubert: The Impromptus, Op. 90 & 142—Murray Perahia, piano (*Digital*—CBS Masterworks)

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Just as the first DASH recorders were appearing, the digital apple cart was upset again by the announcement of yet another proposed standard.

cording. The transport and audio controls are microprocessor-based, and up to 40 audio and transport functions can be programmed. Both electronic and razor-blade editing are possible, and the recorder has digital (AES/EBU) and analog inputs and outputs. Ferrite heads are used to record the data stream. A newly designed error-correction system is claimed to be so powerful that it can provide full correction of burst errors on all tracks simultaneously over a tape length of 1½ inches! Delivery is scheduled for early spring of 1986; there's no pricing information, as yet.

Just as the first DASH recorders were appearing, the digital apple cart was upset again—wouldn't you know it?—by the announcement of yet another proposed digital standard. This time Mitsubishi, Otari and AEG (formerly AEG/Telefunken) got together to promote a digital format they call Prodigital. This is essentially the format Mitsubishi has been using in their two-channel X-80 and 32-channel X-800 digital recorders. The new format incorporates a few minor changes. Needless to say, the DASH and Prodigital (PD) formats are not compatible with each other.

As with the DASH format, Prodigital is really three formats based on tape speeds of 7½, 15, and 30 ips. The two-channel Prodigital format, operating at 7½ or 15 ips on quarter-inch tape, requires 12 tracks—eight digital audio tracks, two auxiliary analog cue tracks, one time-code track, and one auxiliary digital track. Sampling frequencies are 48 and 44.1 kHz, with 16-bit linear quantization and a Reed-Solomon code used for error correction. Both electronic and razor-blade editing are possible. The 16-channel PD format uses a total of 24 tracks at 30 ips on half-inch tape: 16 digital tracks, four parity tracks, two auxiliary analog cue tracks, one time-code track, and one auxiliary digital track. The 32-channel PD format uses 45 tracks at 30 ips on 1-inch tape. There are 32 digital audio tracks and eight parity tracks, plus the others common to all three Prodigital formats. Sampling frequencies and quantization of the PD-16 and PD-32 are the same as those of the PD-2. As you might expect, reaction to this new Prodigital format was mixed—some people compared the battle between Prodigital and DASH to the Beta/VHS wars. In any case, because of the similarity of the PD format to the existing Mitsubishi format, recorders for this new standard will be available in fairly short order.

Sony also introduced the successor to its PCM-1610 digital processor, the PCM-1630. This is smaller and less expensive than the 1610 but is said to incorporate many new features and refinements. There is a newly designed analog input filter, claimed to eliminate phase distortion, and the digital filter now uses oversampling at 88.2 kHz. This is said to provide a much gentler roll-off curve with a high-frequency cut-off of 24 kHz, and thus to restore the audio signal without phase distortion. The PCM-1630 has a large, 500-VA toroidal transformer in its power supply, along with six high-capacity storage capacitors. The processor also features transformerless inputs and outputs. Some interesting new accessory boards provide RAR (read after read) and RAW (read after write) functions. The PCM-1630 is an integral part of Sony's elaborate new Compact Disc mastering system. Deliveries should commence this winter.

The famous Viennese Bösendorfer piano has been demonstrated at a number of New York Audio Engineering Society conventions. Everyone who loves the piano is always impressed with the magnificent instrument's rich sonority and beautiful sound.

At this AES convention, Bösendorfer's exhibit booth showed only a videotape presentation featuring this great piano. But the tape was not intended as a substitute for the real thing. It merely documented one of the most fascinating collaborations between music and audio engineering that I have ever encountered: The Bösendorfer 290 SE system. Small groups of people were invited to audition the system at the showroom of Curt Swidler Artist Pianos, Bösendorfer's new agent in New York; I was invited to a press demonstration after the convention had ended.

The 290 SE system consists of a 9½-foot Bösendorfer Imperial concert grand piano (which I have had the

In Bösendorfer's 290 SE system, a computer records the mechanical functions of a 9½-foot grand piano whose hammers and pedals have been fitted with optical sensors.

Every nuance of piano performance is perfectly recorded and reproduced by the Bösendorfer 290 SE, a fascinating collaboration of music and engineering.

pleasure of recording several times), fitted with optical sensors on all its hammers and pedals. These sensors sample the velocity of the piano hammers, 800 times per second, as the instrument is being played. The digitally coded piano functions are then recorded on floppy disks in a computer, on audio tape, or both.

The playback system consists of selective-velocity solenoids which are fitted to all the hammers and pedals from the underside of the piano. In playback, the encoded data on the disk or tape is used to control the solenoids, which then operate the piano's mechanism to reproduce the original performance. Because optical sensors record the performance data, there is no direct mechanical coupling to the piano; consequently, the piano action responds in normal fashion. The sensitivity of the system is so high that every nuance, every aspect of dynamic scale and expression, is perfectly recorded and then reproduced.

At the press conference, Charles Rosen, a well-known concert pianist, played a number of short pieces which were recorded on floppy disks. Then he stepped away from the piano. On playback it was uncanny to see the keys being depressed and hear a facsimile performance of the music that had just been played. Mr. Rosen pronounced the playback an exact mirror of his touch and dynamic expression.

With the floppy disks and the computer (with its CRT terminal), all sorts of editing is possible. Mr. Rosen played a short section with a deliberate wrong note. A few minutes' work on the computer keyboard, and the wrong note was removed and replaced with the proper one. If desired, virtually any aspect of a performance can be edited in the computer—tempos can be speeded up or slowed down, new phrases substituted, etc.

The Bösendorfer 290 SE system was jointly developed by Wayne Stahnke, a California computer designer and audio engineer, and the research and development department of Kimball International. (The Kimball Piano Company of Jasper, Indiana, owns Bösendorfer.) The system has many obvious applications. In recording studios, an edited performance could be used for rehearsals and retakes, with no need for the artist to be present. The 290 SE could also find wide educational use at universities and conservatories (one is in use now at MIT), and would be highly valued by composers.

The Bösendorfer 290 SE system that I heard was an actual production unit. Its $110,000 price includes the specially fitted Imperial concert grand piano plus all the recording and computer hardware. One can imagine the great pianists of the world recording performances from the piano repertoire on the 290 SE; then, for those wealthy enough to own a system, or for institutions that had one, it would almost be like having a Horowitz or an Ashkenazy in residence! A

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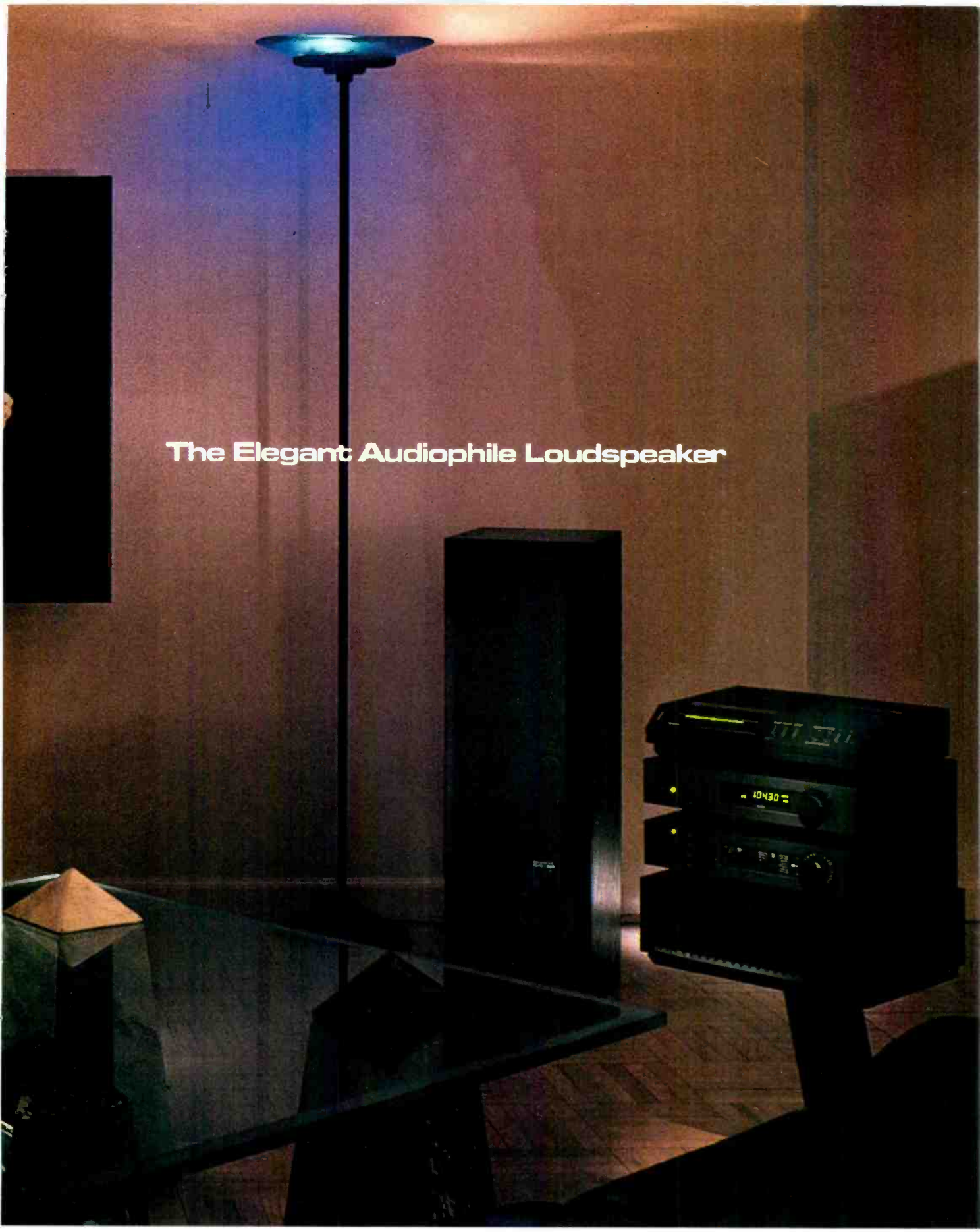

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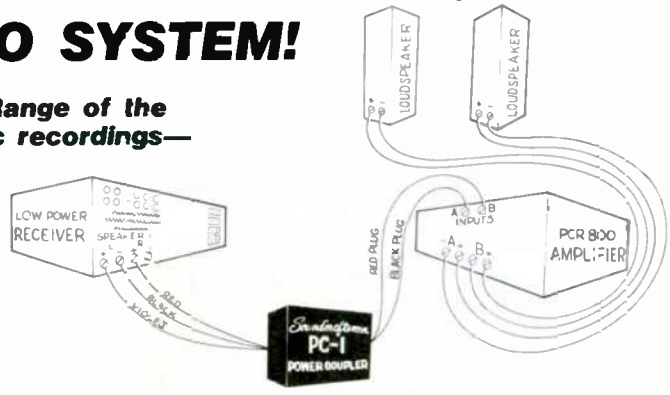

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Boston Acoustics

KEN POHLMANN

THE RIGHT ANGLE

Illustration: David Reau Johnson

Imagine that you're the president and sole owner of the Intergalactic Widget Corporation. You've just returned from your summer vacation; since you're so filthy rich, and you have a fondness for Monte Carlo, this particular vacation has lasted about 12 years. You immediately call a corporate meeting. Your faithful factory manager, Elroy, reviews the sales trend, presenting a chart that shows sales of the company's product rising almost exponentially. Nonetheless, you panic, frantically beseeching Smedlap, your faithful engineer, to start a crash research and development program to find a new product. Smedlap and Elroy look at each other, wide-eyed. Has the Chief gone mad?

Well, the Chief has always been eccentric, but nevertheless astute. The "Widget" in his company's name actually refers to prerecorded analog cassettes, and the sales curve parallels that medium's rise to dominance in the U.S. (Sales of LPs peaked in 1979 and were surpassed by cassettes in 1982.) So why is the Chief panicking?

The answer, of course, is digital audio. Compact Disc sales are still only a fraction of either LP or cassette sales, but the CD's growth has been rapid, and is expected to double annually for the next several years. If today's trend stays on course, the CD will pose serious threats to the analog tape and disc industry within five years. And when record-once and erasable/recordable CDs hit the market, analog tape and disc might be doomed. Smedlap, ace engineer at Intergalactic Widget Corporation, therefore hurries to his workbench to contemplate new product development as well as IWC's new advertising slogan, "Where there's tape, there's hope."

Sure, analog tape suffers from wear and tear, it loses high frequencies to friction from guides and heads, savage equalization is required, duplication necessarily doubles noise with each generation, distortion and hiss are inseparable companions, etc. Yet tape has an undeniable asset: Music is a sequential event, and a spooled length of tape lends itself to sequential storage. While a random-access disc might be convenient for locating a musical selection, the playing itself is always sequential. Tape is thus an inherently suitable medium for storing music information.

Analog tape's bandwidth is well matched to music's requirements, too. The tape must be able to accommodate the analog signal's entire range of frequencies. But an audio frequency range of 0 Hz to 20 kHz requires a tape bandwidth of not much more than 20 kHz—not too hard to achieve today, though it took several decades of tape progress to reach it.

And the principles of analog recording are simple. A plastic ribbon is evenly coated with a thin layer of acicular (needle-like) magnetic particles which behave as tiny magnets, with north and south poles. The particles are oriented along the length of the tape, but on a tape with no net magnetization, the north and south poles are randomly distributed. When an audio signal is applied (by passing the tape over a head which turns that signal into a varying magnetic field), the poles begin to orient themselves according to the strength and direction of the magnetic field at the moment each particle passes the head. As signal amplitude increases, more and more particles' magnetic poles align themselves. This is called longitudinal recording.

The process has its limits. For one thing, when the signal amplitude rises to the point where all possible particles have aligned themselves with the signal, the tape becomes saturated. Any further increase in amplitude will cause severe distortion—clipping—as the signal flattens out against the tape's rigid limits, eventually turning sine waves into near-square waves.

However, given particles small enough to follow the period of a high-frequency audio waveform, and enough of them to encode a sufficient range of amplitudes, analog tape recording is achieved.

This much Smedlap already knows. But, he wonders, would it be possible to fight digital with digital? The answer, as anyone who has ever encountered a computer storage medium (or a professional digital tape recorder) knows, is "yes."

The digital tape recording process is essentially identical to that described above. However, instead of trying to record the subtle variations of an analog waveform, we are trying to record the more clear-cut, logical transitions

Perpendicular recording, with particles aligned at right angles to the tape surface, allows greater particle density than traditional methods do.

between bits. Here, that bane of analog recording, saturation, works *for* us. Its squaring of the waveform is ideal for the binary nature of digital data. Thus, instead of a continuously variable net orientation of particles, there are only two orientations. Each change in polarity is sensed at the read head as a binary digit. That makes our job much easier, in some ways: Tape noise and waveform distortion are irrelevant, as long as the polarity change can be read. (In fact, the waveform actually recorded on tape is far from a clean square wave; that would waste valuable bandwidth.)

It is bandwidth that is the chief problem with the digital approach. In a digital recording, the signal waveform must be encoded as sampled data words, accompanied by additional data for synchronization, error correction and so on. The upshot is a considerable number of bits, each of which must be encoded as a level transition. As a result, digitally recording a 20-kHz audio signal might require a tape bandwidth of 500 kHz. To achieve this, digital tape uses formulations different from those of analog tape, and mechanical tolerances (such as head-to-tape contact) are more critical.

As Smedlap studies the problem, he becomes acutely aware of the magnitude of the medium's storage requirements. He observes that, with a 48-kHz sampling rate and a tape speed of 30 ips, a density of over 20 kilobits per inch is required. To achieve digital longitudinal recording, he must resort to particles with high magnetic energy levels (and hence higher packing densities), higher tape speeds, multiple recording tracks and esoteric head technology (such as thin-film heads, which are manufactured with methods akin to those used for integrated circuits).

Even with these technological tricks, longitudinal recording has a finite recording density; as smaller and smaller particles are packed closer and closer together, self-demagnetization occurs—the poles neutralize each other, and signal output diminishes. The practical limit seems to be 25 kilobits per inch.

Smedlap is white-knuckled; a 30-ips digital cassette would be larger than most household pets. He ponders: Instead of aligning the particles lengthwise along the tape, how about lining them at a right angle to the tape surface? Such a method, called perpendicular (or vertical) recording, allows for greater particle density since it is the particle width that is the determining factor. Moreover, the thinner the particle, the greater its length-to-thickness ratio, and hence its magnetic strength. In other words, the denser the particle packing, the more robust the medium. The problem of self-demagnetization vanishes, so extremely short wavelengths can be recorded. A digitization system requiring storage for 800,000 bits per second would consume 40 inches per second of longitudinally recorded tape, but only 2 inches of perpendicular.

However, perpendicular media require costly manufacturing techniques; researchers have used alloys of chromium and cobalt in the form of hexagonal crystals. Furthermore, the alloy must be deposited onto the backing in a vacuum chamber. Clearly, more efficient methods will be required for mass production.

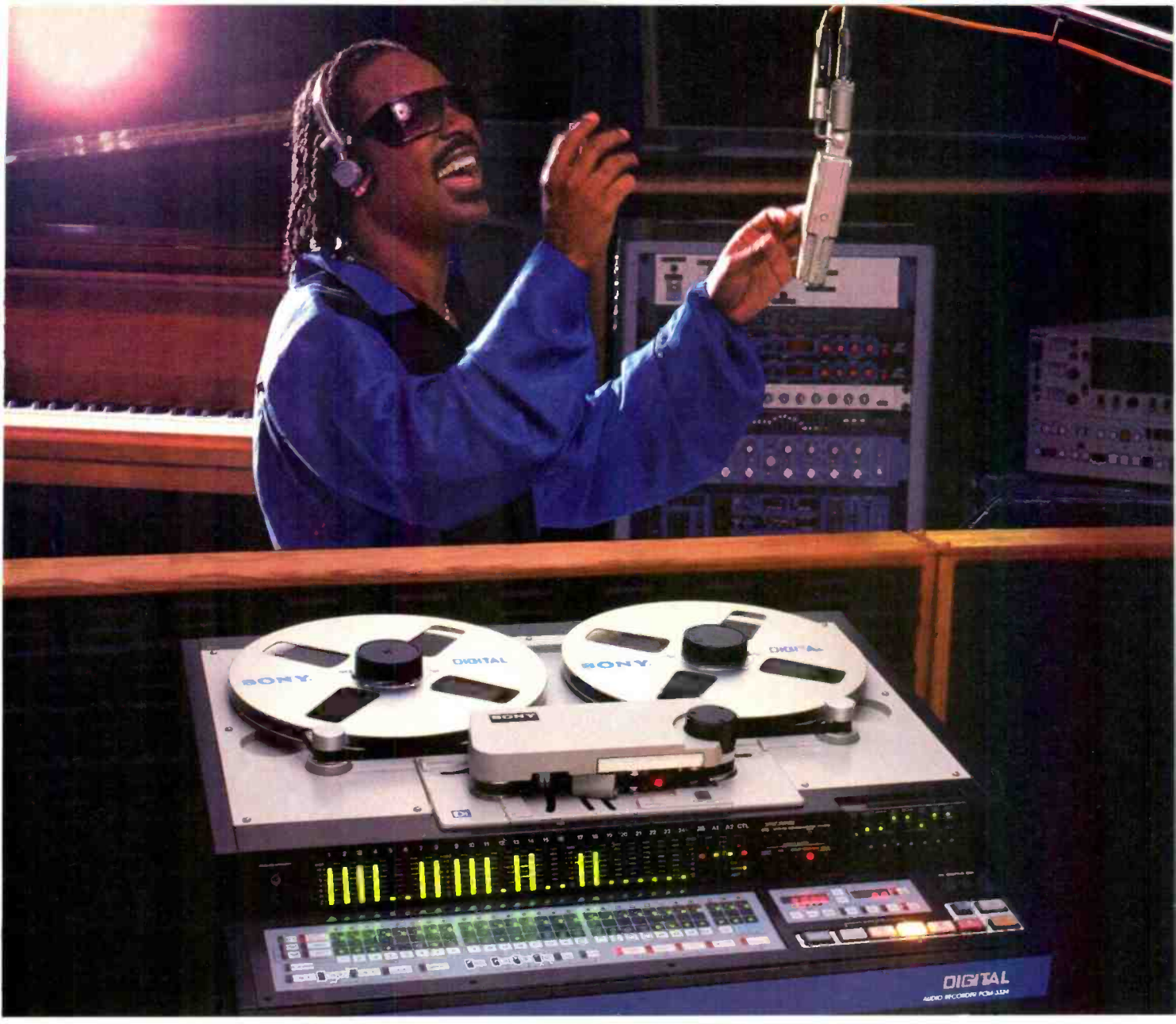
Suddenly Smedlap is struck by a brilliant notion. Why not take advantage of the fact that a magnetic layer can be magnetized in any direction? With a two-way technique called isotropic recording, the oxide layer may be magnetized in both longitudinal and perpendicular modes, simultaneously. With special head configurations and tape formulations, the two recorded fields may be combined in phase to produce a strong output signal. The head is designed so that the longitudinal field penetrates the tape oxide deeply, and is recorded first. Then the perpendicular field is recorded over the longitudinal one, erasing the longitudinal field nearest the tape surface. Thus, a perpendicular field lies over the longitudinal one. With such isotropic techniques, researchers have achieved recording densities of more than 250 kilobits per inch.

After many sleepless nights, Smedlap is convinced that digital audio tape recording can be achieved with available technology by using longitudinal, perpendicular, or isotropic recording methods. But would such a product be viable in the consumer marketplace? The answer to this question is largely dependent on such considerations as the digital cassette recorder's size, reliability, and cost. And that boils down to the recording mechanism itself—that is, the head and track format. Specifically, should a digital audio cassette employ a stationary or a rotating head system? Each offers certain advantages, as well as disadvantages. A rotating head yields great bandwidth but requires intricate mechanics; a stationary head is mechanically simple but would require many tracks to record the data load.

Meanwhile, the Chief is convinced that Intergalactic Widget Corporation is teetering on the brink of ruin. Smedlap racks his brains, balancing the pros and cons of rotating and stationary heads, not to mention playing time, cassette size, sampling rate, quantization word length . . . .

Actually, Smedlap knows, his hands are tied. IWC can't sell prerecorded digital cassettes until there are digital cassette decks to play them on. And if manufacturers are sane, there will be no such decks until the major companies, at least, agree on tape and player standards—maybe one standard, maybe two (one each for rotary-head and stationary-head designs). Meanwhile, Smedlap must look into all the possibilities, but postpone action until the standards are set.

Will Smedlap find the ideal digital audio cassette system? Will the Chief agree with his engineer's decision? Or will Ted Turner buy IWC with junk bonds and restructure it as a bakery? Tune in next month!



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See dealer listing on page 152

New-Year Greetings

It's come again—another year!! As I have said before (and am glad to be able to say again), thank you for your encouragement. It really does help. Thank you for your criticism, too, both positive and negative (and this includes corrections to some of my math—a field in which I am *not* expert). Thank you to those who have taken time to share ideas which I, in turn, can pass along to the rest of you.

With the November 1985 "Audioclinic," I began my 31st year of service to you. With your help, this can be the best one ever. Keep the questions coming, and I'll keep the answers coming. I'm not on an ego trip; there are times when I don't have the foggiest notion of how to answer a question. When this is the case, I will just tell you that, or, when possible, refer you to someone who can help.

What I offer is a love of music, long experience as a recording engineer, a gang of time spent on the service bench, and an interest in helping others. I look forward to hearing from *you* during 1986.

Turntable Isolation

I have a suggestion for readers with turntable isolation problems. Take a piece of foam rubber approximately 1½ inches thick. On top of the foam, place a 1-inch-thick piece of flagstone or any other stone. Then place the turntable on top of the stone. I have found that this added mass significantly improves the isolation, particularly from footsteps and vibration.—Todd M. James, Reading, Pa.

Speaker Frame Ground

Q. My portable stereo system contains two loudspeakers connected in parallel. From one of the terminal lugs, there is not only a connection to the other speaker in the pair, but also a wire which is directly attached to a rivet that holds a terminal strip to the speaker frame. Why is this connection made?—Richard Roy, Downsview, Ont., Canada

A. If you check the wiring of these speakers, you'll find that the terminal which is wired to a rivet on the speaker basket is also connected to the ground side of the system's amplifier. The manufacturer must have found a need to ground the speaker assembly. In a portable system, the speakers would be close to other components; if the assembly's frame were not grounded, capacitive coupling could result in oscillation.

It is also possible that the manufacturer purchased a quantity of loudspeakers prewired in the way you have described, and simply used them without unwiring the frame ground.

Output Tube Bias Problem

Q. I have a Dynakit Mark III power amplifier which keeps blowing fuses. After the amp has been on for about 15 minutes, the bias voltage for the KT88 tubes will gradually rise from its normal 1.56 V to about 2.6 V—at which time the fuse blows. I'd appreciate a clue to the source of this trouble.—Harry Anderson, Chicago, Ill.

A. As I remember it, the bias voltage readout is really an indication of the output stage's cathode current. This stage's gradual drawing of higher and higher current during operation can result from a number of factors.

First, your output tubes may be gassy. The ionization within the tubes will result in excessive current. Second, a defective component in the bias supply, such as the bias rectifier, may cause the bias supply voltage to drop. If so, the decreasing bias will cause an increase in plate current and cathode current. Since you are measuring voltage drop across a cathode resistor, rather than measuring bias voltage directly, this causes an apparent voltage rise. Third, a leaky coupling capacitor feeding one output tube may cause that tube to draw excessive current, with the same *apparent* voltage rise.

Low Volume from a Mixer

Q. When I play my components through my mixer, I must set the mixer's volume very high—to approximately 8 on a scale of 10. The amplifier volume must also be set to near maximum (though this is not necessary when the amp does not go through the mixer). The level meters on the mixer indicate a low output, −15 dB. Other than this need for high volume-control settings, the mixer works well.—Elmer F. Maye, Jr., Coram, N.Y.

A. You mentioned the "output" of the mixer. If, by this, you mean what we often refer to as the "master pot," it may simply be that you have set your individual "mix pots" too low. The lower the individual input controls are set, the higher the master gain will have to be in order to make up for this. If, however, you do have the mix pots set near their maximum positions and still obtain the results described, something may be wrong with the power supply (the only component common to both channels).

Another thought is that perhaps there is a sensitivity switch or pot which affects the overall gain of the mixer. If the mixer was designed to handle "professional" signal levels as well as those usually encountered in home audio equipment, there is certainly a likelihood of such a sensitivity adjustment, or perhaps one such adjustment for each input channel. If so, you may have set these too low.

If the mixer was intended *solely* for professional service, it may be that no sensitivity adjustments are possible. Levels used in professional recording systems are on the order of 1.2 V, whereas voltages produced by home entertainment equipment are in the range of 0.1 to 0.3 V, a minimum of 12 dB below professional standard levels.

Subwoofer/Satellite Balance

Q. For the past year I have been considering the purchase of a subwoofer to complement my present system—thus making the present loudspeakers act as satellites. I have noticed, however, that the subwoofer in which I am interested has a higher SPL than my present loudspeaker system. Could the integration of this subwoofer (or similarly rated ones) with my original loudspeakers result in audible unbalance as a result of this?—Name withheld

A. The answer to your question depends on how you plan to wire the subwoofer and on your taste in terms of low-frequency response.

Your best bet would probably be to biamplify the system, using a separate power amplifier to drive the subwoofer.

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

Amplifier power output drops with 16-ohm loads, but not necessarily by 50%. How much it drops will depend on the amp.

If there are volume controls on either power amplifier, or the electronic crossover which apportions bass to one amp and higher frequencies to the other, you can use them to lower bass gain till you obtain flat frequency response. If your two amplifiers are of different power, use the lower-powered amp for the satellites.

If cost or other problems force you to use a simple, passive crossover network to separate the highs and lows, you have a problem. Chances are, if there is a balance control associated with this crossover network, that it would adjust the midrange/treble, leaving the SPL produced by the woofer unaffected. If the subwoofer has so much output (compared to that produced by the rest of your loudspeakers) that it is intolerable, you have a few decisions to make. If you have an equalizer, you can lower all frequencies below the crossover point to balance the system.

Notice that I did not offer you the choice of adding an L or T pad to attenuate the signal feeding the subwoofer. Because of the power required to produce bass, heat buildup in the pad would be excessive, thereby requiring an expensive and hard-to-find unit. Further, the use of the pad would lower the damping to the woofer cone. This, in turn, might produce poor sonic results with some woofer designs.

Amplifier Power Output at 16 Ohms

Q. My loudspeaker systems have impedances of 16 ohms. I note that power-amplifier output is never quoted at this impedance. If a typical amplifier produces 150 watts at 8 ohms, will the output be 75 watts at 16 ohms? And are there any variables which would change this picture?—Eugene L. Bershad, Freehold, N.J.

A. The power output from an amplifier will certainly be lower when feeding a 16-ohm load than it will when it feeds an 8-ohm load. The amount of falloff will depend on feedback and upon the internal impedance of the output stage. The reduction at 16 ohms may well be less than half (3 dB), but it is determined by the particular amplifier being used.

Notes

In the July 1985 "Audioclinic," I made a statement to the effect that *all* turntables produce audio output when their surfaces are tapped. One reader wrote to tell me that his B & O 1800 is practically free from such unwanted output, and he believes some other units are also relatively insensitive to mechanical shock. I can't imagine how this is possible, but I surely want to investigate it.

In the October 1985 issue, in the item "Cable Length and Signal Degradation," I said that a 6-dB loss occurs at the frequency where capacitive reactance equals the output impedance of the driver. Another reader reminds me that this loss is really 3 dB.

My thanks to both readers.

HERMAN BURSTEIN

Analog Versus Digital

Q. If I make a cassette or open-reel recording of a Compact Disc, the music sounds more like a phono record—softer, less harsh. Does audio tape round off the transients? Is it possible that digital faithfully records the hard edges that exist in all live music? If I sit close to an orchestra, their instruments can sound very harsh at times, especially when they play loud.

None of my audiophile friends like the sound of digital. Could it be that they like the way magnetic tape affects the music in an analog recording? Isn't the tape that is used for a digital recording magnetic? If so, why would digital sound different? How does digital eliminate tape hiss?—Anthony Mouldin, Lewisville, Tex.

A. Analog cassette decks produce a fairly sharp cutoff above a frequency which is usually under 20 kHz; often this cutoff point is as low as 14 or 15 kHz, depending on the deck, on whether it has a separate head for playback, and on the tape used. Open-reel decks perform similarly, except that the cutoff frequency tends to be higher, depending on tape speed; the lower the speed, the lower the cutoff frequency. These cutoffs may be eliminating the frequencies that produce harshness to your ears. In the case of CD, cutoff does not begin until beyond 20 kHz. Hence CD may be presenting, to a substantial extent, frequencies that are subdued or eliminated when copied on analog tape by your cassette or open-reel deck. These very high frequencies may represent the original music, or they may be distortion products that occur somewhere in the recording chain. It should be noted that many CDs are based on analog tapes which may have been recorded without the maximum possible attention to high fidelity.

Yes, magnetic tape is used for digital recording. The standards set for digital recording preserve frequency response to at least 20 kHz (although not past 22 kHz), so that high treble response is typically more extended than on analog tapes or phono records. And digital recording has a much higher signal-to-noise ratio, about 98 dB unweighted, compared with S/N ratios usually in the 60s or 70s for the other media.

Analog recordings attempt to reproduce the infinite number of gradations of sound by an equally infinite number of gradations in the recording medium—in the case of tape, minute variations in magnetic flux. Such systems are unable to distinguish between very small real signals and the accidental "signals" that come from irregularity in the tape and its magnetization; these irregularities are then heard as hiss.

Digital recordings first encode the sound by a finite (but very large) number of amplitude values, and then encode those values as binary ones and zeroes. The playback system must only distinguish between the two signal values representing ones and zeroes, and these two values can be made very different from each other. (A "one," for example, might be a pulse that saturates the tape, and a "zero" might be another saturated pulse of opposite polarity; each pulse would last for a specified period of time.) The minute irregularities that produce hiss in analog systems are simply ignored by digital systems. In digital recordings, noise depends on the number of bits used to quantize the recorded signal. Sixteen bits are used in CD recordings, which signifies that the audio signal can be represented by 65,536 (or 2^{16}) different levels. The more bits, the less noise.

Mail Problem

Q. I exchange cassette tapes by airmail with friends in Switzerland and France. When I play a tape sent by them, I am astonished at how dull and weary the tape sounds. Is it possible that the tapes have been demagnetized by the Postal Service's equipment or by the X-ray devices used by the U.S. Customs Service?—Kevin P. Moylan, Long Beach, Cal.

A. Your question is a new one to me, and I'm not sure of the answer; perhaps other readers can comment. I suppose it is possible for X-ray inspection to have a deleterious effect, although I have been led to believe otherwise. Possibly the foreign tapes were recorded at slightly too high a speed, so that they play back slow on your equipment and therefore sound "dull and weary." Or perhaps your deck is running slow.

To find out whether cassettes are being harmed in the mail, send one of your own cassettes to a friend abroad, and ask him to mail it back. If it has been harmed, consult the postal authorities about precautions you and your friends might take in the future.

Erase-Head Retraction

Q. Why is it that almost all cassette decks (with the exception of a couple of old portable mono units) permit the erase head to be engaged in the playback mode? Common sense indicates that this causes unnecessary head and tape wear. Or is there a reason that I'm unaware of?—Mitch Bradford, Gypsum, Colo.

A. One probable reason is that of cost; it would be more expensive to design and make a mechanism for disengaging the erase head in playback but not in recording. Second, it may well be that tape alignment would suffer with the erase head disengaged; the tape might skew more and/or differently. Third, I think the problem of head and tape wear is negligible, so far as the erase head is concerned.

Out, Damned Spot

Q. A few months after I bought a three-head tape deck, I noticed a rust-colored spot on the record head. Although the deck's performance hasn't been affected substantially, sometimes it seems I can't record at the same levels I used to without getting distortion. I have tried many kinds of head cleaner, but the spot remains. Does it affect my deck's performance? How can I get rid of it?—Albert Saldarriaga, Mesa, Ariz.

A. Normally a rust-colored spot on a tape head would be produced by tape oxide that has shedded on the head. This would be *easily* removed by isopropyl alcohol, special tape-head cleaner, etc. But since you say the spot isn't removable, it can't be due to tape oxide. It could be an imperfection in the head, which might account for your inability to record at adequately high levels. Your best course, if the deck is under warranty, is to take it to

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.

Not much can be done to get rid of print-through that's already on a tape, but there are steps you can take to avoid it.

your dealer or to an authorized service shop for repair.

Recording at Low Levels

Q. I own a Nakamichi 1000ZXL cassette deck, which I use with a dbx 224 noise-reduction unit. Because the dbx unit virtually eliminates tape hiss, I have been recording pop and rock music from discs at relatively low levels—with average VU readings of −10 dB and peaks of 0 dB. I have, however, noticed a print-through problem during quiet passages of the music on tapes that were recorded about one year ago. How do I eliminate or reduce this problem?

I don't think I can record at a lower level. I use C-90 cassettes. Would a C-60 reduce the print-through? Also, I'm in doubt as to whether it's better to record at a relatively high level to avoid the tape noise floor, or to record at a relatively low level to avoid tape saturation, print-through, etc. If I record at a low level, will the tape eventually self-erase itself? I am under the impression that, since tape-deck frequency response specifications are usually given at −20 dB, the lower the level used during recording the better will be the frequency response of the recording. Is this true?—Robert R. Maigetter, Kewaunee, Wisc.

A. There isn't very much you can do to get rid of the print-through that you have already incurred. It may help somewhat to put such a tape through fast-wind and rewind once or twice before playing it, particularly after a long period of storage. For the future, it may help to use somewhat thicker tapes, such as C-60, which provide more protection against print-through. It may also help to try recording at slightly lower levels, perhaps 3 dB or so lower. After all, with a very high-quality deck such as yours, and with dbx, you probably have S/N in the neighborhood of 90 dB, and it seems quite likely you could give away a few dB of signal-to-noise ratio without an appreciable increase in audible noise. Once you have S/N of about 70 dB, you have very quiet tape reproduction unless you play at thunderous levels. So you may have as much as 15 to 20 dB of S/N to play around with.

Recording at a lower level will not cause self-erasure, which increases with frequency, not level. Recording at lower levels does tend to improve high-frequency response, because it avoids tape saturation. However, it is not necessary or advisable to record in the vicinity of −20 dB, because most program material has a natural drop in the high-frequency region—down 10 dB or more by the time 10 kHz is reached. This offsets the effect of treble boost in recording and thereby helps to avoid tape saturation. On the other hand, some program material may have an unusual amount of high-end energy, and in such cases it is advisable to reduce recording level a few dB; how much to reduce it is a matter of judgment guided by what one hears.

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nd Advanced Technology

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Overwhelmingly acclaimed by audio critics as the reference standard CD player, the B225 makes no compromises in sonic performance or user convenience.

B225 features include:

• Oversampling (176.4 kHz) and digital filtering for superior sound resolution and optimum phase response • Cueing time of less than 3 seconds to any point on the disc • Pre-programming of nearly every conceivable combination of repeat, skip, pause, loop, and autostop functions • Programming steps may use track (selection) or time as boundaries • Dual mode LCD shows total tracks on disc, disc index, track playing, time of track, program step, as well as status of pause, loop, and autostop functions • May be operated using same infrared remote transmitter as other Revox system components.

B791 Tangential Tracking Turntable

With its patented Linatrack tonearm, the B791 provides exceptional sonic performance while rendering record damage of any kind virtually impossible.

B791 features include:

• Servo controlled linear tracking system • Tonearm less than 1 3/4" long from pivot to stylus tip • Hall commutated direct drive motor with quartz-locked speed control • Variable speed control • LED display shows nominal speed and percentage of deviation in variable speed mode.

Agora B Powered Speaker Systems

Digital sound recording challenges the limits of conventional loudspeaker design, and Revox meets this challenge with the new Agora B active speaker systems. Each Agora B enclosure contains three separate power amplifiers—one each for the bass, mid-range, and high-frequency drivers. This tri-amplified design delivers deep, tight bass and breathtaking high frequency transparency.

• Agora B speakers also feature:

• Active filter network instead of passive crossovers • Two bass drivers, one mounted on top of the enclosure and facing inward to eliminate even-order harmonic distortion • Feedback sensing circuit to compensate for back EMF from bass driver • High rigidity titanium dome tweeter • Bass, treble and bass blend adjustment controls.

B205 Remote Control

The lightweight B205 infrared remote control transmitter activates all normal operating functions of your Revox receiver, turntable, CD player, cassette deck, and open reel recorder.

**Transmitter optional. Some units may require optional receiver module.*

***Dolby and Dolby HX Pro are trademarks of Dolby Laboratories.*

Our commitment to music begins here.

Producer/engineer Bob Clearmountain at the Power Station studios, New York. Clearmountain uses these 24-track Studer recorders in his work with Bruce Springsteen, Bryan Adams, Hall & Oates, and Huey Lewis and the News, among others.

When you purchase Revox audio components, you are investing in more than buttons and lights in a box. Your Revox system is the culmination of a 30 year commitment to quality music reproduction that stretches across the entire spectrum of professional and consumer audio.

Our Studer professional recorders dominate the world-class recording studio market. And Studer engineers have been prime movers in development of digital audio systems.

Our recorders and mixing consoles carry this commitment into television and radio studios. From NBC in Washington to CBS in Hollywood to KUFM in Missoula, Montana, broadcasters count on Studer Revox for reliability and superior performance.

We apply the same strict standards of engineering excellence to every Revox home audio component. Because we know what it takes for quality music reproduction. After all, we were there every step of the way.

It continues here.

On-air studio at WFMT, Chicago's classical music "superstation."

And finishes here.

Revox system with B285 Receiver, B225 Compact Disc Player, B215 Cassette Deck, Agora B Powered Speakers, B791 Turntable, and multi-room remote capability.

STUDER REVOX

Studer Revox America

1425 Elm Hill Pike/Nashville, TN 37212/(615) 254-5651

LEONARD FELDMAN

TAPE MEASURE

If you thought the question of tape recording anything for personal, noncommercial use and pleasure was resolved when the U.S. Supreme Court said it was okay to copy TV programs on your VCR, you'd better take another look. It's entirely possible that by this time next year you may be paying 50% to 100% more for every blank cassette you buy. And, if you're in the market for a new cassette deck, it may cost you anywhere from $10 to $75 more than it does now, even if there's zero inflation in the coming 12 months.

The recording industry, pleading poverty even in the best of economic times, is looking to increase its take. It has convinced a Senate subcommittee to sponsor a bill, S. 1739, which would tax blank audio tape used for recording copyrighted musical programs, at the rate of 1¢ per minute of playing time. Audio tape decks would be taxed too: 5% of the deck's price if it's a single-well deck, and 25% if it handles two cassettes at once. In theory, the tax collected would be given to a "royalty tribunal" that would distribute the money to the creative artists, musicians, etc. whose copyrighted works had been copied. In theory, tapes that aren't used for such nasty purposes as copying copyrighted works would be exempt from the tax, as would tape decks that weren't used for recording music programs. In theory, videotape and video recorders wouldn't be involved. After all, the Supreme Court said it was okay to record TV programs, including their audio soundtracks! So much for theory.

The serious impact of this propcsed legislation was brought home to me when I was called upon to testify before a Senate subcommittee on behalf of the Recording Rights Coalition—an association of blank-tape and tape-deck manufacturers, and other interested parties, who feel that anyone has the right to tape any program material providing such recording is not done for commercial gain. Even if you agree that some compensation is due copyright holders when their works are taped by private individuals, the proposed bill is greatly flawed. It would not be able to provide compensation without penalizing the majority of us who do *not* copy programs to avoid buying a prerecorded disc or tape.

Leonard Feldman, Jack Battaglia (of Memtek Products), and Charles D. Ferris (lobbyist for the Audio Recording Rights Coalition) testified in Congress against proposed Senate bill S.1739, legislation which would impose taxes on audio recording equipment and blank audio tape.

The Senate bill suggests that it will be possible to exempt tapes that are not "suitable" for high-quality audio recording. As we all know, even the lowest grade of tape can be used for audio recording. Furthermore, the very teenagers who are probably the chief offenders when it comes to copying albums for friends are the ones who will be buy ng the lowest-cost tapes—those that will supposedly be exempt. At the same time, customers who buy tape for perfectly legal requ rements, such as making copies of records that they bought, for use in portable or car cassette players, will likely buy better grades of tape—the types that will carry the penny-per-minute tax.

As for the bill's attempt not to involve videotape or video recorders this naive approach shows that the good senators are not keeping up with the state of the audio and video arts. As we all know, you can no longer differentiate between video and audio tape, or between video and audio recorders. To begin with, all videotape recorders are also audio recorders. Hi-Fi VCRs, whether Beta or VHS, have audio-only settings which turn them into audio recorders—in terms of the Senate bill's definitions. An even more ludicrous situation arises when you look at the 8-mm video recording format. This new format includes provision for stereo PCM audio-only recording capability, which, on some machines already available, offers as much as 24 hours of recording time. Clearly, the tribunal that will be set up to determine where the tax is to be applied will not be able to overlook such an "audio" recorder or its tape. Based on the penny-per-minute rate called for in the proposed bill, an 8-mm "video" tape that normally sells for something under $6 would be taxed an additional $14.40 because of its extended recording time in the audio-only mode!

The proposed bill is extremely shortsighted from a technological point of view. In all likelihood, future recording media will not be limited to analog audio tape. By as early as 1987 there will surely be DAT (digital audio tape) recorders on the market, and the quality of recordings made on them will be even less dependent upon tape grades than is the case with today's cassette format. A digital recording format depends upon the playback machine's ability to recognize pulses (corresponding to the binary digit "1") or the absence of pulses (binary digit "0"). Even the poorest grades of tape (those ostensibly exempted from the proposed tax) will be able to achieve superb digital audio reproduction, free from tape hiss or distortion. Since the royalty tribunal would have the right to

Even if you agree that copyright holders deserve compensation when their works are taped, the Senate's proposed bill is greatly flawed.

reexamine its exempted products from time to time, we can expect that ultimately all kinds of tape would be taxed. And since it's possible to buy some C-90 tapes for not much more than $1, the tax (90¢) would end up being nearly as great as the cost of the product itself.

Recordable Compact Discs (not out of the question, a few years from now) would also come under the scrutiny and jurisdiction of the proposed bill's enforcers. Perhaps, too, you have read about the possibility of recording music digitally on floppy disks. If a future floppy disk serves as a common medium for music storage and computer data storage, is it to be taxed or not? And if it is, can you imagine how angry computer users will be?

If you look back at the history of home entertainment technology, you'll find that every new innovation and invention ultimately benefits not only consumers, but the suppliers of the programming, too. Hollywood was afraid that television would ruin the motion-picture industry. It's done just the reverse. Opera broadcasts on TV haven't hurt attendance at live performances, and there are more active opera companies in the U.S. now than there were before the broadcasts began. By and large, it can be shown that the invention and use of the tape recorder has actually stimulated the music business. Of course there's some copying going on out there to avoid buying records and prerecorded tapes. But the people who tape the most are also the people who buy the most recorded programming.

Obviously, as someone who is interested in high-quality audio, you have a stake in the outcome of this debate. There may still be time to stop this unrealistic and unfair tax. The Senate needs to be informed about the realities of audio tape recording and about the unworkability of proposed legislation S. 1739. If you perceive the serious and costly consequences of such legislation, write to Senator Charles McC. Mathias, Chairman of the Subcommittee on Patents, Copyrights and Trademarks, United States Senate, Washington, D.C. 20510. Let him know how you feel about this proposed tax and suggest that the government stay out of the picture—and the sound.

THE
TIME/ENERGY
SERIES

EPICURE
PRODUCTS
INCORPORATED

Enter No. 22 on Reader Service Card

Computers have made something possible for hi-fi sound that wasn't possible before. Because of computers EPI engineers can analyze speaker performance to an extent that can't even be conceived of with conventional methods.

The new computer-tested EPI speakers will bring you sound with unheard-of detail. They will "separate" the instruments so that you can hear the parts, as well as the sum. They will give you a sound that is crystal clear, uncolored, and more natural than it has ever been.

For some of you it is enough to know *what* the Time/Energy Series will do for you. Others of you will also want to know *how*, and for you we have prepared the following discourse.

THE STEADY STATE SIGNAL AND THE SHORT SONIC EVENT.

From the beginning, improvements in speakers have come from testing, experimentation, and more testing. The bottom-line test has always been how well the speakers reproduce music. Sound comes to us through vibrations. We speak of these vibrations as signals, or sonic events. There are a variety of signals that we use to recognize sound, from short and explosive to long and steady. The limiting factor in conventional speaker testing techniques is that they evaluate only the performance of a speaker while it is reproducing a continuous, steady state test signal. This means that until very recently a great deal of the information that the ear uses to recognize sound, specifically the short sonic events, could not be evaluated. Enter the computer.

THE MISSING LINK.

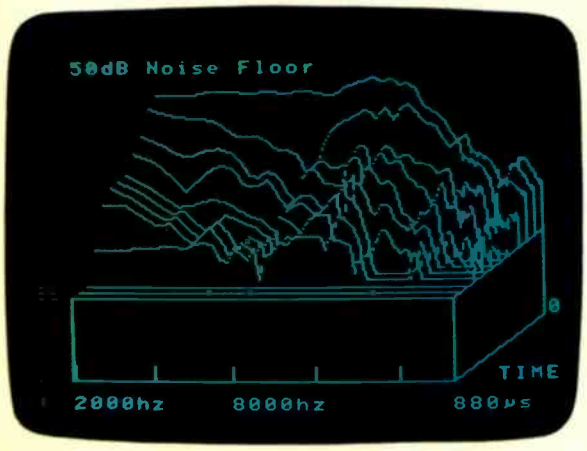
Much of the research done with the computer in the engineering lab centered on the way a speaker component (driver) reproduces short sonic events. To do this the driver being tested is driven with a very short, electronically generated signal pulse. The sound produced by the driver in response to the signal pulse is picked up by a laboratory microphone, and sent on to an analog/digital converter. The converter converts the continuously varying voltage signal from the microphone into discreet digital bits of information, which are then stored in the computer's memory circuits. The key here is the computer's incredible speed. The speed with which it can accept and store the data allows it to provide enormously detailed information on how the driver responds to the very short test pulse. The next step is to take this new information and use it to evaluate existing drivers.

NEW SOURCE OF DISTORTION.

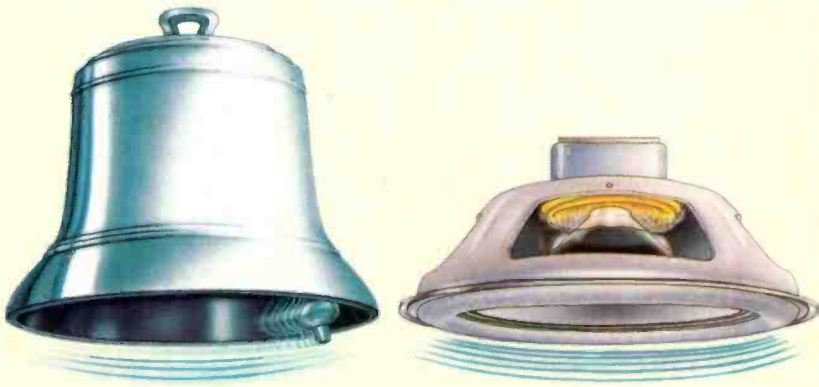
When we used a short pulse to test drivers with high quality but conventional cone and diaphragm materials we found they would continue to produce sound long after the signal had stopped. The driver would add sound energy to the original signal: one of the basic definitions of distortion. Because the phenomenon has to do with the sound energy the driver produces and the time frame in which it is produced we refer to it as Time/Energy (T/E) response. We had found a new source of distortion and coloration. The next question was, why were the drivers responding this way?

JUST LIKE RINGING A BELL.

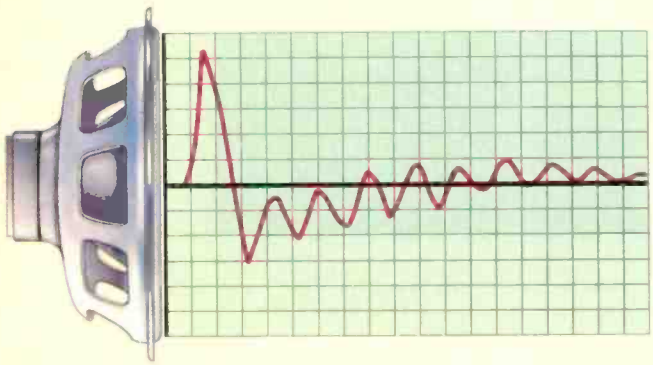
Ideally the cone or diaphragm of a driver should act only to transfer the motional



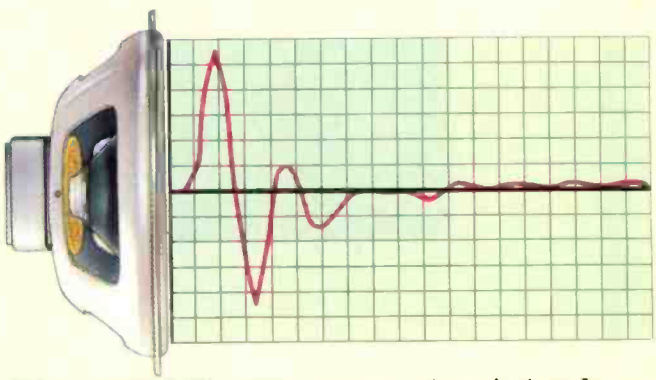
Computers provide information that conventional tests cannot. The display above shows how the various frequencies the driver produces fade away after the signal is cut off.



A conventional driver's cone rings like a bell. The voice coil motion makes the cone flex and store energy which is later released causing Time/Energy distortion.



The illustration shows a conventional cone "ringing" long after the electrical impulse from the amplifier has ended. It's known as Time/Energy distortion.



The new EPI Time/Energy cone doesn't ring. It gives you pure, uncolored sound.

nergy generated by the voice coil to the ir. If it does this and this alone it produces ure sound. But if it should (and until now it lways has) flex upon receiving the motional nergy it will produce distortion along with ound. An excellent analogy is the behavior f a ringing bell.

When a bell is struck, the energy from the mpact is imparted to the body of the bell. This causes the sides of the bell to flex and tore the energy. The energy is then released s the sides of the bell flex back and forth, generating sound. The cone or diaphragm of a driver can act in somewhat the same way. The motional energy generated by the voice coil causes the cone or diaphragm to flex so hat some of the energy is stored in the cone/ diaphragm structure, and then released. The cone, in other words, continues to "ring" after the driver should have stopped producing sound. This ringing is what we call Time/Energy distortion. It's proper in a bell, but in a speaker it produces distortion.

THE SEARCH FOR THE IDEAL MATERIAL.

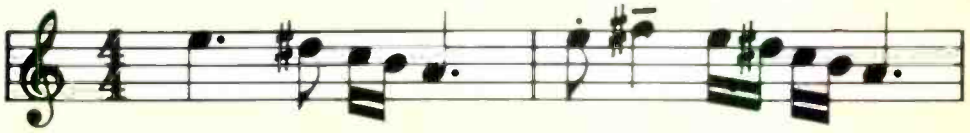
The ideal cone/diaphragm material would be infinitely stiff so that it wouldn't flex and infinitely damped so that any potential ringing would be smothered. As you might imagine, there is no such material. So the EPI engineers began to experiment with combinations of materials that might together achieve the results one material alone couldn't. Rather quickly it became apparent that the ideal materials for a tweeter wouldn't be the same for a woofer. Whereas a relatively thin material with an applied layer of damping compound worked best for tweeters, woofers required a thicker material with a layer of solid damping material bonded to it for optimum results.

In the case of the tweeter, once the best combination of materials had been found it was discovered they wouldn't work with the existing tweeter shape. Although it had excellent Time/Energy characteristics it yielded poor extreme high frequency response. After much experimentation a shape was found that gave excellent high frequency response and retained all of the performance benefits of both our original inverted dome tweeter and the new composite diaphragm material.

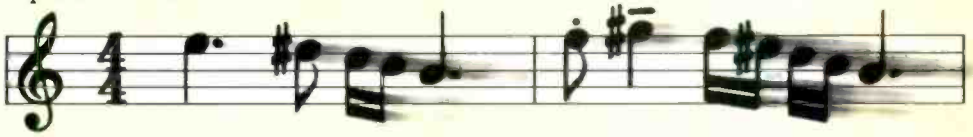
In the case of the woofer, it was found that a light layer of stiff plastic bonded to a layer of highly damped foam material was an ideal combination. To assure that the bond between the two layers would be uniform and permanent the EPI engineers developed a special bonding process and special tools and fixtures to perform the process.

CLOSER THAN EVER TO PURE SOUND.

All the drivers in the T/E Series speakers have Time/Energy response that is vastly superior to the older designs that were made with conventional cone and diaphragm materials. These new drivers stop producing sound almost immediately after the electrical signal from the amplifier ends. As a result they have more natural, less colored sound when reproducing solo instruments, and when reproducing a group they provide greater detail, definition, and sense of separation between the instruments. It is no exaggeration to say that this marks the most dramatic improvement in the fundamental fidelity of our speakers in the entire history of EPI. We haven't been able to produce sound this pure until now. And we don't think you have ever heard sound this pure until now.



The new Time/Energy speakers give you crystal clear music and unheard-of separation between instruments.



The Time/Energy distortion of conventional speakers results in a blurring of the music.

The cone layers are bonded together with a lamination process developed by EPI. The composite cone material has an ideal combination of stiffness and damping.

T/E 70 and T/E 100

The two loudspeakers that have brought more musical enjoyment to more people than any others have been elevated to a new level of performance with the Time/Energy driver technology. The sonic benefits of that technology ensure that the T/E 70 and T/E 100 will, like their predecessors, be given the highest performance ratings by stereo equipment reviewers.

From the new T/E tweeter to the bilayer laminated woofer cone the T/E 70 incorporates the same Time/Energy research technology that was applied to the largest models in the line. So the T/E 70 will produce a stereo image so large and so transparent that it is hard to believe it is being produced by such a compact speaker.

For more than a decade the EPI 100 has been used as the standard for comparison by knowledgeable stereo enthusiasts. The addition of the Time/Energy driver technology makes the T/E 100 the new standard. The increased dispersion of the T/E tweeter and the decreased distortion of all the drivers that resulted from the Time/Energy research ensures that the T/E 100 will continue to be regarded as the best speaker in its class.

EPI

T/E 100 PLUS and T/E 120

Any music fan will appreciate the clean, open sound of the two smallest models of the Time/Energy speakers series. But for anyone who might want a speaker that is also a bit stronger in the extreme low frequency range EPI offers the T/E 100 Plus and T/E 120.

At first glance the most striking thing about the T/E 100 Plus is its modern oak-grain vinyl veneered cabinet. What is not obvious is the larger interior volume of the cabinet that allows the bilayer woofer cone to move freely and so produce better bass response. Not just more bass, but deeper fundamental bass response. The sparkling high frequency reproduction and midrange detail of the Time/Energy drivers is well complemented by the extended bass response of the T/E 100 Plus.

The T/E 120 is a two-way speaker with a 10" Time/Energy technology bilayer cone bass driver. With its large cone area the woofer can effortlessly generate deep, powerful bass energy. The T/E 120 woofer was carefully engineered to match the efficiency of the T/E tweeter so the overall frequency response is smooth and balanced.

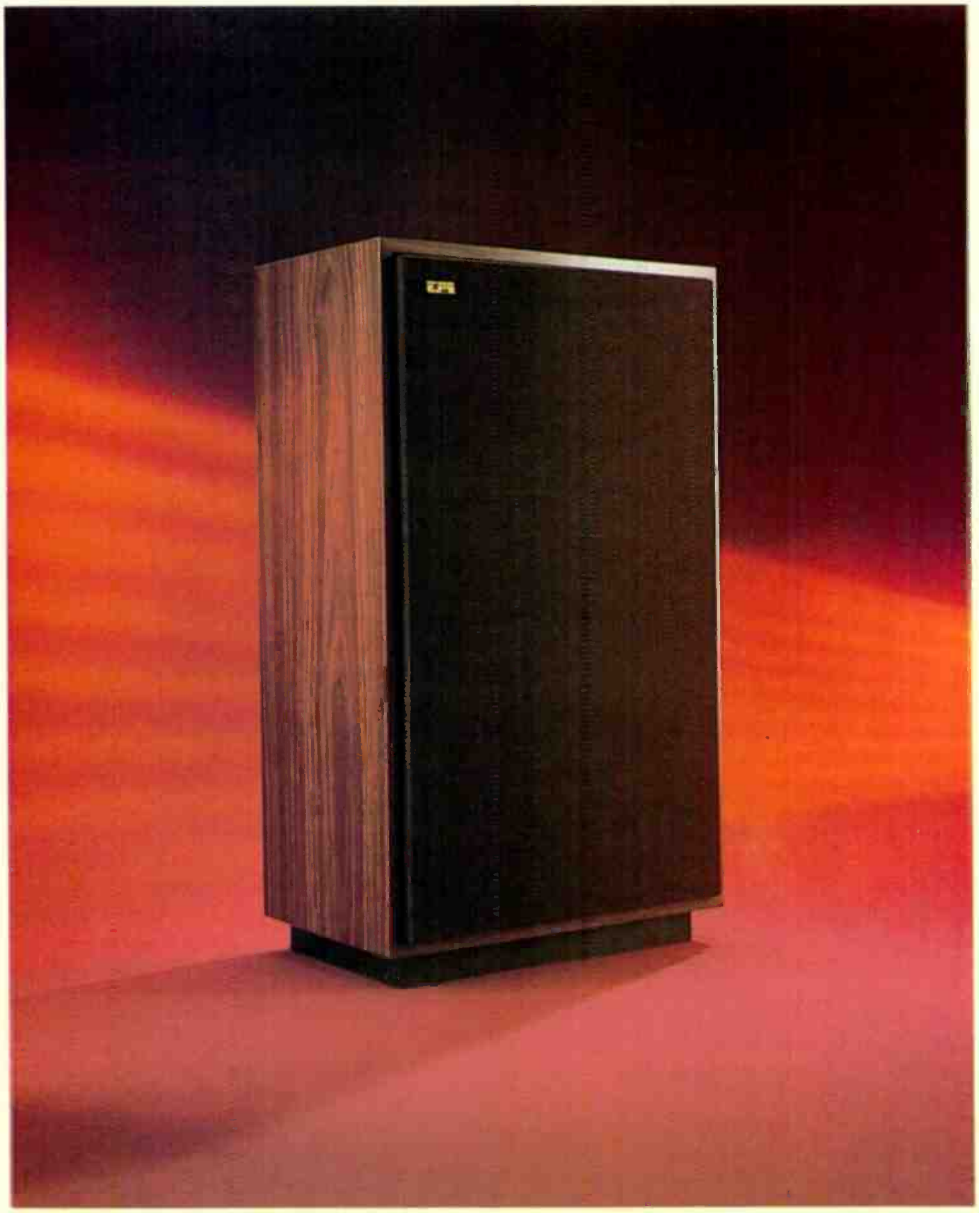
T/E 320

The compact, floor-standing T/E 320 produces the kind of sound that is typically associated with much larger, more expensive speaker systems.

The high tweeter crossover point of the three-way T/E 320 reduces the frequency range the tweeter must reproduce. So distortion is lower and power capacity is higher.

Of course the Time/Energy bilayer cone technology was applied to the acoustically isolated midrange driver. Critical midrange information is reproduced with exquisite detail.

Adding bilayer cones to EPI's most advanced woofer (which has a patented "Focused Field" magnet structure) ensures that it will continue to be noted for its low distortion and wide dynamic range.

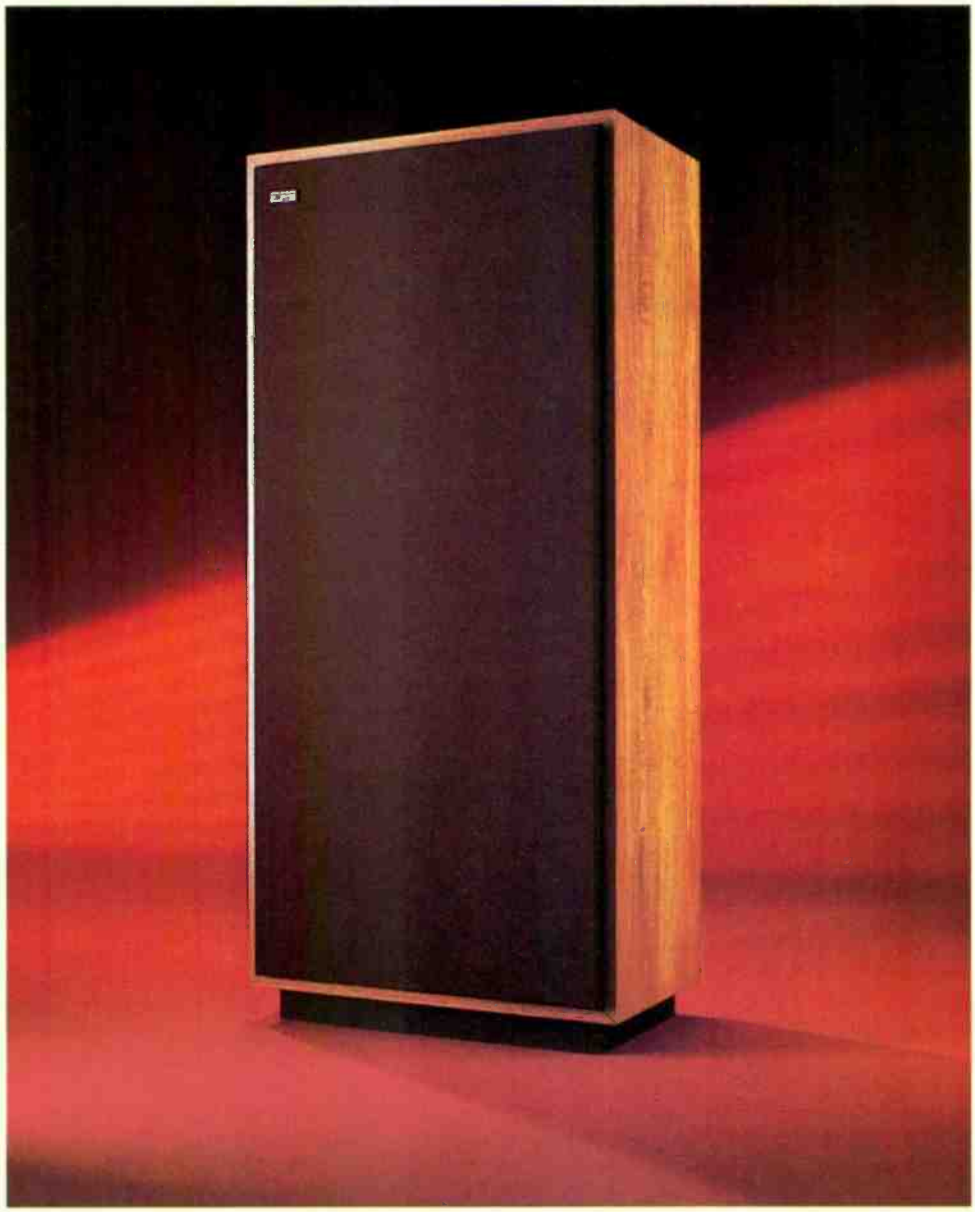


T/E 360

With the superb sound reproduction capabilities of a Time/Energy technology three-driver system and a cabinet large enough to extend bass response to the deepest musical fundamentals the T/E 360 is the practical extreme of sound reproduction performance.

The drivers of the T/E 360 produce sound that is so clean and so dynamic that it is, at once, startling and thrilling. A unique "Passive Piston" bass radiator reinforces the patented "Focused Field" woofer to add a physical quality to the bass reproduction of the T/E 360.

The light oak-grain vinyl veneered cabinet encloses all this high technology hardware in a way that makes the T/E 360 a visual as well as an aural triumph.



SPECIFICATIONS

	T/E 70	T/E 100	T/E 100 PLUS	T/E 120	T/E 320	T/E 360
FREQUENCY RESPONSE	55 Hz-20 KHz ± 3 dB	40 Hz-20 KHz ± 3 dB	38 Hz-20 KHz ± 3 dB	38 Hz-20 KHz ± 3 dB	42 Hz-20 KHz ± 3 dB	32 Hz-20 KHz ± 3 dB
PRACTICAL POWER RANGE	15-80 Watts	15-90 Watts	15-90 Watts	15-90 Watts	20-250 Watts	20-250 Watts
COMPONENT DRIVERS	1-1" Tweeter 1-6" Woofer	1-1" Tweeter 1-8" Woofer	1-1" Tweeter 1-8" Woofer	1-1" Tweeter 1-10" Woofer	1-1" Tweeter 1-4" Midrange 1-10" Woofer	1-1" Tweeter 1-4" Midrange 1-10" Woofer
CROSSOVER FREQUENCIES	1800 Hz	1800 Hz	1800 Hz	1600 Hz	700 Hz and 3000 Hz	700 Hz and 3000 Hz
NOMINAL IMPEDANCE	8 Ohms	8 Ohms	8 Ohms	8 Ohms	4 Ohms	4 Ohms
CABINET FINISH	Walnut-grain vinyl	Walnut-grain vinyl	Oak-grain vinyl	Walnut-grain vinyl	Walnut-grain vinyl	Oak-grain vinyl
GRILLE	Brown cloth	Brown cloth	Brown cloth	Brown cloth	Brown cloth	Brown cloth
SIZE (H x W x D)	16"x 10½"x 7½"	20"x 12"x 8¾"	21¾"x 13½"x 8¾"	25¼"x 15"x 10½"	29"x 17"x 10½"	37½"x 17"x 10½"
WEIGHT	18 lbs. (shipped in pairs)	23 lbs.	27 lbs.	34 lbs.	52 lbs.	60 lbs.

Epicure Products Incorporated

Epicure Products, Incorporated, Newburyport, Mass. 01950
A Penril Company
Printed in U.S.A. 3.3

IVAN BERGER

STEAL THIS IDEA

Scrambled Stereos

One theft-prevention idea that keeps resurfacing is to make car stereos that won't work if stolen. Nakamichi used such a lock-out circuit in their TD-1200 car stereo a few years back, and Mercedes-Benz, BMW and Saab have announced stereos with this feature for their 1986 models. Disconnect such a radio from its power supply, and its brains scramble; it won't work again until its individual access code is punched in on its station buttons.

The trouble with this system is that it does not go far enough. Someone steals your expensive stereo—damaging your car to do so—and sells the gear he stole; getting it to work again is the ultimate buyer's problem, not the thief's. Professional fences would soon learn not to accept such radios, but the thief could still peddle the stereo to unwary denizens of street corners or bars—which, I suspect, is where most stolen stereos are resold, anyway. So you still suffer, and the thief still profits.

Cutting the thief's profit out is easy. Just emblazon every radio that has a lock-out circuit with decals that scream "This Radio Inoperative Without Security Code!" You're still out one stereo, a dashboard and a pane of glass, but at least you have the satisfaction of knowing that the thief got nothing for his trouble.

But thefts will only be *prevented* when the thieves know in advance that your radio's not worth stealing. Saab and BMW therefore provide decals to advertise the fact, and Saab also offers a big sign with a suction cup to stick inside the window. But signs alone aren't good enough—the first night Saab's test car was parked in Manhattan, sign and all, its radio and equalizer were stolen.

If the system became universal, offered by every car maker and every maker of aftermarket stereo equipment, thieves would quickly learn that it's no good to steal new cars' stereos. (Then they'd concentrate on those in older cars, alas). If enough companies got behind the system, they could even sponsor public-service TV ads, showing thieves wasting their efforts to get stereos they couldn't sell.

Some equipment would still be stolen during the transitional period, while thieves were getting the word. So there should also be a scheme to at least get the stolen goods back to the original owners, who'd have the access codes to make them usable again. If the stereo carried a sticker that explained the lock-out, and the thief weren't in too much of a rush to make a getaway, he might well ditch it in a nearby trash can; search for a few blocks, and you might find it.

But you can't count on such luck. As a backup, I'd suggest an insurance policy of sorts. When you bought a stereo system with a lock-out, you could get a sticker with your dealer's name and address, promising a small reward if the equipment was returned there. When you bought the "policy," you'd sign a charge slip committing you to reimburse the dealer for the reward. If the stereo came back, the dealer would call you and process the charge. I'm not sure how much the reward should be—just large enough to encourage someone who found the radio to return it, but not large enough for anyone to steal it just for the reward. Perhaps the dealer should also photograph the person claiming the reward, and get some identification, so that those who showed up with suspiciously many "finds" could be tracked down by the police.

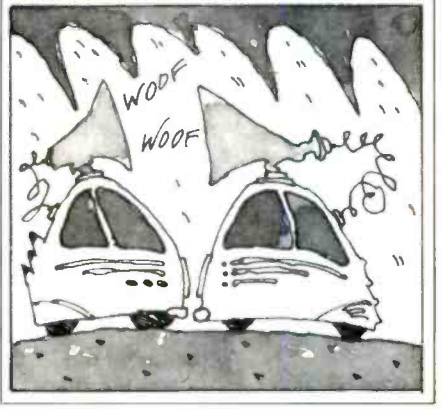
What's a Woofer?

The speaker section of our annual Car Stereo Directory issue each May has a column for manufacturers to indicate what purpose their individual drivers serve. That is, are they subwoofers, woofers, midranges or tweeters? Fine, but what's the difference between a woofer and subwoofer?

Both handle bass, and you can find examples of either type listing any low-frequency limit you choose as your dividing line, so that won't do. And while subwoofers are normally only used below 250 Hz, their drivers are usually capable of going higher, so the high-frequency limit isn't always a giveaway, either.

Size is an indication: Any speaker larger than 6 × 9 inches is almost certainly a subwoofer—at least, in the car. But then there are companies like Dynamic Acoustics listing 8-inch "woofers" and Gold Sound listing 15-inch ones.

It's all in the eye of the manufacturer. The only companies which give you concrete clues to their thinking on the subject are those who list both woofers and subwoofers in their lines, no two drawing the same distinction between them. For Polk, the difference seems to be a crossover built into the subwoofer; for Polydax, it's size, with 6½-inch or smaller speakers woofing and 8-inchers subwoofing, and for Pyle the difference is dual voice-coils on subwoofers, so one driver can serve both channels without further electronics. The differences between the differences seem as great as those between the categories they define.



Illustrations: Thomas H. Waters

The CD's small diameter made dashboard players possible. Making them practical meant solving problems of vibration and heat.

One for the Road

One reason the Compact Disc was made 4.7 inches in diameter was to allow its use in dashboard car-stereo slots. But that still left a lot of problems for player designers to solve. An article in *JEI* (*Japan Electronic Industry*) details some of the problems which Pioneer faced and solved.

High- and low-frequency vibrations required different solutions. High-frequency vibrations were handled by suspending the transport on rubber cushions, while the servos that control the laser's tracking were beefed up to handle low-frequency ones. Neither approach could work alone: Extending the servo's frequency range to cover high-frequency vibrations, says Pioneer, would make it too easily influenced by disc defects or dirt, causing track skips even when the car was sitting still. Extending the suspension's range to cover low frequencies would require more space than was available.

For those occasional shocks which neither the servo nor suspension can handle, Pioneer provided a "last-address memory." Apparently, this circuit memorizes the last valid address and compares it to the next address read by the laser; if the two

addresses differ to a greater-than-normal degree, it stops play and returns the laser to the last memorized address point.

According to Pioneer, "Extensive testing showed that most vibrations which exceed the . . . resistance . . . of the CDX-P1 are only transitional. Vibrations of this magnitude, perhaps a car accident, would affect listeners also. In many cases, the listener may not even notice the momentary disappearance of sound." How true—in an accident, the destruction of the car would be far more distracting.

Temperature extremes can create problems for any mechanical or electronic system in a car, but CD players have one special problem: Laser life is reduced by high-temperature operation. At 60° C, for instance, breakdowns are 10 times as common as they are at 25° C. Pioneer's players therefore have a thermal shutdown circuit which keeps them from operating at temperatures above 60° to 65° C (about 140° to 149° F, at which point you'll probably be more concerned with cooling off than listening to music, anyway).

Heat is apparently one reason why many automotive CD players have outboard circuit boxes. Packaging some of the circuits separately not only distributes bulk, but keeps the components that produce the most heat away from the package which contains the laser. In the Sony and Alpine players, for example, the power supply's d.c.-to-d.c. converter is a separate package.

I don't expect outboard circuits to be with us long, however. VLSI chips, with more functions than ordinary ICs, will cut down on both bulk and heat. If only because of portable players, there will probably be more use of C-MOS or other IC construction techniques which save battery power by wasting less of it as heat. And low-voltage circuits may be developed which won't require d.c.-to-d.c. converters.

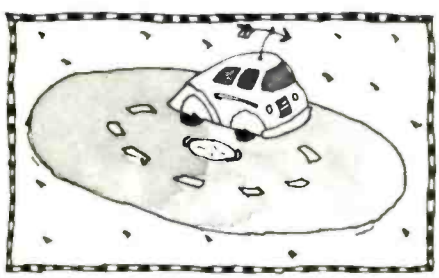
Chicago, Not *Chicago*

The time may come when, while driving, you will ask your passenger to load up the Chicago CD and not expect rock music. Instead, a display screen on your dash will light up with a map of the Chicago area. Punch in your destination and your current location (if the system isn't sophisticated enough to sense where you are from satellite signals), and both points will light up on the map.

A navigation system like this, but with the maps stored on cassettes instead of CDs, has now been announced by a company named Etak, of Sunnyvale, Cal. It will cost about $1,400 with a 4½-inch screen, $1,600 with a 7-inch screen.

It's no surprise that the first such system uses tape instead of CD; Compact Discs cost a lot to master, which means high prices when the customer base is too small to buy many copies of a given region's map disc. But if such systems were to become widely available (especially if they were offered as factory options by major car manufacturers), CD would probably turn out to be the medium of choice.

Why CD? A standard Compact Disc player's mechanism could offer fast access to different map segments, which audio tape transports can't. (I note that Etak makes its own tape transport, probably based on computer data-transport technology.) And by the time such navigation systems arrive, CD transports should be starting to replace cassette drives as the standard car-stereo mechanism. (The in-dash package would, however, need extra electronics to handle both audio and maps.)



A CD can also hold a lot more than a cassette—enough, says Philips, to cover every town and city in New England, with hotel and restaurant information (down to room rates and menus), plus a national map of the Interstate highway system. Philips, Blaupunkt, and Delco have all been experimenting with such CD systems, and Etak plans to offer them, too, once map discs become available. This will only work, however, if all the companies to offer CD navigation systems choose the same data format for their discs.

If you can't afford it, spare yourself the heartache of listening to it.

We are all aware that money aside, it is an easy matter to upscale our quality of life, but difficult to lower it. In this regard, ignorance is bliss and strict abstinence is sometimes better than a taste of something finer that we can't have. So it is with Concord high-fidelity, high performance car audio. One listen, one taste, will significantly alter your demands for mobile high-fidelity.

Uncompromising performance; the Concord story begins and ends with it. Concord's performance engineering over the years has resulted in a list of mesmerizing characteristics that, as you become aware of them, will change your perception of car stereo.

For instance: A sound critics claim is the best they've *ever* heard in a car stereo—home high-fidelity sound. ☐ Superb stereo imaging, wide band frequency response, and very low distortion levels are just some of the qualities of Concord's exclusive Matched Phase Amorphous Core Tape Head. ☐ Electronic DC Servo tape drive for extended life and accurate control of tape speed. ☐ A cleaner sounding FM than you ever believed possible, thanks to the exclusive Concord FNR FM noise reduction system. ☐ High powered inboard amplifiers–rated at 50 watts–and the ability to simply plug in external amplifiers for additional power.

A few of the features found in the HPL 540 shown here are: Dolby B and C noise reduction systems, tuner/tape switch, tape search, and the smooth convenience of full logic tape controls. The ergonomic design insures easy operation of all functions.

One listen to all of this and you will be exhilarated, and if you've read this far you are no longer blissfully unaware. Your taste has been improved. If you can afford it, you already *deserve*, and probably *demand* the best in design, engineering and of course –uncompromising performance.

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The concert continues with the

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Imagine a car audio system that could deliver music as rich and full as the live concert you just attended. Music that surrounds you with solid basses, crystal clear highs and subtle overtones. A high fidelity audio system that delivers concert hall realism to you and all your passengers.

Ford and JBL have taken this music lover's dream and turned it into a reality. They have combined their efforts and resources to develop a remarkable high fidelity audio system exclusively for Lincoln Continental — and you.

JBL, the recognized leader in professional loudspeaker design, has been delivering breathtaking sound in concert halls, theaters and movie houses for over forty years. In fact, today, over 70% of the world's top recording studios use JBL loudspeakers.

Ford expertise in electronics and audio engineering speaks for itself with over 50 years of audio design. In addition, Ford maintains one of the most technically advanced audio

new Ford JBL Audio System.

The 1986 Lincoln Continental is shown at the Los Angeles Music Center, both equipped with JBL loudspeakers.

development and test facilities in the world.

Together, they have provided for Lincoln Continental, the Ford JBL audio system which features:

- 12 speakers strategically located throughout the car that have been adjusted and equalized to the surrounding acoustics.
- 140 watts of total system power* that has been designed with extremely low distortion for comfortable listening even at high volume for long periods of time.

*Supplied by 4 amplifiers, each 35 watts per channel into 4 ohms at 1 KHz with less than .07% total harmonic distortion.

- Advanced audio features including full electronic tuning, Automatic Music Search, Dolby® B and DNR® noise reduction systems and automatic tape equalization.

Dolby is a registered trademark of Dolby Laboratories Licensing Corporation.

DNR is a registered trademark of National Semiconductor Corporation.

- Plus a low frequency control computer for continuous loudness compensation and reduced distortion.

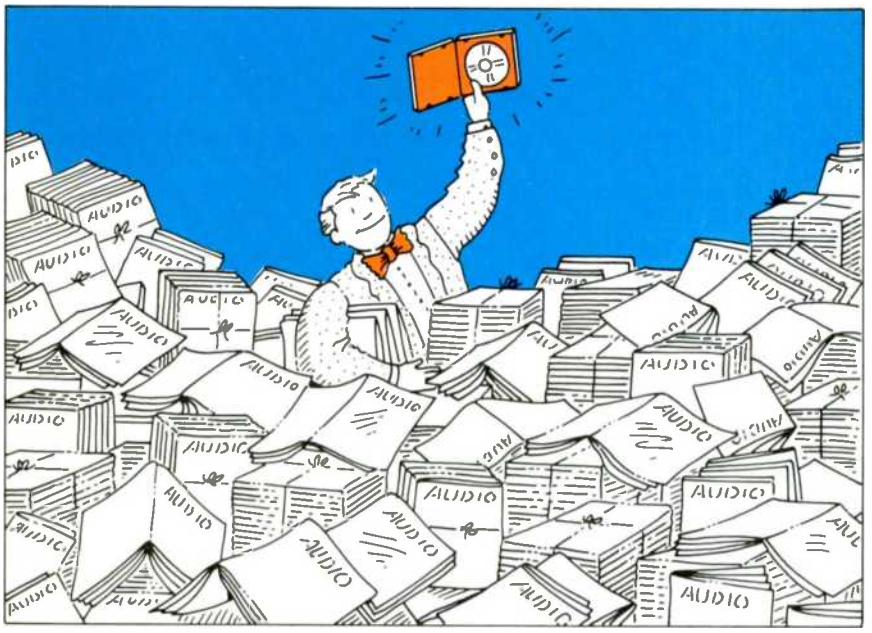
All in all, an amazing audio system. But it's still almost impossible to imagine how good it really sounds until you hear it for yourself.

Ford JBL

AUDIO SYSTEMS

IVAN BERGER

CD BY THE BOOK



Illustrations: Teresa Anderko

ROM Ruminations

Before pocket calculators, I never sat down to idly figure out large numbers; now, I do. So I whipped my calculator out the other day and figured out how many bytes of audio data are encoded on a CD: 772,632,000. That's figured at 2 bytes (16 bits) per sample × 44,100 samples per second × 60 seconds per minute × 73 minutes of music per CD × 2 channels. The figure for a CD-ROM, the computer data-storage version, is only about 550,000,000, however.

Why the difference? Because on the computer version, more data space must be given over to error-correcting codes. Audio CD players correct what they can, but are still forced to conceal a few uncorrectable errors by intelligent fudging. Such error concealment is possible only because audio is somewhat predictable: If one data sample shows a signal with a value of +12, and the value reaches +16 two samples later, then you won't be very far off the mark if you assume the sample in between is +14.

With computer data, there's no such predictability; the byte between those samples could as easily be 0 or −127. Accuracy counts more with computer data or programs too: An error that would create a barely noticeable twinge of distortion on a musical recording could throw computer programs haywire, changing your fat bank balance into a deficit or changing an instruction from "run program" to "ruin programmer." No wonder that CD-ROM's error-correction system, according to Denon, "supplements the normal audio-CD correction system and improves it by a factor of 100." It had better do that.

And I would only be surprised, not astonished, if audiophile record companies someday adopted this format for audio too. The disc's capacity would shrink from about 73 to 52 minutes of music (only a bit more than an LP's), and new players would be required, but error-correction accuracy would go up, theoretically lowering noise and distortion.

Meanwhile, of what use is CD-ROM? The format is designed for computer use, but I don't expect to see too many programs distributed that way soon, at least for personal computers. The capacity is too high To fill a CD-ROM would require a lot of programs, and no two users could be expected to want the same assortment. Program versions change too fast, too—with floppies, you can send back the original disk and have the revisions recorded on it.

What we will see on CD-ROM are data bases, like the Grolier encyclopedia, whose 20-odd volumes *are* now available on a CD-ROM. The text fills only 58 megabytes of the disc—plus 60 megabytes for an index that shows where every significant word in the text can be found. At that, less than a quarter of the disc is used, leaving room for about 3,500 illustrations in a future edition. The CD-ROM's advantages here include lower "printing" cost, more compact storage, and such possibilities as illustrations with limited-animation sequences.

To put that in an audio perspective, this magazine's entire output to date, in 38 years of publication, comes to about 70,000 pages. If that were all text, it would amount to 70 million words or about 420 million bytes of data—less than one CD-ROM. In that format, getting your computer to search for some half-remembered article of 10 years back would be simple, though it might take the computer some time to find exactly what you wanted. Exhaustive indexing like Grolier's would double the storage requirements, turning *Audio*'s back-issue file into a two-disc album, but would make searching simpler and faster. Including the illustrations would multiply storage needs considerably, probably bulging the file out to a disc per decade. (For magazines, it might be most practical to remove multiple appearances of repeated ads, to save space. But let's not omit them altogether—they're part of the fun and a good part of the information.)

Other reference works might be of use to us as well. How about a single, master *Schwann* catalog, showing every disc they've ever listed, when it first appeared and when it was discontinued? That would tip you off to the original date of recordings reappearing on CD (if you care), help you chart artists' careers, or tell you the catalog number of that old record that you just decided to try and find.

Big companies could put their service manuals on CD, for distribution both to service shops and to those who want to do their own repairs. Transistor and IC cross-reference manuals could cover every

semiconductor type back to the Bell Labs prototype. Complete audio reference libraries on disc could go back to Lord Rayleigh. Reference books for phonograph collectors could become truly exhaustive . . . . The possibilities are endless.

So far, of course, you can't use your audio CD player for CD-ROMs. The odds are that you can't even use your home computer to access them—the special drives and interfaces are just beginning to appear. But tomorrow's CD players will, I strongly suspect, have multiple outputs: Standard audio (perhaps including quadraphonic surround sound), subcode data (such as graphics, lyrics or titles) and CD-ROM data.

But having a multi-use machine at home could create new problems. I can just hear it now: "Sorry to interrupt your opera, Mom, but I have to look something up on the encyclopedia disc . . . ."

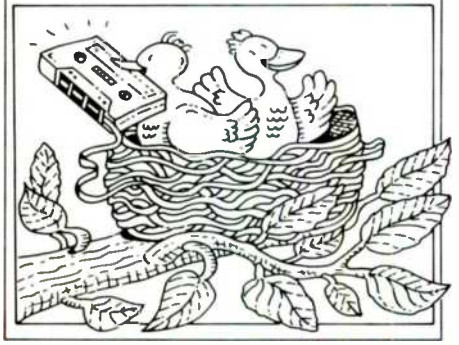
The Audiophile, Defined

What is an audiophile? According to Keith Peterson, of Phoenix Gold cables, he's someone who "continues to upgrade his hardware in order to prove that all software is bad."

Signs of the Times

The New York Times' "Metropolitan Diary" column, a while back, chronicled an up-to-date avian note: A bird's nest in Central Park constructed mainly of cassette tape.

I encountered another sign of electronics' impact in northern California: A TV satellite dish rimmed with Christmas lights.



Confessions of a Gain-Rider

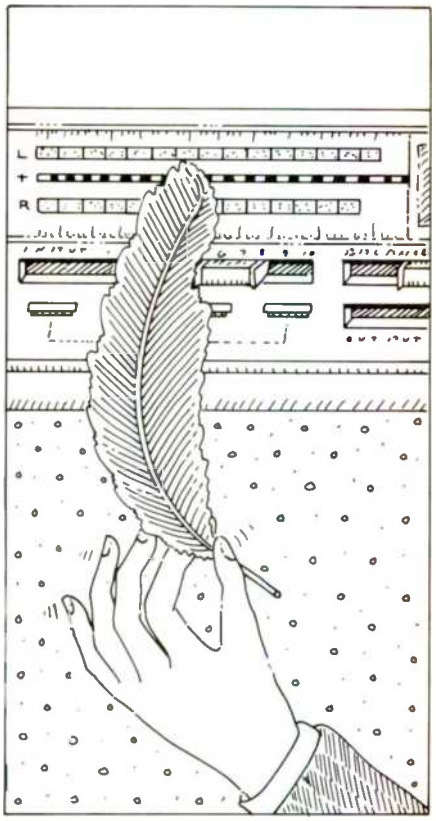
Even before digital recording gave us about as much dynamic range as we can use, the practice of "gain-riding"—varying recording levels as you tape—had gotten a bad name for itself. A recent "Tape Guide" item criticized the practice; some editors here consider it anathema. As for me, I used to do it all the time, and still do, on rare occasions. The reason I now do it rarely is not because it's wrong or I've outgrown it, but because today's equipment makes it far less necessary.

Gain-riding is criticized because it alters—compresses—the signal's dynamic range. It's senseless to do this when there isn't any need. But there are times you have to, times when the signal simply won't fit on the tape without a bit of active intervention.

When I first started recording, my deck's dynamic range was too limited even for dubbing the LP records of the time, let alone for taping live performance, without making some gain adjustment. Now, what with Dolby C and dbx NR, I can get enough dynamic range on tape for hands-free dubbing of LPs and even most CDs (a sign that CDs don't use all the dynamic range available, either), and I no longer make many live recordings. So I ride gain the way you'd ride a park bench—find a good place to sit, and stay there.

However, live recording still sometimes exceeds the range of my equipment. (For example, some performers I've taped habitually move up toward the mike when playing loud, and move back when playing quietly.) To compensate, you have to compress the music just a bit to make it fit the medium. At that point, the only choice left to you is whether to be an intelligent compressor or a stupid one.

The intelligent way to ride gain is to anticipate problems and work with the music. For example, start reducing level, very slowly, at the start of a big crescendo, and keep reducing level more slowly than the music is increasing it. This way, the music's dynamics keep on building (though not as much as if you'd left them alone), partially concealing your work. As the music drops down toward a pianissimo or lower level, which might get lost in the noise, start increasing gain again, s-l-o-w-l-y. If you know the music well enough (following a score helps, if you can read scores and there is one), you can often make your adjustments so subtly that a bystander can barely tell your hands are moving.



What's given gain-riding a bad name, I feel, is doing just the opposite. If you yank the gain down just when the needle pins or the red LEDs light up, and then haul it back up when the meter's shown no life at all for several seconds, you're actually doing more harm to the music than the recorder's own noise and distortion would.

The trick is to react to what's coming up, not to the damage that's already done. You want your signal compressed j-u-s-t enough to avoid distortion at one end of the scale and burial by noise at the other. But you don't want it to sound compressed; you want to leave no fingerprints on the performance.

"CARVER CD PLAYER: SUPERB SOUND PLUS THE DIGITAL TIME LENS"

AUDIO MAGAZINE

"Leave it to Bob Carver to come up with a CD player designed to please both those who love CDs and those who still have reservations about their sound quality."
—Leonard Feldman
AUDIO MAGAZINE

The Carver Compact Disc Player answers the audiophile's demand for a CD Player which provides not only the greater dynamic range and richer bass expected from compact disc technology, but also the musicality, spectral balance and spatial qualities of well executed analog high fidelity recordings.

LOGICAL

How logical it is for a physicist dedicated to delivering music with maximum dynamic impact to offer a state-of-the-art CD player. Anyone who ever wondered why Carver makes amplifiers capable of delivering hundreds of watts of power need wonder no longer after they have heard the Carver Compact Disc Player as a sound source.

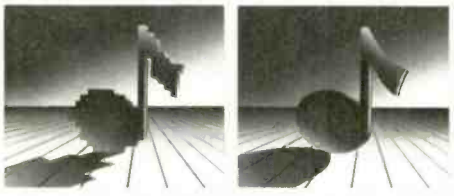
There are dozens of models of compact disc players now available, many of them demonstrating little regard for the finer points of digital playback technology. Bob Carver was in no hurry. He wanted to do digital right. And he did.

The state of the art has advanced considerably since the first players appeared several years ago. The Carver Compact Disc Player makes use of the latest **triple laser beam** pickups, **sophisticated oversampling**, **digital filtering** technology and, very importantly, Carver's unique distortion reducing **dither signal** that effectively removes the low level quantization distortion existing in all other CD players.

Except for features like display and programming, the real determining factor in CD player quality is its ability to reconstruct music from digital information bits. And that is not an easy job nor one that can be effectively achieved while skimping on circuitry.

IMPROVED TRACKING

The Carver Compact Disc Player reads discs with more precisely focused laser power than most other models, resulting in improved tracking and less chance of drop-outs when dust or smudges are encountered on a CD.



The Digital Time Lens circuitry restores the octave-to-octave balance originally intended by the musician and recording engineer.

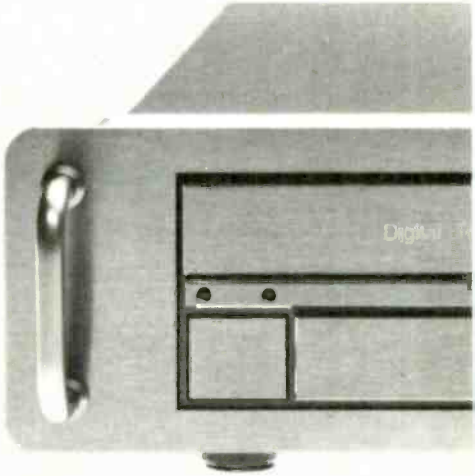
DIGITAL FILTERING

Along with a potentially audible signal ranging up to 20kHz, there are endless images of the signal at 40kHz, 80kHz and 160kHz. While they are above the range of human hearing, they must be removed from the signal to prevent harmonic problems which could turn into audible distortion. Earlier CD models placed an anti-imaging filter after the digital/analog converter stage. Carver uses DIGITAL filtering ahead of the D/A converter through a process called multiple oversampling. The signal is passed through a shift register which delays the samples, so that the weighted average of a large number of signals is generated. Through a complicated process, frequency bands are suppressed between 20kHz and 160kHz, eliminating harmonic distortion problems early on before the complicated D/A 16 bit translation.

The same oversampling process also distributes the same amount of noise over twice as wide a frequency range, resulting in half as much noise in the final signal. Then after translation to analog, the signal is once again filtered for a gentle roll-off above 20kHz. This yields a marvelously natural musical sound to the final output.

ABSENCE OF PHASE ERROR

One of the important tests applied to determine the effectiveness of digital-to-analog translation circuitry is the reproduction of a square wave.

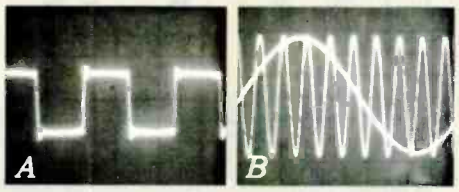


CARVER

POWERFUL

Corporation, PO Box 1237, Lynnwood, WA 9804

"Reproduction of a 1kHz digitally generated signal was as close to a true square wave as I have ever seen from a CD player that used digital filtering. (The Carver Digital Disc Player) shows a virtual absence of phase error."
AUDIO MAGAZINE



A. Square-wave reproduction, 1kHz.

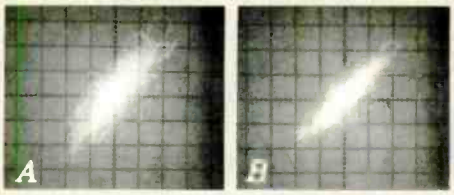
B. Two-tone phase test signal (200Hz and 2kHz) with Digital Time Lens off.

PLUS THE DIGITAL TIME LENS

On top of this unerring ability to produce natural, real-sounding music from the CD's digital bits, the Carver Compact Disc Player has the remarkable Digital Time Lens circuit to insure your listening enjoyment.

The Carver Compact Disc Player is the world's **only** compact disc player to address the problem of the bright, hot, harsh sounding midrange and a lack of ambience and spatial detail characteristic of the **majority** of compact discs currently available.

When Bob Carver obtained his first compact disc player, he was surprised at the sound derived from most of the compact discs he purchased. The three-dimensional musical perspective which his analog system provided in lush abundance on phono discs evaporated into a flat, brittle wasteland. After extensive testing, Bob uncovered two fundamental flaws in almost all compact discs: 1) An unpleasant, harsh spectral energy balance. The overall octave-to-octave energy balance was shifted on the CD towards more midrange above 400Hz; 2) The amount of L-R signal (which carries the spacial detail of the music) on the CD was inexplicably, but substantially, reduced when compared with the amount of L-R signal found on the corresponding analog disc.



A. Lissajous pattern showing spatial detail (L-R)/(L+R) ratio from an LP record.

B. The same instant of music but taken from the CD version. Note the decreased (L-R) content, as shown by the narrowed trace.

Carver's circuitry corrects the ratio of L-R to L+R by performing one extra, but important mathematical operation on the signal stream that all other CD players fail to perform. This final operation makes all the difference.

The result is a natural sound with more of the three-dimensional information that places us in the same space with performers. You won't need the Digital Time Lens on all CDs. But it is there when you need it.

In the beginning, Carver hoped, indeed he expected, that once recording artists and engineers became more experienced with CD technology fewer and fewer CDs would require the Digital Time Lens. But both laboratory and listening tests reveal that the great majority of even the most recently released CDs benefits significantly from the Digital Time Lens.

EASY TO USE

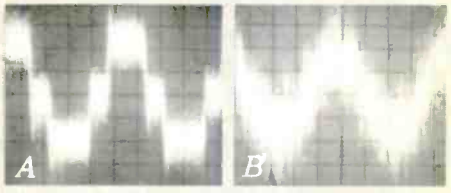
Ease of operation is a hallmark of Carver components and the Carver Compact Disc Player is no exception. A subtle but easy-to-read LCD display not only shows selection number, elapsed time and total time of the CD, but also "talks" to the user. Turn on the Carver Compact Disc Player and the display asks for a disc. When the disc tray is open, the display reminds you with an OPEN readout. When a CD has completed playing, the multi-function display reads END.

With the Carver Compact Disc Player's Programmable Random Access Playback System, track search and programming of different selections is a snap, as is automatic repeat of a previous selection or an entire CD. For classical music lovers, the Carver Compact Disc Player has complete indexing capabilities as well.

The large, easy-to-use feather-touch controls include pause, fast forward and reverse. You can even monitor music at high speed to find a certain portion of a selection.

We know you really enjoy music so, you owe it to yourself to begin your digital experience with the only full feature CD player that has the Carver touch. The only CD player that can actually improve on what is already the best playback medium ever offered.

Audition the Carver Compact Disc Player with Digital Time Lens at your Carver Dealer.



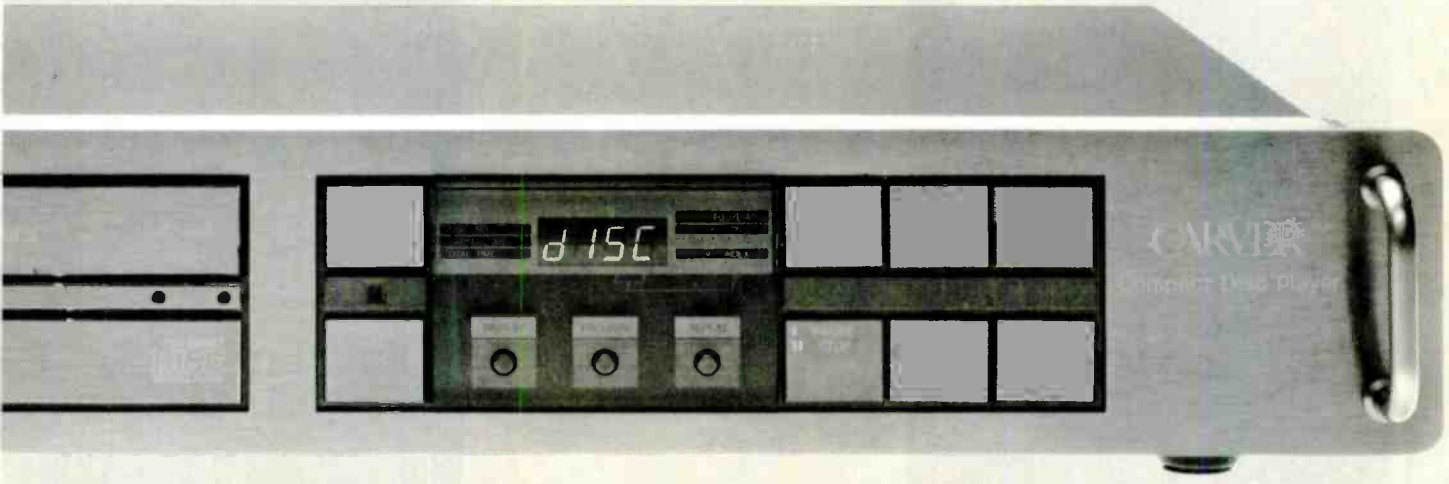
A. Ultra-low-level (4 significant bits) 1kHz signal, as reproduced by conventional CD players.

B. Same signal with dither added before D/A conversion by Carver CD player. Note that dither has caused the distorted step-wise approximation of the 1kHz tone virtually to vanish. Quantization distortion has been reduced to insignificance.

IF YOU ALREADY HAVE A CD PLAYER

By buying a CD Player you made a commitment to vastly improve your sound source, now you can go the short extra step that lets digital realize its true potential.

That step is the CARVER Digital Time Lens. Simply connect it between your CD player and your preamplifier or receiver.



MUSICAL ACCURATE

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MUSEUM OF

The Show Place

Certain people on Manhattan's 53rd Street take the broadcast media very seriously. Some of these folks toil at CBS headquarters, an elegant Eero Saarinen-designed skyscraper, the imposing black facade of which bears witness to the financial importance of both radio and TV. A block away, in a narrow, 14-story building that once housed an annex to the Stork Club, others view these media as profound cultural forces.

The mandate of the latter group, those who staff the Museum of Broadcasting, is to preserve, catalog and showcase radio and television art. Prior to the museum's creation a decade ago by CBS founder and former chairman William S. Paley, the public had no access whatever to the wealth of material that has been beamed over the airwaves, and the Museum of Broadcasting remains the sole institution in the world to make this available. It is, museum president Robert M. Batscha states, a true collection rather than a mere repository, in that its contents have been carefully selected. "We look for the best, the most socially or politically significant, what is culturally important," comments Batscha.

It's estimated that a million and a half hours of programming have been broadcast since television went on the air just after World War II, and Batscha won't even attempt to guess how many of these hours he's seen.

Illustration: Philip Anderson

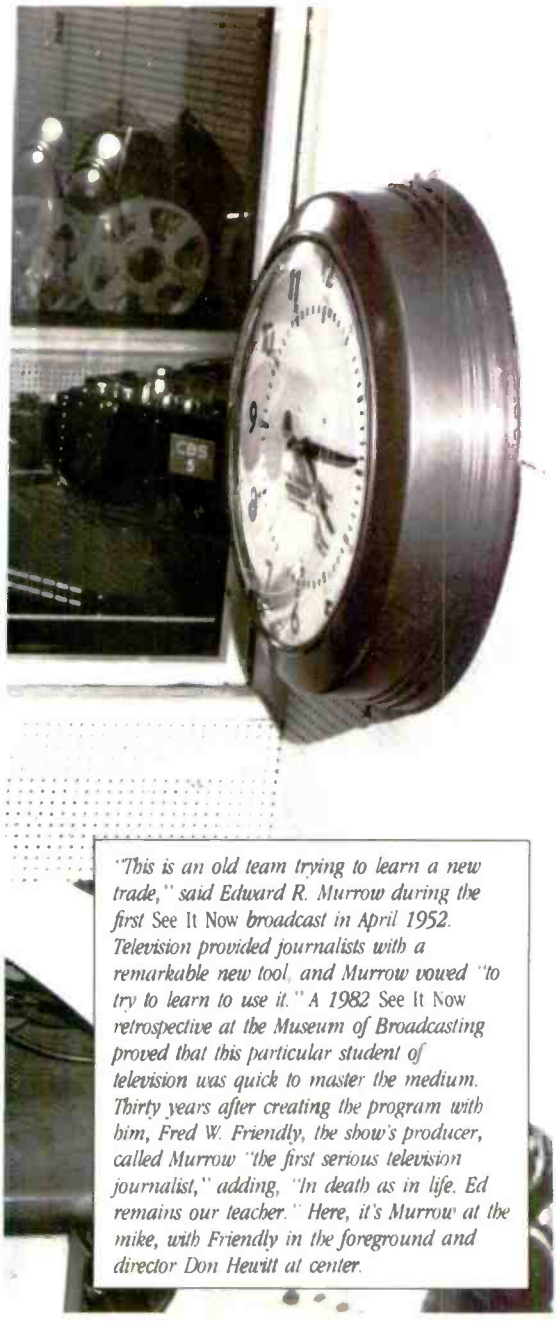
David Lander

Museum of Broadcasting president Bob Batscha calls Lucille Ball "the Charlie Chaplin of television." I Love Lucy, which aired from 1951 through 1957, set the standard for situation comedies and won more than 200 awards, five of them Emmys. The original Lucy series was succeeded by second-, third- and fourth-generation shows that chronicled the lovable redhead's antics through 1974.

Viewing consoles at the Museum.

BROADCASTING

The first television station west of the Mississippi to be licensed, KTLA was known for its on-the-spot coverage of news events. In 1952, station founder Klaus Landsberg used U.S. Marine helicopters to transport relay equipment to a 6,000-foot-high mountain peak for the first live broadcast of an atomic test. An electronics wiz from boyhood, Landsberg (left) built his first radio at the age of nine and, after fleeing Nazi Germany in 1937, worked with DuMont Laboratories before moving to Los Angeles to set up KTLA for Paramount Pictures. Landsberg died in 1956 at the age of 40. Wrote drama and TV critic Cecil Smith, "He believed television was a God-given instrument in which one could watch the world happen and it was his mission in life to make it work."



"This is an old team trying to learn a new trade," said Edward R. Murrow during the first See It Now *broadcast in April 1952. Television provided journalists with a remarkable new tool, and Murrow vowed "to try to learn to use it." A 1982* See It Now *retrospective at the Museum of Broadcasting proved that this particular student of television was quick to master the medium. Thirty years after creating the program with him, Fred W. Friendly, the show's producer, called Murrow "the first serious television journalist," adding, "In death as in life, Ed remains our teacher." Here, it's Murrow at the mike, with Friendly in the foreground and director Don Hewitt at center.*

The Ph.D. and former professor, who has written several articles and a book on TV journalism, does note that the museum's collection now contains 10% of that total and is currently adding about 3,000 hours a year. Some 10,000 hours of radio programming are also in its archive; though television has been the subject of all the museum's exhibitions to date, it has always collected radio programs and recently received a grant that enabled the hiring of a full-time curator for that medium.

The museum's implied elevation of TV formats such as the sitcom to "culturally important" art forms may strike some as curious since they were, after all, created for mass viewing and had wide popular appeal. This, however, was also the case with the plays of William Shakespeare. "If you look at it selectively," Batscha says of television, "you can see some extraordinary work."

Extraordinary is an adjective that tends to recur when Batscha discusses particular TV programs and their creators. It's uttered in connection with the televised concerts of Arturo Toscanini that were the subject of the museum's first exhibition in March 1982. And it's applied to the shows of

Six-time Emmy winner Rod Serling once remarked that "any art form . . . spews out an overwhelming percentage of inferior stuff. Unfortunately, television's product is equated with its bad things, unlike Broadway, which is held up in terms of its successes." Among others, TV's successes include ballets by master choreographer George Balanchine, which were the subject of a 1984 Museum of Broadcasting exhibition.

The 1950s have come to be known as television's Golden Age. Part of what made the medium glow so brightly throughout that decade was Playhouse 90, *an ongoing series of live teleplays penned by the like of Paddy Chayevsky, Gore Vidal, Reginald Rose, and Rod Serling. While it was Serling's award-winning* Twilight Zone *series that turned the author into a star, he also won Emmys for other screenplays, such as* Requiem for a Heavyweight, *which aired on* Playhouse 90 *in 1956.* Requiem's *protagonist was a pathetic, past-his-prime boxer called Mountain McClintock, played by Jack Palance. Palance is flanked here by Keenan Wynn (left) and Ed Wynn.*

Another Emmy-winning Rod Serling screenplay was The Comedian, *in which Mickey Rooney played the tyrannical leading man. One highlight of this 1957* Playhouse 90 *episode was a rare acting appearance by Mel Torme, who quickly proved his gifts were not limited to a remarkable singing voice. In this photo, Torme is to the right of the overcoated Rooney. The cast also included (from left to right) Edmond O'Brien, Kim Hunter, and Constance Ford.*

veteran writers Richard Levinson and William Link, the team responsible for such dramas as *The Execution of Private Slovik* and *My Sweet Charlie*, as well as series characters Columbo and McCloud. Batscha uses it again when he refers to pioneering producer Norman Lear.

Those who dismiss television as artistically insignificant might compare the Museum of Broadcasting with two other, neighboring institutions. Until recently, the objects displayed at the Museum of American Folk Art were viewed as naive, if charming—rough-hewn products of untrained artisans. Today the respect for high-quality primitive portraits, Shaker furniture, carved decoys and the like is mirrored in the formidable prices they fetch. As for the Museum of Modern Art's daunting collection, more than a few of its masterpieces were the object of scorn and ridicule when initially displayed.

As well as providing work for top-rank writers, anthology programs of the '50s were showcases for young performers like Paul Newman, shown (near right) with Grace Raynor in a 1953 series titled The Web. *Newman was in his late 20s at the time. That same season, 22-year-old James Dean appeared with Betsy Palmer and Walter Hampden on a show called* Danger.

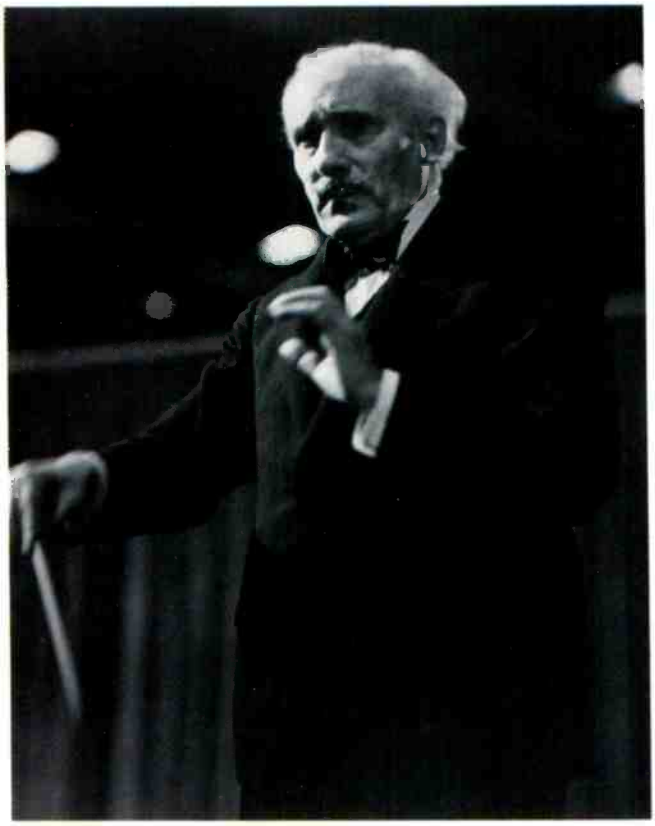
Museum president Batscha believes the 1963 assassination of President John F. Kennedy, and the events that followed it, add up to the most momentous experience in the history of TV. "It brought a population together," he commented. "Anybody who was around can think of the moment when they heard about it and can remember the three days spent in front of their television."

Material comes to the museum from a variety of sources, including the three major TV networks (each of which currently supplies about 300 programs a year), individual stations, performers, and various collectors. "Often we identify programs we want to have and can't find, and we actually go look for them," Batscha states. Two televised Toscanini concerts, once thought lost, are among these. In the hope of turning them up, museum personnel began calling people involved with their production and finally located engineers who, as Batscha euphemistically describes it, "were by the truck when the kinescopes fell off." Both, he adds, were devout fans of the maestro and delighted that copies of these programs would be made and preserved.

The Museum of Broadcasting keeps no originals; instead, two taped copies are made of each program. A half-inch cassette is kept on the premises and a ¾-inch "master" is stored in a separate venue, an old nuclear fallout shelter, the location of which Batscha declines to divulge. Rights to the programs themselves are held by their owners, and the museum is allowed to play them only on the premises or during travelling exhibitions.

The museum sometimes applies enhancement techniques to original material; the Toscanini kinescopes, for example, had to be resynchronized. The recording of President Truman's August 1945 announcement of the bombing of Hiroshima needed more drastic restoration, since the disc of his speech was found broken into 18 pieces. Happily, the procedure proved successful.

Attendance at the Museum of Broadcasting has tripled in the three years since the institution began screening exhibitions, and visitors are as varied as the program material. One of the 23 custom-built viewing consoles in its two study centers may be occupied by a student on a given day and a screenwriter or noted actor the next. In preparation for his role in a forthcoming TV movie as Edward R. Murrow, Daniel J. Travanti recently spent a week there studying the late newscaster's programs.



It is not commonly known that Arturo Toscanini and Gustav Mahler were contemporaries and rival conductors. Thanks to his long life, enormous energy and the medium of television, we have a visual record of Toscanini conducting. The maestro was 81 when he first appeared on TV with the NBC Symphony Orchestra, and nearly 85 at the time of his last televised concert in March 1952.

Photograph: Frank Driggs Collection

Rock 'n' roll was important to television long before the advent of MTV. A generation of fans first saw Elvis Presley on Tommy and Jimmy Dorsey's Stage Show *in 1956. The King's early TV appearances, along with those of The Beatles on* The Ed Sullivan Show *nearly a decade later, are the Museum of Broadcasting's most-requested programs.*

The building on Manhattan's East 53rd Street that houses the museum has its own brand of charm. Its past incarnation as a nightclub is evident in such architectural details as elevator doors that sport bronze reliefs of half-nude maidens, and dumbwaiters, which these days are used to shuttle videotapes from floor to floor.

Musical programming has always been an important part of the Museum of Broadcasting's repertory, and at least one exhibition a year is devoted to the art. An exhibit spotlighting choreographer George Balanchine followed the inaugural Toscanini event, and a full 60 hours of videotape featuring Leonard Bernstein's television appearances were unreeled this past fall, followed by a show consisting of 40 hours of jazz programming.

The museum's 1986 calendar includes a celebration of the Texaco-sponsored programs that featured the Metropolitan Opera. Material will be culled from some 40 years of Saturday-afternoon radio broadcasts, as well as recent telecasts. A

BUILD A SLOW-CIRCUIT

DANIEL DUFRESNE

For those of you who have problems with turn-on surges, the circuit in Fig. 1, an a.c. slow-start circuit, can be of some help. When turned on, it slowly raises the voltage at the load terminals, limiting the inrush current. I have made one such unit, and it has been working perfectly for the last two years. (And it works fine here too.—*E.P.*)

This is a phase-control circuit in which the turn-on phase delay of a triac is automatically varied, from a maximum to a minimum, at a preset rate. Changing the phase of the triac's turn-on point changes the output voltage. As a result, the power-supply capacitors in equipment connected to the circuit's output will charge slowly, limiting the turn-on current peaks through the component's parts (i.e., transformers, rectifiers, capacitors, switches, and associated wiring) to safer, lower values. This triac circuit has many advantages over circuits using relays or thermistors: It is all solid-state; it has a smooth turn-on of more than 200 steps; when properly designed, it generates less interference than other circuits, and finally, it is universal—that is, it does not need to be readjusted for each application. The circuit's power switch can be inserted in series with both the load and the control circuit or only in the control circuit. If the switch is for the control circuit alone, it can be a low-current type, chosen for esthetics.

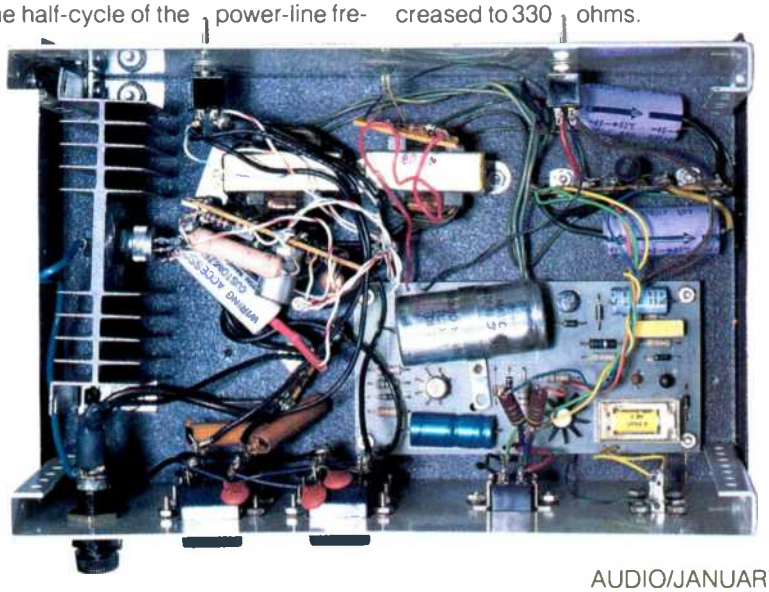
The circuit is designed to power inductive loads, such as transformers, because these are the most common type of power-supply impedance and the most difficult triac-triggering situation. The difficulty resides in the fact that the turn-on signal must be applied long enough for the triac's current flow to be greater than the holding current. In the case of an inductive circuit, this process takes time.

The circuit works as shown by the schematic (Fig. 1) and the timing diagram (Fig. 2). When power is turned on, capacitor C1 is at 0 V, diode D6 is conducting, and diode D7 is not. Capacitor C2 charges, through resistor R5, in a little less time than the duration of one half-cycle of the power-line frequency (i.e., less than 1/120 S). When Q1 triggers, it turns on the light-emitting diode in U1, which triggers the triac in U1. This turns on the main triac, Q2, delivering power to the load.

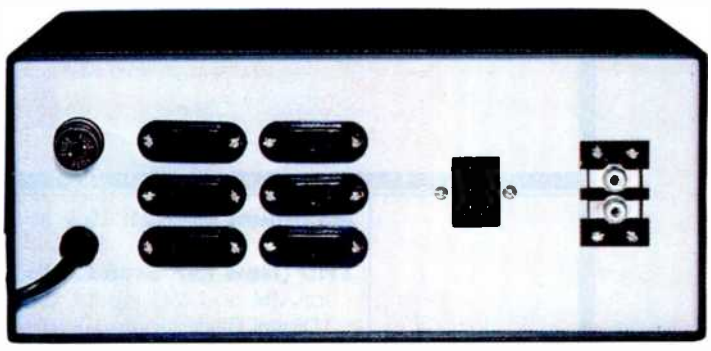
As C1 charges, current flowing through R4 and D7 charges C2 faster. Therefore, the triac turns on earlier in the cycle, delivering more voltage. Finally, C1 is removed from the circuit by R3 and D6. As long as the full-on trigger point is less than 90°, there is no loss of power to the controlled devices. This is because capacitor-input power supplies are peak detectors and thus respond to the peak of the voltage. Further reduction of the full-on, turn-on phase angle lessens interference. The voltage delivered to the load is shown (in Fig. 2) to be zero after the output voltage's zero crossing. However, if the load is inductive, the triac will conduct until the current drops below the holding level.

The power supply shown here is unfiltered. A transformer can be used in place of R1, the dropping resistor. The circuit's time constant is about 2 S; to slow down the process, the time constant of R3 and C1 must be increased.

The MOC3011 triac opto-coupler (U1) triggers when the current through its built-in LED reaches 10 mA; the maximum permissible current through this diode is 50 mA. Resistor R8 limits the current to the LED; if a less sensitive coupler is used (such as the optional MOC3010, which triggers at 15 mA), the value of R8 should be decreased to 330 ohms.



START



Resistor R9 limits the trigger current delivered to Q2; again, its value should be adjusted to the device you use. Note that the maximum permissible current through U1's triac is 100 mA and that the triggering current to Q2 should be less than this value. Network R10 and C3 form a protective snubber for the triac in U1, and R11 and C4 do the same for Q2. Triac Q2 must be mounted on a heat-sink with a thermal impedance of less than 5° C per watt.

Although this circuit limits the turn-on current surges to a reasonable level, some amplifiers will generate extraneous noise at their outputs during turn-on. You won't know if yours is among them until you try it out.

Physically, the circuit is quite small (except for Q2 and its heat-sink), and you may even be able to install it in the equipment that it powers. Care must be taken in wiring this circuit because of the hazardous voltages. Make sure to properly insulate all live parts. More information on triacs and slow-start circuits can be found in the *SCR Manual, Including Triacs and Other Thyristors, Fifth Edition* by D. R. Grafman (General Electric, 1972).

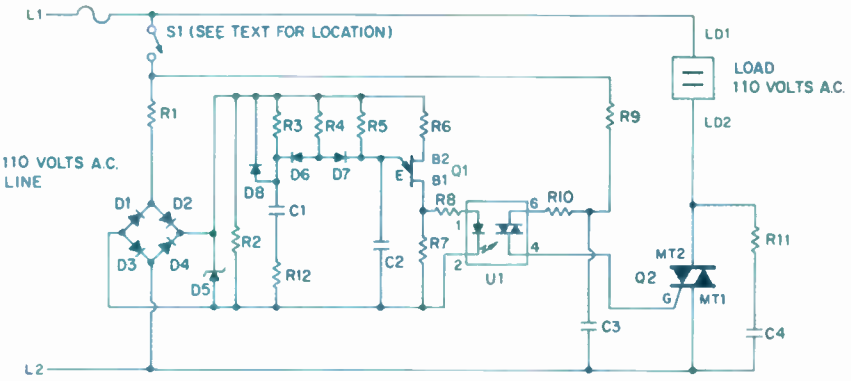


Fig. 1—Schematic diagram.

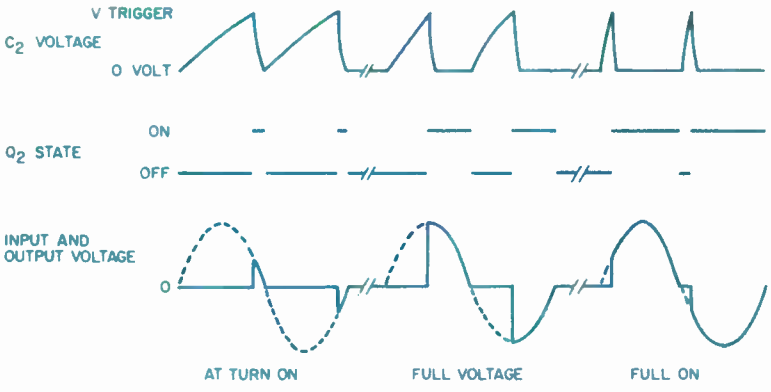


Fig. 2—Timing diagram. Transistor Q1 (not indicated) turns on when C2's voltage (upper trace) is higher than Q1's trigger voltage; this discharges C2. Transistor Q1 also triggers triac Q2 (middle traces), which delivers voltage to the output (lower trace). The output-voltage buildup is best seen by comparing the "on" times of Q2 with the output (solid lower trace) just below it; the dashed lines show input from the a.c. line.

PARTS LIST

Resistors
(All 5%, ¼ watt, unless otherwise noted)
R1—3.3 kilohms, 10%, 7 watts.
R2—10 kilohms.
R3—47 kilohms.
R4—4.7 kilohms.
R5—470 kilohms.
R6—1 kilohm, ½ watt.
R7—220 ohms.
R8—470 ohms.
R9—5.1 kilohms, 5 watts.
R10—180 ohms, ½ watt.
R11—100 ohms, 10%, 1 watt.
R12—5.1 kilohms.

Capacitors
C1—470 µF, 25 V.
C2—0.1 µF, 25 V.
C3, C4—0.033 µF, 600 V.

Miscellaneous
D1 through D4, D6 through D8—IN4004, 1-A, 400-PIV diodes.
D5—IN4744, 15-V, 10%, 1-watt zener diode.
Q1—2N4871 unijunction transistor.
Q2—2N5574, 15-A, 400-V triac.
U1—MOC3011, triac opto-coupler (the MOC3010 can also be used if R8 is changed; see text).
S1—Switch, single-pole, single-throw 250 V a.c., sufficient current rating (see text).
Heat-sink, heat-sink grease, cabinet, solder, circuit board, etc.

Most electronic-parts stores, such as Radio Shack, will carry the above. If Q2 is not available locally, it can be purchased from Solid State Sales, P.O. Box 74, Somerville, Mass. 02143, (617) 547-7053, or at 139 Hampshire St., Cambridge, Mass. 02139. U1 can be obtained from Active Electronic Sales, P.O. Box 9100, Westboro, Mass. 01581, or from any supplier of Motorola semiconductor devices.

TANDBERG 3008A PREAMP AND 3009A AMP

Manufacturer's Specifications

Preamplifier

Frequency Response: Line inputs, 20 Hz to 20 kHz, +0, −0.1 dB; 1.6 Hz to 250 kHz, ±3 dB. MM and MC phono inputs, RIAA 20 Hz to 20 kHz, ±0.2 dB.

Maximum Output: 10 V at clipping level.

THD (New IHF Standard): 0.004% for MM and MC inputs, 0.003% for "Digital Disc" inputs, 0.007% for line inputs.

Phono Input Sensitivity for 0.5 V Output at 1 kHz: 1.0 mV input for MM, 60 μV for MC.

Phono Input Overload: 290 mV for MM, 17 mV for MC.

S/N Ratio: 74 dB, A-weighted, for MM input; 78 dBA for MC input; 95 dBA for line inputs.

High-Level Sensitivity: 70 mV.

Phono Input Impedances: Selectable, 33/47/100 kilohms paralleled by 20/120/350 pF for MM cartridges; 150 ohms for MC cartridges.

Dimensions: 17⅛ in. W × 3¼ in. H × 13¾ in. D (43.5 cm × 8.3 cm × 34.9 cm).

Weight: 39.9 lbs. (18.1 kg).

Price: $795.

Power Amplifier

Power Output: 20 Hz to 20 kHz, 200 watts rms continuous into 8 ohms, 330 watts rms into 4 ohms, 456 watts rms into 2 ohms; 1,512 watts peak (pulse) power into 0.5 ohm.

Rated THD: Less than 0.05%, 1 to 2 ohms; less than 0.01%, 8 ohms.

Frequency Response: 0.07 Hz to 1.5 MHz, +0, −0.2 dB at 1 watt output.

S/N Ratio: 94 dB referred to 1 watt into 8 ohms, A-weighted; 117 dB referred to 200 watts into 8 ohms.

IM Distortion: Less than 0.05% at rated output.

Damping Factor: 250, wide-band.

Input Sensitivity: 150 mV for 1 watt output, 2.12 V for rated output.

Slew Rate: 250 V/μS.

Rise-Time: 0.9 μS.

Dimensions: 17⅛ in. W × 3¼ in. H × 13¾ in. D (43.5 cm × 8.3 cm × 34.9 cm).

Weight: 25 lbs. (11.3 kg).

Price: $995.

Company Address: Labriola Court, Armonk, N.Y. 10504.

For literature, circle No. 90

The 3008A preamplifier and 3009A power amplifier sit at the top of Tandberg's line of stereo products. These slim, attractive, Scandinavian-styled components represent the latest in Tandberg's thoughts about audio design. Their circuitry employs discrete components (no ICs), polyester capacitors (with low dielectric absorption) and metal-film resistors in the signal path, and minimal amounts of overall negative feedback—features believed by many audiophiles to be necessary for the best sonics.

The 3009A is rated to deliver 200 watts into 8 ohms and a staggering 1,512 watts (pulsed) into 0.5 ohm. The unit, an adaptation of the firm's 3006A stereo amplifier, is a monaural, high-current design that can deliver very high power into speaker loads, even ones with very low impedances. The low-impedance capability was intended for those who wish to drive several loudspeakers wired in parallel, or speaker systems with an intrinsically low load impedance such as the Apogee Scintilla. (The Scintilla can be configured as a 4- or a 1-ohm speaker, and many audiophiles feel it sounds better in the 1-ohm configuration.)

The black chassis of the Tandberg amp and preamp are of rack width but lack mounting "ears." Each unit stands only 3¼ inches high, and their 13¾-inch chassis depth is convenient for placing these components on shelves or wall units. The 3009A weighs only 25 pounds, unusually light for a 200-watt mono amplifier.

Our samples came with rosewood side panels which allow two monaural amplifiers to be stacked for stereo use (single rosewood panels are also available). We have since learned that Tandberg does not recommend this arrangement for optimum performance, but we found it produced no ill effects.

Control Layouts

The preamp's front panel features a large number of controls. At the far left are the on/off switch and the headphone jack and its volume control. Next come four buttons which control monitoring and two-way dubbing facilities for two tape decks. Near the front panel's center are buttons for the subsonic filter and the tone-control defeat, the bass and treble tone controls, and buttons for stereo/mono and loudness-compensation switching. At the right is a rotary input selector, with positions for "Tuner," "MC" (moving-coil) and "MM" (moving-magnet) phono cartridges, and "Digital Disc." At the far right is a small balance control and a large, detented volume control.

On the preamp's rear panel are the signal, a.c., and ground connections. The high-level signal jacks include inputs and outputs for two tape decks, inputs for a tuner and a CD player, and the main preamp outputs. The phono stage has separate pairs of jacks for the MM and MC inputs. Loading for MM cartridges is controlled by two toggles, one

selecting load impedances of 100, 47 or 33 kilohms, and the other selecting load capacitances of 20, 120 or 350 pF. The back panel also features an unswitched a.c. output rated at 600 watts, and three switched outputs rated at a total of 300 watts. A fuse, a switchable 115- or 230-V a.c. input, and a detachable line cord make up the remainder of this highly functional back panel.

The amplifier's front panel contains only a power switch, an LED power-on pilot light just above the switch, and a second LED mounted at the front panel's right side, which serves as a clipping indicator. The rear panel holds nickel-plated signal input connectors, and five-way speaker binding posts of somewhat nonstandard design. Like the preamp, the amp has a detachable line cord.

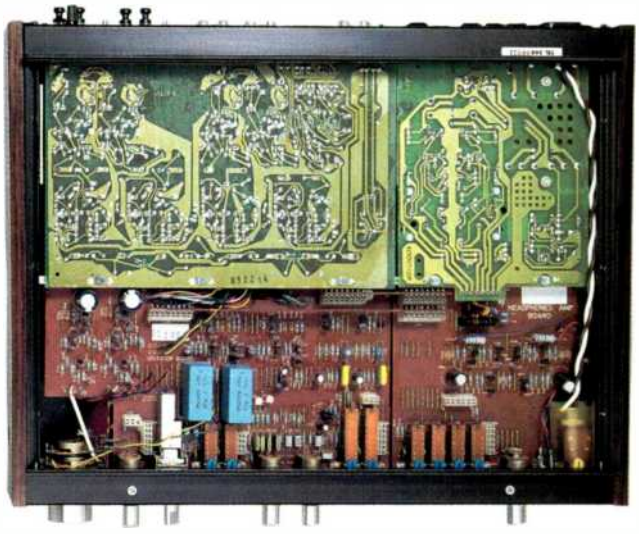
Mechanical Construction

The usual approach to audiophile-component construction is to make components that are as heavily built as their professional equivalents, but neater, and to pay little attention to styling beyond the functional. Tandberg took a different course. Instead of the usual, heavy chassis with bolted-on panels, Tandberg built this amp and preamp around light but strong (and attractive) aluminum extrusions. The strongest ones, logically enough, make up the front and rear panels. Lighter extrusions for the sides serve as attachment points for the side covers and for a number of sheet-metal subchassis that hold internal components in place. These subchassis, and the liberally vented bottoms, are of thin, dull-finished sheet steel. The tops are made of two heavy, slotted extrusions which lock into place, covering the attachment screws. This technique minimizes the number of screw heads visible on the top and side cover panels, thus enhancing the components' appearance, but may lack the strength of a more "unitized" assembly. All chassis components are held together with sheet-metal screws rather than the machine screws which we prefer. While we would not recommend this construction for professional use (and abuse), we find it adequately strong for its intended home applications. The light chassis, dull-steel bottom and internal structures, and cost-effective fasteners make it clear that Tandberg favors external cosmetics over internal overbuilding; audiophiles who worship the innards of their components will not be as pleased. We prefer less slick, more purely functional styling, but all that's a matter of taste.

In the rear two-thirds of the amplifier chassis, vertical, chimney-type heat-sink castings flank and support the large toroidal transformer. The venting of the top and bottom leaves a number of open areas to act as flues for these heat radiators, making a fan unnecessary despite the amplifier's slim design.

The quality of the major circuit boards and the components on them is just what you'd expect for a product in this

Tandberg's light but strong and attractive chassis and their choice of components emphasize practical performance over impressive overbuilding.



price range. The amplifier's boards are epoxy-glass, with component-designator screening and solder mask, but they lack the clean finish and solid mounting that is important to some enthusiasts. Most resistors are ordinary 5% types, but there are trimpots and 1% devices where needed for precision. The 3009A's capacitors include 85° C stand-up electrolytics, polypropylenes, and a huge 2.2-μF Wima MKP cap used for input coupling. Interconnection between boards is made via nylon modular plug/socket units with nickel-plated pins and insulation-displacement wire termination.

The amplifier's power supply uses a large toroidal transformer, which not only has a low enough profile to fit in the slim package, but radiates much less 60-Hz magnetic hum than conventional, E-I laminated transformers. When the mono 3009A amplifier was adapted from the stereo Model 3006A, the space vacated by the second channel's driver board was filled with two additional power-supply electrolytic capacitors. The resulting complement of four 15,000-μF, 80-V electrolytic capacitors stores the full-wave rectified output of the 3009A's transformer. This gives a very high energy storage of 123 joules.

The 3008A preamplifier refines the integration of mechanical structure, user controls, and circuit boards found in the companion power amplifier. Identical decorative and structural extrusions are used in both products, but they suit the preamplifier even better than they do the amplifier. Not only is the lightweight, screwed-together frame perfectly adequate for the preamplifier, but only one crosspiece is required to support the inner edges of the 3008A's four main circuit boards. The front edges of the forward p.c. boards are supported by the front-panel controls and switches. The rear edges of the other two boards have protruding tabs which fit into slots in the vertical, rear-panel boards. We prefer designs in which the circuit boards are firmly screwed down to spacers or chassis mounting bosses; even so, this construction is efficient and provides exceptional service access.

The preamp's circuit boards have clean and open layouts, solder mask, and component designators. The two front p.c. boards are made from what appears to be brown phenolic material. This material doesn't have the strength and crack resistance of the epoxy-glass used for the other two boards.

Component quality is mixed. Tandberg apparently opted for expensive parts only where they felt there would be sonic merit in doing so. Among the higher quality components are eight very large, 10-μF capacitors and four 4.7-μF capacitors, apparently made from carefully selected dielectric materials. There are many other board-mounted polypropylene and chip capacitors, along with 1% resistors. On the less expensive side, one can find eight exposed-track trimmers (subject to problems with dust if they ever need to be readjusted) and push-on modular connectors. Many board-to-board audio runs are made via twisted-pair leads or simply bundled parallel runs. This did not seem too promising for achieving low crosstalk, but our tests showed otherwise.

As with the amplifier, the 3008A's controls have a firm but lightweight action, without the solid, positive feel found in the controls on more expensive preamplifiers. The step-type volume control is an ordinary rotary pot, with a toothed wheel and spring to provide the detents. This action can be defeated easily if need be. All the rotary control elements appear to be the inexpensive, popular, and very satisfactory ones made by Alps.

Preamplifier Circuitry

The preamplifier utilizes two pairs of RIAA amplifiers for each channel. The moving-coil input goes into an MC input amplifier whose gain and noise performance are optimized for low-output, low-impedance moving-coil cartridges. The MM inputs on the rear panel go into MM phono amplifiers that have lower gain and whose inputs are optimized for MM cartridges. Both MM and MC input signals are applied first to flat pre-preamplifiers before being routed to a passive, high-frequency RIAA equalizer. The low-frequency portion of the RIAA equalization is provided by feedback around the second phono-amplifier stage. Input overload from pre-equalized square waves, a common problem in pre-preamplifiers, is avoided here by relatively low gain and very high (±32 V) rail voltages. (Tandberg was wise to use discrete transistor circuitry; these voltages would not be possible using common low-noise integrated circuits.) To prevent d.c. offset, the phono preamp's output at the selector switch uses capacitive coupling, as opposed to the popular servo-amplifier approach. Four large, rectangular, 4.7-μF polyester coupling capacitors are firmly mounted on the preamplifier's circuit board.

The discrete transistor circuits in the phono section and in the line output stage are very simple, using only five to seven bipolar devices per gain block. An unusual feature is the single-transistor emitter-follower unity-gain buffer used on all line inputs except CD. These buffers' low output impedance probably is the reason we did not find the crosstalk that the interior wiring led us to expect.

Amplifier Circuitry

As mentioned above, the 3009A design is a mono conversion of Tandberg's highly regarded 3006A stereo amplifier.

We liked the preamp's convenience, the amp's combination of high power and light weight, and the sound of both units.

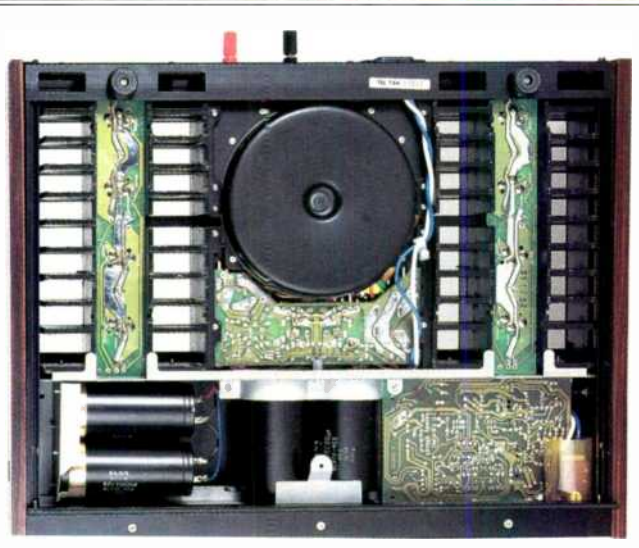
Like the 3006A, this amplifier uses MOS-FET output transistors. MOS-FETs have several advantages, including a region with a negative thermal characteristic. This means that their internal resistance rises as they become hotter, which tends to turn them off. (Bipolar devices, on the other hand, have a positive thermal characteristic, which necessitates additional circuitry to make them thermally stable.) In addition, MOS-FETs tend to have greater bandwidth than bipolars, and can switch on and off at higher frequencies.

MOS-FETs may not be *inherently* superior to bipolar transistors, but every MOS-FET amplifier we have tested handles very high frequencies, particularly square waves, with much less strain than bipolar amplifiers do. MOS-FET amplifiers usually clip more cleanly, and mutual conduction is generally not evident until very high frequencies (around 100 kHz). MOS-FET amps run hotter at all levels and require higher rail voltages.

The eight MOS-FET output devices that made up the stereo 3006A's two channels are tied in parallel to make up the 3009A's single output. Paralleling the output stages doubles their current-delivery capacity, greatly enhancing their ability to drive low-impedance loads. Paralleling output stages can be done more easily with MOS-FET outputs than with bipolar transistors; paralleling two bipolar output stages would impose heavy current-delivery demands on the driver stage. MOS-FETs, on the other hand, require very little current compared to bipolar devices, even at high frequencies. A single driver stage, carried over from the 3006A, has adequate power to drive the 3009A's two paralleled MOS-FET output stages.

The 3009A incorporates 28 discrete transistor devices and field-effect transistors (FETs) in the amplification channel, not to mention those found in the power supply, servo circuit and clipping indicator. The signal path begins as the input feeds a dual-complementary, single-ended FET input. (It is not a differential input, the kind very commonly found in amp designs these days.) Next, the signal goes to four complementary gain and level-shift stages. These are connected like four independent cascaded amplifiers, each depending on local feedback only. The signal then goes to a driver with three emitter-follower stages, each with extremely low current gain. Associated with that triple emitter-follower are a pair of transistors used to set output-stage bias. This group provides the drive for the paralleled output MOS-FETs (four up and four down) via individual 680-ohm resistors to their gates.

Tandberg's error-correction circuit is a bit unusual. The output signal is linked to the bases of two transistors. In our reading of the schematic, these two transistors form a bias-setting circuit, where the output signal is amplified and applied to the drivers in such a way as to generate negative feedback around the unity-gain output stage. (To have negative feedback around a unity-gain stage requires amplification of the feedback signal itself.) Tandberg, however, describes the two-transistor circuit as a comparator which generates a feed-forward error-correction signal, because the correction signal can be greater than the output of the first emitter follower, and thus the entire circuit can have a negative output. A distortion-nulling pot at this point trims the compared gain for minimum distortion and, Tandberg says, for unity gain. Whether feedback or feed-forward is the method, the 3009A's ultra-low output impedance and distortion, plus its ringing on square waves when driving a capacitive load, indicate to us that some form of error correction is in use around the output stages. However one views Tandberg's actual signal-correction method, it functions very well, particularly at high frequencies.



The 3009A's circuitry eliminates d.c. offset by means of a large input-coupling capacitor. The circuit includes a servo amplifier by which the service technician can adjust a trimpot to null d.c. When fault conditions (including overdrive and short-circuits) are sensed, speaker relays open. These relays employ contacts coated with 24-karat gold. Because gold plating is usually very thin, it disappears after the relays open several times under full power. Coauthor Clark's experience in developing clean relay switching for comparators led him to conclude that gold plating is best applied to low-level circuits, where big arcs that vaporize gold plating don't occur.

The output stage is wired directly to the output terminals, without a conventional output-decoupling network. The main feature of the conventional network is a series inductor which, at supersonic frequencies, isolates the amp from highly capacitive loads which might cause it to oscillate. This series inductor (r.f. choke) circuit can also affect the upper audio frequencies, causing a slight isolation at frequencies as low as 10 to 20 kHz, thus lowering the damping factor in this range.

Tandberg's design avoids the shortcomings of output-decoupling networks, but it is influenced by capacitive output loads despite the lack of overall negative feedback. Since our tests, Tandberg has introduced a modification (now present in all production units) to limit this influence to the ringing we observed, and prevent oscillation without resorting to the more common inductive circuit. The modification places a series-connected resistor and capacitor in parallel across the outputs. This terminates the amplifier at supersonic frequencies, yet does not limit the unit's excellent damping factor.

The amplifier easily meets and exceeds its power ratings. For instance, continuous power into 0.5 ohm is 684 watts, an outstanding figure.

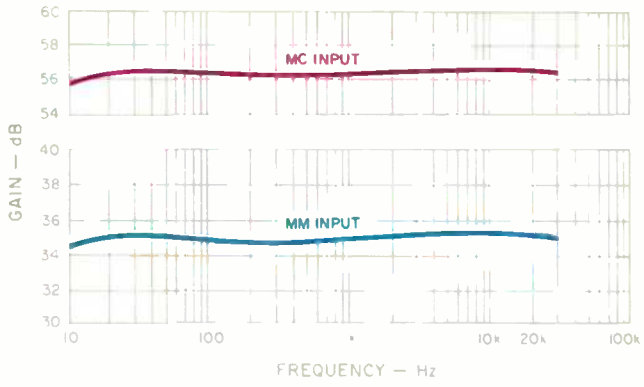


Fig. 1—RIAA response, 3008A preamplifier. Top curve is MC input with 100-ohm load; bottom curve is MM input with 47-kilohm load.

Preamplifier Measurements

Measured from input to main output, using a standard IHF load, the left channel's phono gain was 52.6 dB for the MM input and 73.8 dB for the MC jack. IHF sensitivity, measured from input to main output, was 0.1 mV for the preamplifier's MC input, 1.2 mV for MM phono, and 17.4 mV for all auxiliary line-level inputs.

Signal-to-noise ratios were measured next. The A-weighted measurements included 80.5 dB for the MM phono input and 70.5 dB for the MC phono input—both very good.

Phono overload for the standard 1-kHz input signal was 330 mV at the MM input and 17 mV at the MC input. Overload for the auxiliary stage, measured from auxiliary input to main output, was a high 12.0 V, in keeping with Tandberg's attempt to provide a high overload for the outputs of Compact Disc players. "Line in" input overload in a preamp is only of concern when the selected input is amplified before being applied to the volume control. With direct application to the volume control, the signal is attenuated before it can cause an overload. The 3008A, however, has buffer amplifiers and, if selected, an active subsonic filter ahead of the volume control.

Phono RIAA equalization error initially measured ±1.0 dB, 20 Hz to 20 kHz, but this was for a very early production unit. Replacing two resistors brought our test unit up to par with current production, with an improvement in this measurement to ±0.3 dB for the MM input and ±0.2 dB for the MC input, 20 Hz to 20 kHz, as shown in Fig. 1.

Channel-to-channel crosstalk in the phono section was found to be greater than −49.5 dB in the MC phono section and −49.0 dB in the MM section, both from 20 Hz to 20 kHz. This is a respectable figure for any preamp.

The line amplifier section's THD + N was found to be less than 0.014%, 20 Hz to 20 kHz, at 10 V output using either a normal or IHF load. On the oscilloscope, the distortion appeared primarily as low-order harmonics and was fairly constant across the audio band.

Amplifier Measurements

The 3009A was first run for one hour at 33% of rated power (about 66.7 watts per channel) into 8-ohm loads with a 1-kHz test signal. The chassis top became warm, but the amplifier didn't thermally shut down.

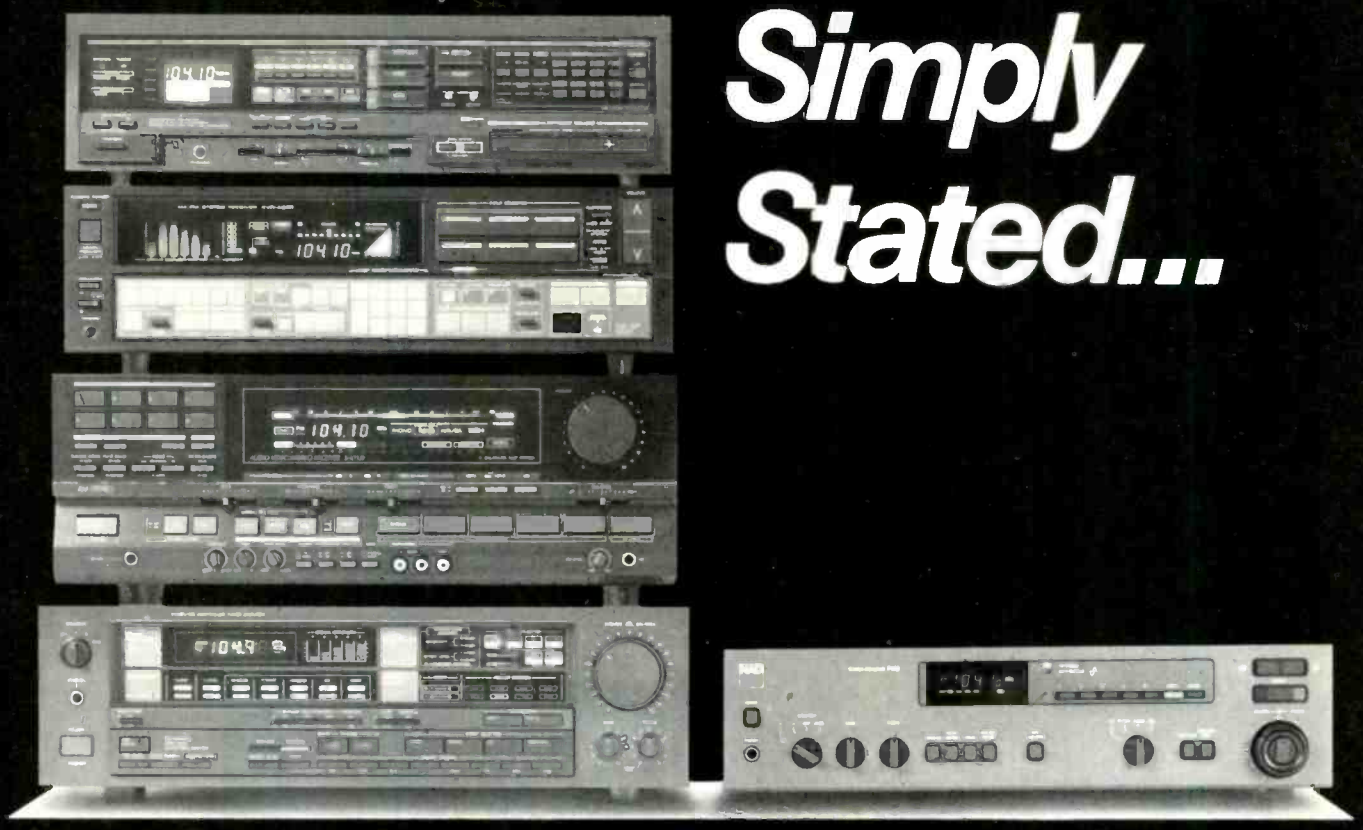
Voltage gain was found to be 28.9 dB. This requires an input of 1.44 V for full power into an 8-ohm load. The IHF sensitivity for 1 watt into 8-ohm loads at 1 kHz was 102 mV.

Power output from 20 Hz to 20 kHz for a variety of load conditions is shown in Table I. The amplifier easily meets and exceeds the manufacturer's specified continuous power ratings at 8, 4, and 2 ohms. Continuous power into 0.5 ohm is a very strong 684 watts, an outstanding figure. Dynamic headroom measured 1.1 dB (45.2 V, 255.0 watts) relative to 200 watts rated power into 8 ohms. The 4-ohm IHF headroom was 1.3 dB (44.4 V, 449.0 watts). These figures indicate a power supply with tighter-than-usual voltage regulation.

Our standard test of peak output current utilizes a 20-mS pulse (repeated at a 0.5-S rate) driving one channel of the amplifier into a 0.1-ohm load. Under these conditions, the 3009A delivered 7.1 amperes rms (right channel), a low figure for instantaneous rms current delivery among high-powered amps on the market today. Yet, at 0.5 ohm, the Tandberg delivered a staggering 37 amperes rms of current, which is a record for amplifier current delivery on our test bench. Most amplifiers we have tested put more current into a short than any other load. The delivery of 37 amperes rms (52.3 peak amperes) into 0.5-ohm loads basically confirms Tandberg's claim that the 3009A has 55-ampere peak output capability. It is theoretically conceivable that the protection circuitry could mistake a highly reactive, low-impedance load as a short and limit the amplifier's output. This would be a most unusual condition, however, and we did not encounter it in practice.

Operating the amp at rated output power, the maximum total harmonic distortion plus noise (THD + N), 20 Hz to 20 kHz, measured 0.049% for 8-ohm loads (at 40.0 V/200 watts), 0.029% for 4-ohm loads (at 36.3 V/330 watts), and 0.033% for 2-ohm loads (at 30.0 V/450 watts). Measurements at lower levels all indicated lower distortion, as shown in Table II.

The 3009A produces an exemplary 20-kHz, full-power square wave. The lack of an output network allows the 3009A to maintain a high damping factor at supersonic frequencies, resulting in great control of the rise-time and overshoot of the 20-kHz square wave. The low-frequency damping factor measured 264 for 8 ohms and remained at 101 up to 20 kHz for the wide-band damping factor. Figure 2 illustrates the 3009A's 20-kHz square-wave response at rated power, 200 watts per channel, into 8 ohms. Rise-time is less than 1 μS. The slew rate is asymmetrical, 177 V/μS in the positive direction and 160 V/μS negative, as measured on a 50-MHz oscilloscope. IHF slew factor into 8 ohms was a very high 10.0 (200 kHz). Adding a 0.1-μF capacitor in parallel with the 8-ohm output load caused considerable ringing, as shown in Fig. 3. However, capacitors as large as



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The Tandberg amp's wide sound stage and its three-dimensional field were remarkable, and the preamp delivered the same spacious sonics.

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The 1-watt frequency response into 8 ohms shows the amplifier to be well within ±0.1 dB from 20 Hz to 20 kHz. The −3 dB points are about 400 kHz at the high-frequency end and 0.17 Hz at the low end. Input impedance is somewhat frequency-dependent, measuring 105 kilohms at 1 kHz and 39 kilohms at 20 kHz.

The IHF signal-to-noise ratio, which is A-weighted noise referred to 1 watt output into 8 ohms, measured an excellent 91.9 dBA.

Crosstalk measurements generally do not apply to monophonic amplifiers, but we measured the crosstalk possible when two Tandberg units were mounted together in the optional rosewood frame. Crosstalk versus frequency was measured by driving one amp and measuring the leakage into the other, with the unused input terminated by a 1-kilohm resistor. Even with one amp stacked on top of the other, the separation between the two was greater than 99.6 dB from 20 Hz to 20 kHz!

Use and Listening Tests

Equipment used by coauthor Greenhill to evaluate the Tandberg 3008A preamp and 3009A amplifier included a Linn Sondek turntable with a Magnepan Unitrac 1 arm, Accuphase AC-2 moving-coil and Shure V15 Type V-MR cartridges, a Philips Compact Disc player, a Mark Levinson ML-7 reference preamp, and Mark Levinson ML-9, Onkyo M-510, Classé Audio DR-3 and Bryston 4B solid-state power amps. Apogee Scintilla, Snell Type A-III, and Jung/Randall-modified Dahlquist DQ-10A loudspeakers were used. Tandberg's recently developed speaker wire and interconnect cable were supplied to Greenhill for the listening evaluation; the cable employs a proprietary dielectric insulation material developed by Norwegian chemical and petroleum-product manufacturers.

The 3009A amplifier's speaker terminals do not accommodate heavy audiophile speaker cables or many types of speaker-connector hardware. After some experimentation, we settled on single banana plugs, which made adequate electrical contact even though they could not be pushed in all the way (because each terminal post's inner well is a bit too shallow). Spacing between the terminals is too narrow for double bananas. We feel bare wires don't make optimal contact, either, because the ridge on the knurled plastic clamp that forces the wire against the terminal's metal base deforms before sufficient pressure is generated. Spade-lug wire terminators were tried, but the pressure on the one-sided contact still seemed low to us for the rated 55 peak amperes.

If one or more pairs of Tandberg 3009As are used in a system, they should be turned on in sequence rather than simultaneously. This is true for most high-power amplifiers that don't contain turn-on surge-limiting circuitry.

Subjectively, Clark was struck by the sexy Scandinavian styling of two 3009A amps stacked one atop the other with the rosewood side panels. He also admired the thermal cooling vents and the reworked back panel, which lent the product a sort of modified "hot rod" quality.

Clark auditioned these components in his home system, and in his special listening room whose design was based on a study by the International Electronics Commission (IEC). The amplifier was interfaced with a number of different kinds of equipment, including Fried Studio IV speakers. Clark found the easy, sparkling sound matched his visual reactions to the product. He also found the 3008A preamp to have fast, detailed sonics that matched the amplifier's. Other audio professionals visited Clark's listening room and drove a pair of 813B Urei monitors with the 3009As. They were very impressed by the amplifier's power, especially considering its small size, and said the 3009A was the most powerful-sounding amp they had yet heard driving these massive speakers!

In Greenhill's evaluation, the two amplifiers were kept six feet apart, short speaker-cable runs were employed, and the units were gain-matched to a number of other fine amplifiers for open testing. Greenhill found the Tandberg amplifier's bass response seemed slightly less defined over his reference Snell Type A-III speakers. The Tandbergs

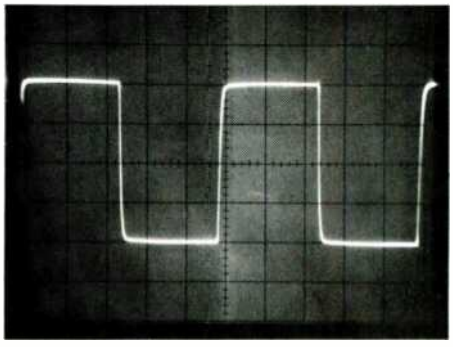

Fig. 2—Response of 3009A amplifier to a 20-kHz square wave, at 200 watts into 8-ohm load. (Scales: Horizontal, 10 μS/div.; vertical, 20 V/div.)

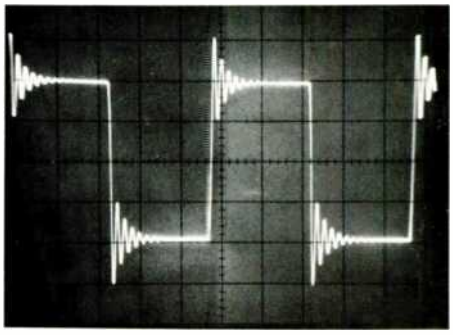

Fig. 3—Same as Fig. 2, but showing effect of a 0.1-μF capacitor across the load.

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could not deliver the high sound pressure levels of the higher rated (at 8 ohms) Onkyo M-510, nor did they deliver as much depth of imaging as two Classé Audio DR-3s. Yet the Tandbergs excelled in all other areas, showing remarkable sound-stage width and ability to separate singers and instruments in a three-dimensional field. This high definition may be attributable to the dual-mono design, with its absence of crosstalk. The preamp delivered the same spacious sonics, with midrange speed and detailing, while being free of midrange brightness.

The amps were then transported to another system, composed of Quad ESL-63 electrostatic loudspeakers, a Spectral DMC-10 (Gamma version) preamp, Krell KMA100 mono amplifiers, Monster Cable interconnects, and Randall speaker wire. The audiophile who had assembled this system found the Tandbergs' sound accurate, although the Krell amplifiers (which cost more than twice as much as the 3009A pair) just edged out the 3009As by playing with "greater air, more ambience and definition in the highs," whereas the Tandbergs produced "smoother highs with less definition." For him, the Tandberg amps represented an excellent value.

After living with the 3009A amplifiers for more than two months, Clark ran a series of controlled, double-blind listening tests. He made 16 identification attempts over a 1½-hour listening session, using a Bryston 4B (dual-mono) amplifier for comparison. The results were 12 correct out of 16 trials, a statistically significant score. (We consider a score statistically significant when there is less than one chance in 20 of that score's being due to random guessing.)

In the same room at a later time—and using the same test records, amplifiers, and order of presentation of test trials—Clark tried to replicate this feat. During this second attempt, he achieved only seven correct identifications out of 16 trials, which we consider a statistically nonsignificant result. Because all conditions were held the same for these two tests, he felt it reasonable to combine the test results for a total of 19 correct out of 32 trials, again a result we do not consider significant.

In an attempt to resolve the different outcomes of the two Clark tests, Greenhill ran additional controlled listening sessions with the 3009As. Over a two-week period, he carried out six more tests, consisting of 208 controlled, double-blind A/B/X comparisons, gain-matching the Tandbergs with two other expensive amplifiers—the Levinson ML-9 and the Onkyo M-510.

If one separately analyzes each of the different listening tests we conducted, involving a total of 240 controlled trials, one sees there were no statistically significant sonic differences found between the Tandberg and the other amplifiers, some of which cost twice as much as the 3009As. This finding suggests that increasing the number of listening tests over our usual 16 trials will not necessarily uncover a subtle sonic difference between amplifiers.

On the other hand, our subjective listening sessions left us highly impressed by the sonics of both Tandberg products. Over and over, we used both amp and preamp in our reviewing and for recreational music listening—which is what audio is about, after all! The 3008A preamplifier was more convenient to set up, use, and demonstrate than other, more expensive but perhaps less elaborate preamps. We particularly liked the preamp's headphone controls. As for the amplifier, two 3009As were lighter and easier to set up than many heavy audiophile stereo amplifiers, and were at least as powerful!

The 3009A provided clean, effortless sound. Greenhill found over the months that these amplifiers continued to deliver outstanding transient speed and sound-stage width, with pinpoint instrumental placement, even though the results of the extensive double-blind tests revealed no distinctive sonic "fingerprint" for the amplifier which could be shown with statistical significance.

We feel very positive about these two new products from Tandberg. They are two of the best-designed, best-performing components we have tested for *Audio*. The 3008A preamplifier offers the prospective buyer a clever electronic design and outstanding functionality. The amplifier, which easily qualifies as a serious audiophile product, utilizes a paralleled MOS-FET output stage to deliver exceptional high-current performance, superb high-frequency response, and high power in a lightweight chassis at a reasonable price. We have only praise for the 3009A's sharp design and hot-rod performance.

Laurence L. Greenhill and David L. Clark

TABLE I

Maximum power output at 0.1% THD + N, 20 Hz to 20 kHz, 3009A amplifier.

Load, Ohms	Voltage	Current, Amps rms	Continuous Power, Watts	IHF Dynamic Power, Watts
8	45.2	5.7	255	359
4	44.4	10.6	449	402
2	37.2	18.6	692	414
1	28.6	28.6	818	286
0.5	18.5	37.0	684	
0.1	2.0	7.1	5	

TABLE II

THD + N (%) at rated output, 3009A amplifier.

Freq., Hz	8 Ohms, 200 wpc, 40 V	4 Ohms, 330 wpc, 36.3 V	2 Ohms, 450 wpc, 30 V
20	0.019	0.016	0.023
200	0.019	0.016	0.020
2k	0.020	0.016	0.019
20k	0.049	0.029	0.033

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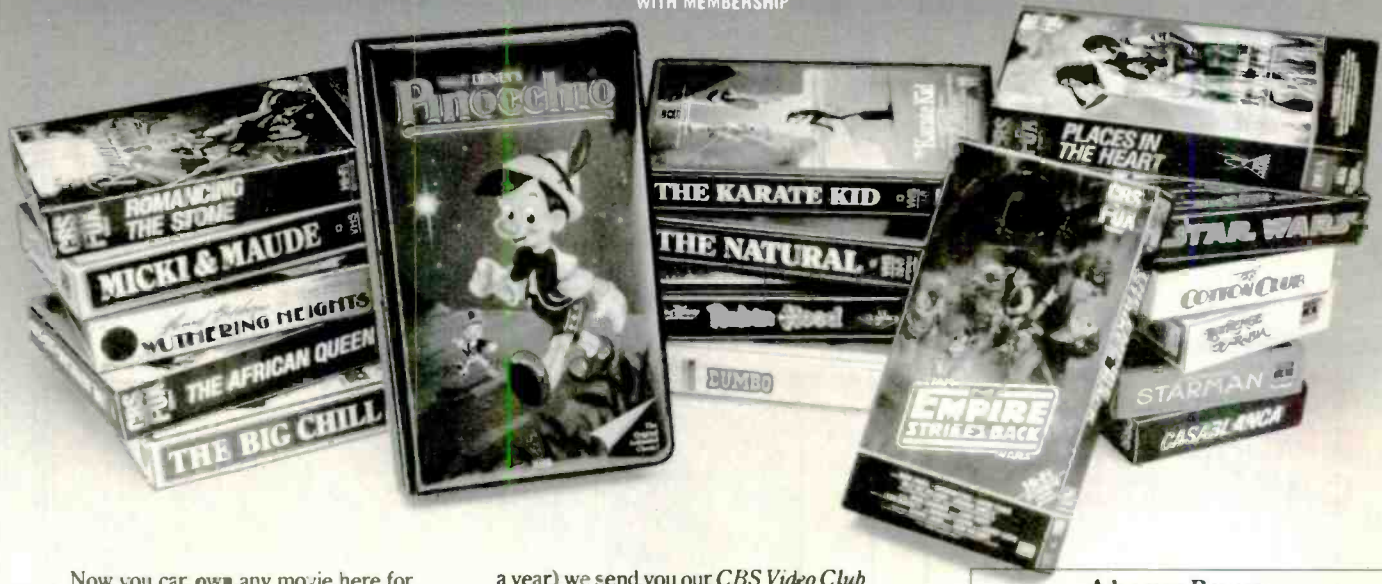

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THE BIG CHILL	1527022	STRIPES	1513162	PORKY'S	0775112
THE FLAMINGO KID	7135032	THE LONGEST DAY	0577052	THE ALAMO	0583052
THE EMPIRE STRIKES BACK	0910092	ALIEN	0002322	REVENGE OF THE NERDS	0925022
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THE KARATE KID	1710092	BUTCH CASSIDY & THE SUNDANCE KID	0517302	WEST SIDE STORY	0505342
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Magnetic Circuit: All "HPF" core, precision-polished finish.
Cantilever: Tapered boron pipe.
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Magnet: Neodymium; magnetic energy, (BH)max equals 35 mG•Oe.
Frequency Response: 5 Hz to 100 kHz; 15 Hz to 70 kHz, ±3 dB; 20 Hz to 15 kHz, ±0.5 dB.
Temperature Characteristics: 20° C, ±0.5 dB at 10 kHz, ±2 dB at 20 kHz.
Output Voltage: 2.5 mV at 1 kHz at 5 cm/S, zero to peak, lateral velocity; 3.5 mV at 1 kHz at 5 cm/S, zero to peak, 45° velocity.
Channel Separation: Greater than 25 dB at 1 kHz; greater than 20 dB at 10 kHz.
Channel Balance: Within 0.7 dB at 1 kHz.
Compliance: 12 × 10^{-6} cm/dyne (100 Hz).
D.c. Resistance: 500 ohms.
Inductance: 240 mH.
Impedance: 1.6 kilohms (1 kHz).
Recommended Load Resistance: 47 kilohms.
Recommended Load Capacitance: Less than 200 pF.
Stylus Tip: 0.2 × 0.7 mil, elliptical; 0.07-mm square-block diamond tip.
Effective Moving Mass: 0.109 mg.
Tracking Force Range: 1.25 grams, ±0.25 gram.
Overhang Adjustment Range: 52 mm, ±3 mm.
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For literature, circle No. 91

The difficulty of installing and aligning phono cartridges is one of the major barriers to replacing and upgrading them, and there is a definite trend towards simplifying this process. Several conventionally mounted cartridges come with special alignment tools, and the plug-in P-mount system (which requires virtually no adjustment) is growing in popularity. But the oldest approach to the problem is to integrate the cartridge and the arm or headshell.

The Mk4 version of the Technics 205C moving-magnet cartridge exemplifies this trend. It is available both as a P-mount cartridge and integrated into a "universal" shell that fits all "S" or "J" shaped arms which accept a standard shell design. I tested the latter version. The primary advantage of this integrated type is the ease with which both the overhang and azimuth alignment can be set with a single screw.

The most significant improvement claimed for the Technics EPC-205CMk4 over the previous 205C models is its super-lightweight cantilever, made out of a tapered, pure boron tube; the metal has been crystallized and then processed into a cantilever with a laser beam. This design results in a dramatic reduction in the effective tip mass, which is 0.109 mg. My measurements confirm the extreme stiffness of the tiny cantilever tube, which measures 8 mils in diameter at the tip and only 10 mils near the disc magnet. Care should be exercised when handling the cartridge or placing the stylus on the record,

inasmuch as pure boron is a bit brittle and the cantilever could be fractured if the stylus is dropped on a vinyl record more than three times or so.

The core material used in the magnetic circuit is "HPF" (a registered trademark), finely polished for superior high-frequency response to realize the flat transmission characteristics of an electric generator part. The armature magnet is made from neodymium—a trivalent metallic element of the rare-earth group—which has extremely strong magnetic energy [(BH)max equals 35 mG•Oe].

Butanol rubber is used for the damper on the majority of phono cartridges. Its major drawback is that it is temperature-sensitive. Technics developed a special material for the damper, called "TTDD" (Technics Temperature Defense Damper), which is quite insensitive to temperature variations.

The elliptical, nude-diamond stylus tip measures 0.2 × 0.7 mils and is only 4 mils across the flat area.

Like all Technics phono cartridges, the EPC-205CMk4 comes in a plastic box which also contains the usual assortment of mounting screws, stylus brush, screwdriver, and removable stylus guard. Also supplied is a printed frequency response curve which appears to be a general one but is actually made by the cartridge at hand, according to Technics.

Fig. 1—Frequency response (top curve) and separation as measured by two test discs (bottom curves).

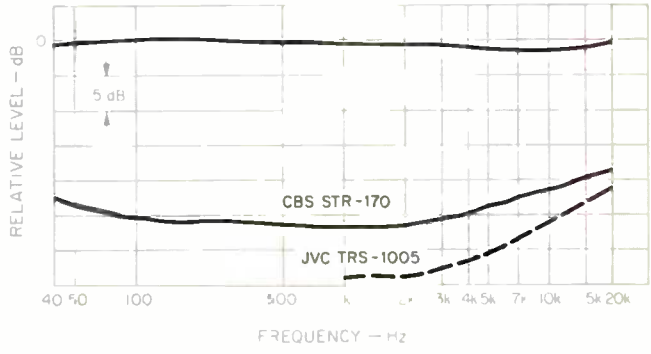
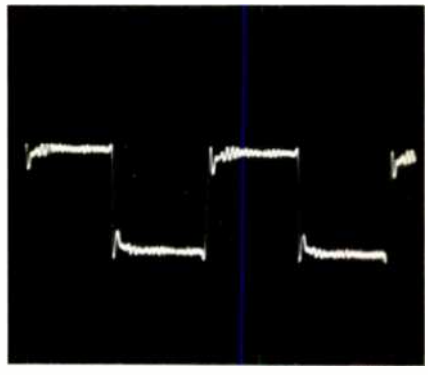


Fig. 2—Response to a 1-kHz square wave.



Measurements

The EPC-205CMk4, which comes mounted in its headshell, was plugged into a fairly light S-shaped tonearm that is a part of the EDS 25F turntable. The Dennesen Geometric Soundtracktor was used to orient the cartridge in the headshell and tonearm.

Laboratory tests were conducted at an ambient temperature of 70° F (21.11° C) and a relative humidity of 70%, ±3%. The tracking force for all reported tests was set at 1.25 grams, and anti-skating force was 1.5 grams. The cartridge load was 47 kilohms and about 175 pF capacitance for all the tests. (The EPC-205CMk4 cartridge, incidentally, appears to be slightly capacitance-sensitive.)

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

Frequency response, using the CBS STR-170 test record, is +0.25, −1.5 dB from 40 Hz to 20 kHz (Fig. 1). Separation is 26.5 dB at 1 kHz, 20.5 dB at 10 kHz, and 19 dB at 20 kHz. Using the JVC TRS-1005 test record, frequency response from 1 to 20 kHz is practically identical to that using the CBS disc, but the separation from 1 to 20 kHz is not only better, but quite remarkable: 35 dB at 1 kHz, 25 dB at 10 kHz, and 22 dB at 20 kHz. These data indicate that the EPC-205CMk4 has excellent frequency response and very good high-frequency separation.

The 1-kHz square-wave response (Fig. 2) is relatively flat; the ringing shown is on the test record at about 42 kHz, and was probably generated by the cutter head when the master was cut. The arm/cartridge low-frequency lateral resonance is 5.5 Hz, and the vertical resonance is also 5.5 Hz; both were measured with the EDS tonearm. The high-frequency resonance is at about 34 kHz. Despite the unusually low lateral and vertical resonant frequency, I did not hear any mistracking or distortion at any time. However, there seemed to be a hint of instability when some 12-inch, 45-rpm records were played.

Using the Dynamic Sound DMA-1 dynamic mass analyzer, I measured the arm/cartridge dynamic mass as 21 grams and the dynamic vertical compliance as 40 × 10^{-6} cm/dyne at the vertical resonant frequency of 5.5 Hz. The effective mass of the tonearm is 5.5 grams. The vertical stylus angle measured 24° for each channel. Lightly tapping the elevated tonearm elicited no microphonics, indicating that the cantilever assembly has an extremely low mass.

The following test records were used in making the measurements: Shure TTR-103, TTR-109, TTR-110, TTR-115, and TTR-117; Columbia STR-100, STR-112, and STR-170; JVC TRS-1005; Micro-Acoustics TT 2002; DIN 45.549; Ortofon 0001 and 0003, and EIAJ 31-1.

Other measured data are: Wt., 15.8 grams. D.c. resistance, 560 ohms; in-

Test data indicate that the EPC-205CMk4 has excellent frequency response and very good high-frequency separation.

ductance, 240 mH. Opt. tracking force, 1.25 grams. Opt. anti-skating force, 1.5 grams. Output, 0.706 mV/cm/S. IM distortion (200/4000 Hz, 4-to-1): Lateral (+9 dB), 1.2%; vertical (+6 dB), 2.6%. Crosstalk, 26.5 dB with CBS STR-170 and 32 dB with Shure TTR-109. Channel balance, 0.5 dB. Trackability: High-freq. (10.8 kHz, pulsed), 30 cm/S; mid-freq. (1000 and 1500 Hz, lateral cut), 25 cm/S; low-freq. (400 and 4000 Hz, lateral cut), 30 cm/S. The 300-Hz test band of the DIN 45.549 test disc was tracked cleanly to 100 microns (0.01 cm) in the right channel and 120 microns (0.012 cm) in the left. This is quite an achievement for the cantilever; not so very long ago, 60 to 70 microns was considered very good for any cartridge. The EPC-205CMk4 was also able to play all the test bands on the Shure Obstacle Course Era III, Era IV and Era V test records, certainly another remarkable feat.

Use and Listening Tests

The equipment used in the listening tests included the Technics EPA-A250 (S-shaped) interchangeable tonearm, attached to the Technics EPA-B500 tonearm base and mounted on a Technics SP-10MkII turntable. Also used were the Audio-Technica AT666EX vacuum disc stabilizer, the Amber FF 17 preamplifier, two VSP Labs TransMos 150 amplifiers (each used in the 300-watt mono mode), Discrete Technology speaker cable and interconnecting cable, a pair of B & W 801F loudspeakers, and the Technics SL-P10 CD player. Extensive listening tests were done before and again after the laboratory tests. In the pretest listening period, I also used the EDS-25F turntable with its own tonearm.

The low-frequency resonance of the EPC-205CMk4, in combination with the Technics tonearm described above, was 6 Hz. This is the same resonance frequency exhibited by all other recently tested cartridges when mounted in this arm, and ordinarily such a combination would have problems with record warps which cycle at about this frequency. However, at no time did I encounter any problem of mistracking or distortion during many hours of listening, whether I used the anti-resonance device or not—a tribute to the arm's design.

While listening to a wide variety of recordings, I noted, in particular, the excellent sonic clarity and lack of detectable coloration. Bass response was tight and well defined. Transient response and tracking ability, as well as applause definition, were excellent. The cannon shots on the Telarc "1812 Overture," with their very high recorded velocity, were reproduced without a bit of difficulty—all sounded very natural. Stereo imaging and depth were very good. The human singing voice was reproduced rather well and sounded better than on many expensive phono cartridges. All in all, the EPC-205CMk4 acquitted itself rather well and sounded silky and pleasing.

As I had done on occasion in the past, I compared two analog records with their CD versions, where both had been derived from the same digital master tape. On Beethoven's *Symphony No. 3 (Eroica)* (O. Suitner, Staatskapelle Berlin, Denon OX-7202-ND PCM on LP and C-37-7011 on CD), the cartridge reproduced this recording quite accurately, as it did the Mussorgsky "Pictures at an Exhibition" and "Night on Bald Mountain" (L. Maazel, Cleveland Orchestra, Telarc 10042 on LP and CD-80042 on CD).

After having played numerous recordings, I am firmly convinced that Technics' moderately priced EPC-205CMk4 is a genuinely "musical" phono cartridge that faithfully reproduces every nuance present on a record. Anyone looking for an excellent phono cartridge at a moderate price should consider it a superb choice.

B. V. Pisha

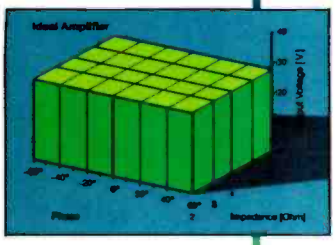
TRIAD

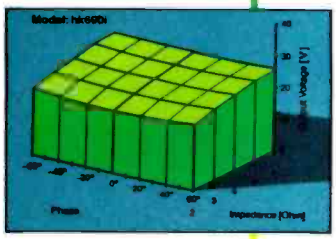
harman/kardon

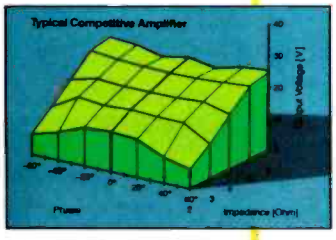
JBL

HIGH CURRENT CAPABILITY... THE PROVEN POWER REQUIREMENT

While most manufacturers design their amplifiers to produce the best possible FTC power ratings, Harman Kardon designs equipment to produce the best possible sonic quality. FTC power ratings are determined by the continuous power an amplifier can drive into a resistor—typically 8 Ohms—which is supposed to represent a loudspeaker load. However, when actually playing music, a speaker does not react like a simple resistor. A low frequency transient can make a nominally rated 8 Ohm speaker instantaneously demand 6 times as much current as an 8 Ohm resistor. For this reason every Harman Kardon amplifier and receiver incorporates High instantaneous Current Capability (HCC) to properly drive any loudspeaker system, regardless of its impedance.







To demonstrate reactive load proficiency, Harman Kardon has developed a 3-dimensional graphic technique that exhibits amplifier output voltage (Volts), load impedance (Ohms) and current phase (Degrees).

REACTIVE LOAD PROFICIENCY

Recently, some manufacturers have tried to imitate Harman Kardon's HCC, and show improved power ratings in 4 and 2 Ohm resistive loads. However, they are not providing a third, critical dimension of loudspeaker drive potential—the ability to drive reactive loads.

By only designing for resistive loads, the amplifier will only be able to drive loudspeakers under very specific conditions: When they draw current totally in-phase with the music (voltage) signal. However, loudspeakers are nearly always drawing a current that is out-of-phase with the music (voltage) signal, which dissipates higher internal power. Amplifiers not capable of withstanding this dissipation must have output protection, usually in the form of current limiting. This ultimately results in significantly less power driven into the loudspeaker. As a result, peak music signals sound less powerful and the full potential of the loudspeaker is not realized.

NOT ALL COMPACT DISC PLAYERS ARE CREATED EQUAL

The compact disc medium is capable of elevating sonic standards to new levels. However, all compact disc players do not deliver the same quality of sound. Harman Kardon, renowned for superior quality audio/video components, applied their carefully developed design philosophies to the sonically superior HD500.

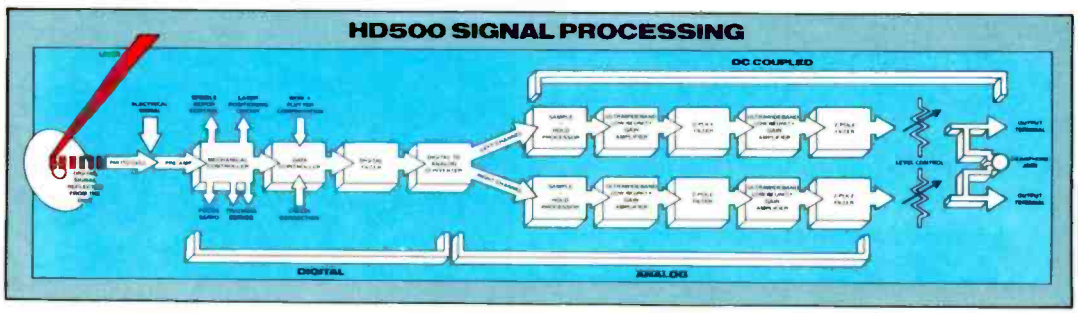
The digital sections of compact disc players are all basically the same, comprised primarily of integrated circuits (ICs). To create a superior sounding product, Harman Kardon paid particular attention to the design of the analog output section.

The most significant problems inherent in the compact disc medium are ultrasonic signals, known as "alias error." Most digital-to-analog converters employ a digital filter that suppresses these ultrasonic signals by 40dB. But, even at 40dB below the music, these signals cause the conventional analog sections to create highly audible intermodulation (IM) distortion.

To reduce this IM, conventional designs try to remove as much of the ultrasonic signals as is possible. Some manufacturers use digital filtering, but the result is a "processed" sound quality, lacking in detail. Others employ steep multi-stage 2-dimensional sounding analog filters with high negative feedback: This method produces severe phase shifts at mid-range and high audio frequencies, in addition to producing transient intermodulation distortion (TIM).

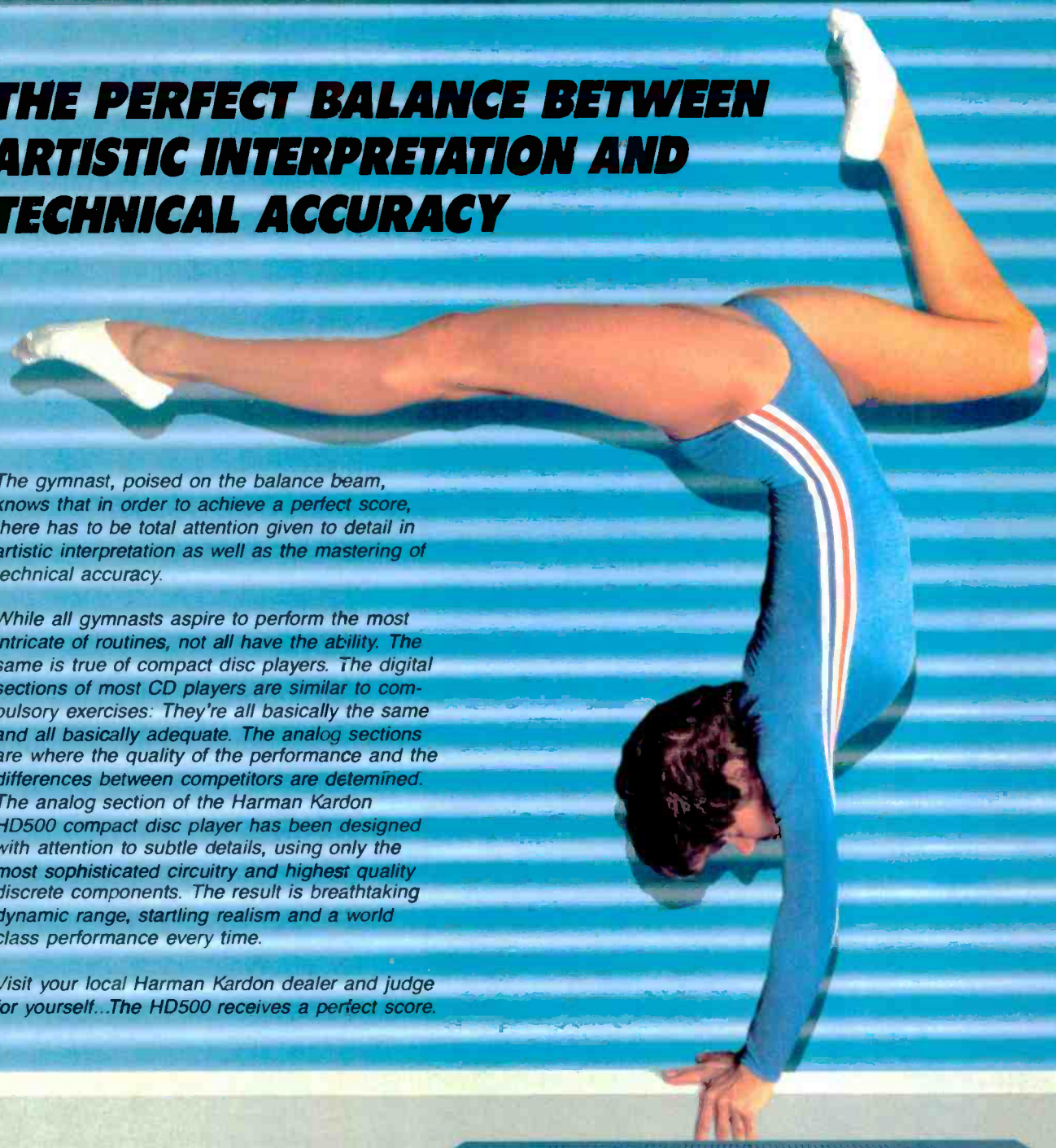
In sharp contrast, Harman Kardon developed an analog output section with exceptionally low IM, so that audible effects from the signals are virtually eliminated. A simple analog filter was then added to gradually reduce these ultrasonic signals. In addition, this section utilizes no negative feedback, which also eliminates TIM, yielding 3-dimensional imaging and clear, crisp sound.

For ease of operation, the HD500 is equipped with a full-function infra-red wireless remote control, which duplicates all of the front panel functions. The HD500 has been carefully designed to complement the sound and look of all Harman Kardon audio/video components. The Harman Kardon HD500... Created better than the rest.



THE HARMAN KARDON HD500 COMPACT DISC PLAYER

THE PERFECT BALANCE BETWEEN ARTISTIC INTERPRETATION AND TECHNICAL ACCURACY



The gymnast, poised on the balance beam, knows that in order to achieve a perfect score, there has to be total attention given to detail in artistic interpretation as well as the mastering of technical accuracy.

While all gymnasts aspire to perform the most intricate of routines, not all have the ability. The same is true of compact disc players. The digital sections of most CD players are similar to compulsory exercises: They're all basically the same and all basically adequate. The analog sections are where the quality of the performance and the differences between competitors are detemined. The analog section of the Harman Kardon HD500 compact disc player has been designed with attention to subtle details, using only the most sophisticated circuitry and highest quality discrete components. The result is breathtaking dynamic range, startling realism and a world class performance every time.

Visit your local Harman Kardon dealer and judge for yourself...The HD500 receives a perfect score.

harman/kardon

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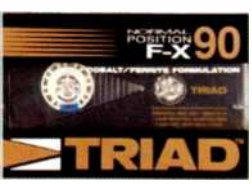
ETAL TAPE

EM-X 90

ETAL FOR THE
RICE OF CHROME

F-X 90



OBALT-DOPED
ERRITE TAPE

TRIAD AUDIO TAPES: TECHNICAL BREAKTHROUGHS DELIVER HIGHER QUALITY AT LOWER COST

For the first time in fifteen years a new tape technology has been introduced into the market. Newly developed, patented processes enable Triad—one of only four companies worldwide with proprietary formulations for the manufacture of audio tape—to offer sonically superior audio tapes at lower costs.

SUPERIOR METAL TAPE

The MG-X90 is a metal tape for the metal position. Fine crystals form needle shaped ferrous hydroxide particles which are near perfect in uniformity of size and composition. This advanced formulation allows the MG-X to deliver uncommonly high coercivity (1150 Oe) and retentivity (3300 G). The unique patented process that is employed in the manufacture of MG-X allows this pure metal tape to be offered to the consumer without the necessity of paying the premium associated with metal tape. Triad's MG-X defines new parameters of performance.

METAL FOR THE PRICE OF CHROME

The EM-X90 formulation, a metal tape for the high bias (CrO2) position, offers true metal tape at the price of chrome. A technologically advanced process, which has garnered 20 worldwide patents, is utilized on EM-X90. The same process of forming needle shaped ferrous hydroxide particles is utilized as on the MG-X; however, the crystals that are formed are subsequently divided to reduce the tape's coercivity and allow its use in the high bias position. EM-X offers a high MOL (315Hz, +5.0dB) and impressive SOL (10kHz, -3.0dB). Since metal tape is used in the high bias position, it can be used in any home, car or portable cassette unit...A flexibility never before available.

EXCEPTIONAL NORMAL POSITION TAPE

Triad's F-X90, a cobalt-doped ferrite tape for the normal position, has the widest dynamic range and flattest frequency response of any normal bias tape on the market. A unique cobalt saturation method is employed in its manufacture, enabling the F-X to deliver previously unheard of specifications for a normal bias tape: Exceptional coercivity of 380 Oe and retentivity of 1800 G. F-X now becomes the standard by which the performance of all other normal bias tapes will be judged, but none will equal.

All three tape formulations are housed in Triad's precision "Delta" transport mechanism, which is meticulously engineered to ensure the best possible performance. Each of these Triad tape formulations deliver the exceptional dynamic range and performance superiority so important when reproducing digital source material.

MG-X, EM-X and F-X...Delivering a level of quality available only from Triad.

THE NEW JBL "L" SERIES: BRINGING PRO SOUND ALL THE WAY HOME

JBL's technical expertise and sonic accuracy makes JBL loudspeakers the choice of audio professionals around the world. Now, for the first time, the intended original dynamic range, extended frequency response, and re-creation of the full sound stage is available for home use. For the first time ever, the same speakers relied on by the professionals—producers, engineers and performers—to mix their recordings, sets the stage in the home environment.

For those who demand the same superior performance, sonic accuracy, reliability and power handling...The new "L" series from JBL.

The entire "L" series employs pure titanium for the high frequency transducers (tweeters). A high frequency transducer must be light enough to respond instantly to musical transients, yet strong enough to endure crushing force: Titanium has an extremely high strength-to-weight ratio. Until recently, it could not be fabricated thin enough to produce a dome. JBL engineers developed a unique process that forms the titanium dome perfectly and without causing stress fractures, yielding a high frequency response that is flat to 27kHz and smooth and neutral in sound character through the crucial 3kHz to 20kHz range.

Aquaplas, a trademarked substance, was chosen for use in the low frequency transducer cones (woofers) of both the L80T and L100T. JBL engineers have used Aquaplas very successfully in the JBL professional line for the last fifteen years. These low frequency transducers exhibit excellent linearity (low harmonic distortion) and the smoothest natural high frequency roll-off of any low frequency transducer available.

It is the crucial function of the crossover network to distribute the various frequencies to the respective transducers, and, in so doing, "orchestrate" the interaction that changes exceptional components into exceptional sound. Crossover points between components in the "L" series are achieved by High Spatial Identification Networks. Not only do these ensure smooth transducer-to-transducer transitions, they additionally guarantee proper musical placement, as was the intention during the recording process.

JBL's selective use of materials and attention to detail enables the "L" series to generate the most accurate signals with utmost reliability—enormously significant with the prevalence of digital sources.

Additionally, the cabinetry of JBL's new "L" series reflects their tradition of aesthetic as well as acoustic excellence.

The new "L" series from JBL...Bringing professional sound all the way home.

THE NEW JBL "L SERIES" SETS THE STAGE AT HOME

JBL, the most respected name in professional sound for over 40 years, is today's speaker of choice. At live concerts, where 125,000 Watts drive over 600 speakers, and in 70% of the world's recording studios, JBL is the speaker chosen by professionals—performers, engineers and producers—who depend on the highest quality sound and reliability.

Now, for those who demand the same superior performance, JBL introduces the new "L Series." Each speaker in the "L Series" has a direct twin in the JBL professional studio monitor line. For the first time, the speakers relied on by recording engineers to mix the music, are available for your living room.

All of these speakers share the technology that is the cornerstone of JBL's Professional Speaker Systems—all use titanium dome tweeters, filled and laminated polypropylene and Aquaplas drivers, as well as cast frames for sonic accuracy, reliability and power handling.

Visit your local JBL dealer today and listen to professional sound for the home, made in the USA, by the sound professionals...JBL.

The New JBL "L Series".. Bringing Pro Sound All The Way Home.

JBL

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CH160
Harman Kardon
In-dash Unit

T545
JBL Automotive
Loudspeaker

CAR AUDIO...INNOVATIONS THAT OFFER PERFORMANCE PREVIOUSLY AVAILABLE ONLY AT HOME

Teaming Harman Kardon's striking new line of car audio products with JBL's powerful line of automotive loudspeaker systems, leads you to a higher fidelity on the road. Elevating car audio standards, these components and speakers smoothly outdistance the competition by reflecting the excellence so finely honed by both companies in their home audio products over the decades.

Three Harman Kardon in-dash cassette/tuners—the "CH" line—and three power amplifiers—the "CA" line—blaze new trails, all using heavy duty design construction for ruggedness and reliability. Each in-dash unit incorporates a cassette deck section that delivers an exceptional frequency response of 20-20,000Hz ±3dB; and a tuning section that provides a careful balance of sensitivity and interference rejection. Each amplifier offers High instantaneous Current Capability, Low Negative Feedback and Ultrawidebandwidth.

JBL, the number one choice of music professionals, offers a variety of speaker designs to suit your needs, each delivering the big clean sound sought after in automotive loudspeakers. Features include low frequency drivers with ribbon wire voice coils for increased power and efficiency; die-cast aluminum frames and unique graphite frames that provide greater strength and durability; and angled tweeters for extended high frequency response.

The previously unexplored realms of car audio are now within reach, for those tuned to a higher fidelity. From Harman Kardon and JBL.

CA260
Harman Kardon
Automotive Amp

T545
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Loudspeaker

TRIAD

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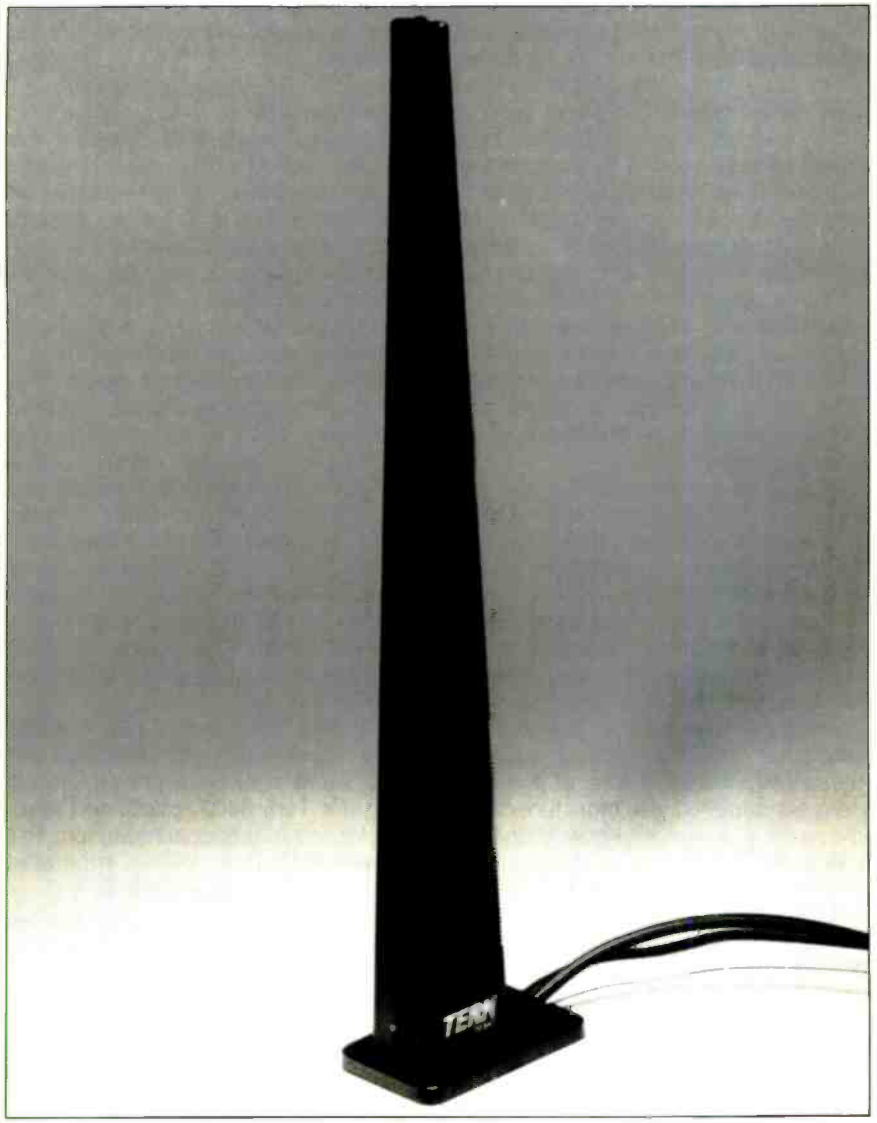
3

TERK 8403 FM ANTENNA



Manufacturer's Specifications
Amplifier Gain: Adjustable, 0 to 18 dB.
Selectivity: 0-dB gain at 50 MHz and at 150 MHz.
Twin-Tone Intermodulation Distortion: Less than 0.1% at 100 mV.
Noise Figure: 3 dB.
Output Matching Accuracy at 75 Ohms: Standing Wave Ratio less than 1.2:1.
Pickup Pattern: Omnidirectional or directional.
Price: $75.
Company Address: 740 Broadway, New York, N.Y. 10003.
For literature, circle No. 92

Every time I write about the need for a good outdoor directional FM antenna, I am bombarded with correspondence from irate readers who tell me they aren't permitted to (or can't) mount a roof antenna. Once in a while I am asked if there is an alternative to a high-gain, directional, multi-element, outdoor FM antenna. The last one I came across was the Beam Box, a clever little component marketed by B·I·C/Avnet. Alas, that antenna, and the company that developed and sold it, are no more.

But don't despair, you apartment dwellers who, for whatever reason, can't mount antennas atop your homes. Now there is another excellent indoor antenna available, the Terk 8403. This little antenna, which comes from Italy, is an active device; that is, it contains an r.f. booster amplifier circuit and must therefore be connected to an a.c. outlet. Normally this is no problem, since you can connect the antenna's line cord to a switched a.c. receptacle on your amplifier or receiver.

The configuration of the Terk 8403 is unusual, to say the least. It stands about 16 inches tall and resembles a tapered obelisk. A visitor to my lab described it as a miniature model of the Washington Monument—except for its black color. Emanating from its base is a coaxial cable, which terminates in a standard F-type connector, and the power line cord. If your particular tuner or receiver is not equipped with a standard, 75-ohm coaxial connector, you can attach the 75/300-ohm transformer supplied with the antenna. The 300-ohm end of this transformer is terminated with a short length of standard twin-lead cable and a pair of spade lugs that fit nicely under most antenna-terminal screws. The owner's manual tells you in detail how to connect the Terk 8403 to a wide variety of antenna terminals—both 75- and 300-ohm—that are found on typical FM tuners and receivers.

With gain at its maximum, I obtained higher readings for signal strength in the directional mode than in the omnidirectional one.

The only user control on the 8403 is a gain adjustment whose small shaft is accessible from the bottom of the antenna base. Since this control covers a very wide range (from no gain to around 24 dB of gain at the middle of the FM band), I found its location a bit disconcerting. Gain is supposed to be adjusted for optimum reception, but to do so you must upend the entire antenna, which often changes the strength of the received signal that you are trying to optimize. In my opinion, the gain control should have been brought up to the front, near the tiny red pilot light. That would allow you to adjust gain without changing the orientation of the antenna itself.

Terk makes a big point of the fact that the antenna, omnidirectional when it is normally oriented (standing on its base), can be made directional when it is oriented horizontally. Indeed, I found this to be the case, and as a result I decided to measure the antenna's reception capabilities for both its omnidirectional and directional orientations.

As in previous tests of this kind, my reference antenna was a carefully measured, folded dipole of the type normally supplied with most tuners and receivers. As we all know, very few users take the trouble to tack up these T-shaped, 300-ohm wire antennas properly, with the upper part of the T stretched out horizontally to its full length and oriented perpendicular to the direction of the incoming signal. But for the purpose of these measurements I did so, mounting mine on a wall that faced New York City's Empire State Building and World Trade Center, where most of my local FM signals originate.

The Terk antenna was placed on the test bench a few feet away from a Blonder-Tongue Model FSM-2 field strength meter. This meter covers the entire VHF and UHF TV-frequency bands, and, since it is continuously tunable, it covers the entire FM band as well. A headphone jack on the test instrument permits the user to monitor the incoming signal modulation. By comparing what I heard with what was received on my frequency-synthesized tuner, I was able to pinpoint the incoming signal frequency without having to wait for station identification announcements. Altitude at the test location is about 75 feet above sea level, and the distance to mid-Manhattan is around 18 miles.

Measurements

Because I wanted to compare this with the kind of performance I would get from the 300-ohm, twin-lead dipole antenna mounted on the wall, I considered whether I should re-orient the reference antenna optimally for each incoming signal. I decided against it because typical users are unlikely to reposition a wire dipole antenna every time they change stations. Accordingly, I picked up nine signals, spaced reasonably apart in frequency, using the simple reference dipole. Signal strengths for these nine different signals, measured in microvolts referred to 75-ohm antenna input impedance, are tabulated in the second column of Table I. With the dipole in its fixed position, signal strengths ranged from a low of 40 μV (the station at 105.9 MHz) to a high of 275 μV (at a frequency of 92.3 MHz).

The third column in Table I represents signal-strength readings for those same stations when picked up using the Terk 8403, positioned vertically for omnidirectional reception. The two readings in this column, separated by a slash, are for minimum and maximum settings of the antenna's gain control. Notice that in every single case, the maximum-gain readings obtained with the Terk antenna in its omnidirectional mode were higher than those obtained with the ordinary dipole placed in a fixed position. The differences in signal strength, however, are not consistent from station to station. Perhaps this is because some stations were more on the dipole's axis than others; perhaps it is because some stations transmit all their energy in horizontal polarization, while others use both vertical and horizontal.

The readings obtained at minimum gain settings of the Terk antenna are all lower than those obtained with the standard twin-lead dipole. This is to be expected since, among other reasons, the overall length of the Terk antenna is barely more than one-quarter of a wavelength at FM frequencies, whereas the standard twin-lead dipole is a half-wavelength long.

The next column contains pairs of readings (for minimum/maximum gain settings) with the Terk antenna positioned horizontally and oriented for highest signal readings. Generally speaking, I obtained higher readings for most of the nine stations I checked

Table I—Comparative strengths (in μV) of incoming FM signals, for standard dipole and Terk 8403 antennas.

		Terk 8403				
			Directional			
Station Frequency, MHz	Dipole	Omnidirectional (Min./Max. Gain)	Oriented Toward Station (Min./Max. Gain)	Gain, dB	Oriented Away from Station (Min./Max. Gain)	Rejection Ratio, dB
89.3	60	20/700	20/700	21.3	N.A./50	22.9
92.3	275	10/300	20/650	7.5	10/75	18.7
95.5	200	15/450	25/600	9.5	18/250	7.6
97.7	100	15/300	33/850	18.6	10/250	10.6
99.5	125	30/800	30/800	16.1	N.A./50	24.1
101.9	70	47/850	60/1000	23.1	N.A./45	26.9
104.3	150	40/500	65/1000	16.5	15/270	11.4
105.9	40	10/80	N.A./100	8.0	N.A./25	12.0
107.5	100	30/600	25/400	12.0	N.A./40	20.0

Notes

1. Gain figure is the ratio, in dB, between the signal strength from the Terk 8403 when set for maximum gain and oriented directionally towards each station and that from a standard dipole. See text.
2. N.A. = Reading too low on field strength meter to accurately read; signal too weak to be usable.

In city listening, the gain control solved overload problems easily, and careful antenna orientation overcame almost all multipath difficulties.

when in this directional mode than when the antenna was standing up in its omnidirectional mode. However, readings were the same for two stations, regardless of the Terk's orientation, one station consistently came in *weaker* with the antenna directionally oriented, and another station came in weaker in the directional mode than in the omni mode when the antenna's gain was set to minimum, but stronger when the gain was set to maximum.

Since maximum signal strength was obtained most often with the antenna in its directional mode, and oriented toward the station, I used these figures (for the Terk's maximum gain setting) to show its gain, in dB, relative to that of a standard dipole for each of the nine stations used in this test. For example, the ratio between the signal strength at 92.3 MHz with the Terk antenna set for maximum gain and oriented towards the station (650 μV) and with the dipole (275 μV) is 650/275, or 2.36. Converting this to decibels yields a result of 7.5 dB, using the formula:

$$dB = 20 \log_{10} V1/V2.$$

Gain is not always the most important aspect of a directional antenna's performance. The ability to reject signals from some angles is also important, in terms of the antenna's ability to reject multipath signal reflections. Directional roof antennas usually reject signals arriving from the rear; the Terk, in its directional mode, rejects signals arriving from the side. Its pattern, in other words, is a figure-8, somewhat like that of the standard dipole.

But the Terk antenna's shape and variable gain make its directivity more useful than a dipole's. Its shape makes it physically easier to orient in any desired direction. And its gain can be varied to meet the task at hand: In the rare cases where aiming the 8403 at the station would bring in multipath along with the strong, direct signal, it can be aimed at a single, weak reflection and its gain raised to compensate. Alternatively, gain can be lowered to drop weaker multipath reflections down to signal levels that the tuner will be able to ignore.

To measure the Terk's directional abilities, I rotated it, still in its directional (horizontal) mode, so as to obtain *minimum* readings for each of the nine stations checked. The larger the ratio

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The 8403 makes it possible to enjoy FM more nearly as it was meant to be heard, at a price that will hardly be noticed.

between signal strengths when the antenna is oriented for maximum and minimum reception of a station, the more directional that antenna is. The ratio of rejection is usually given in dB, as I have done in the last column of Table I. For example, the ratio between the signal strength at 92.3 MHz with the Terk antenna at its maximum gain setting and oriented toward the station (650 μV) and away from it (75 μV) was 650/75, or 8.67:1. Converting this to decibels yields a result of 18.7 dB.

Use and Listening Tests

From earlier tests of active antennas, I have learned that signal-strength readings hardly describe a given antenna's merits. The mere fact that an active antenna provides gain doesn't mean that reception will be improved. For example, if noise is amplified along with the desired signal, there will be little or no improvement in FM quieting. I felt, therefore, that it would be important to experiment with the Terk under actual listening conditions. After doing just that for a week or so, I can report that this little antenna really does a great job. For the most part, I used the antenna with its gain control set nearly to its highest point and with the antenna standing straight up, for omnidirectional reception. Admittedly, my location does not suffer too much from multipath interference, so one night, while visiting someone in New York City, I convinced my host to disconnect his roof antenna (he is one of the lucky few who is allowed to have his own) and to substitute the 8403.

This test was much more severe than the listening tests I had conducted miles away from the city, for now we were plagued with all kinds of multipath and overload problems. Happily, the gain control on the antenna was able to solve the overload problems easily, and careful orientation of the antenna itself (now operated horizontally for greatest directional sensitivity) solved all but the most severe multipath problems. A trace of multipath distortion still could be heard on two incoming signals—but at least a dozen signals had suffered from severe multipath distortion when we tried the standard dipole in this location. Interestingly, the Terk even cleaned up some of the stations that had exhibited multipath distortion when their signals were received via my friend's carefully oriented outdoor antenna.

As an FM-radio devotee, I am always pleased to see new products that make it possible to hear FM more nearly as it was meant to be heard. The Terk 8403 is just such a product, and its cost will hardly be noticed compared to that of your FM tuner or receiver. It will help you get more out of your FM radio than you thought was possible—especially if you are a city dweller who had all but given up hope of receiving clean, noise-free, distortion-free signals. *Leonard Feldman*

4

GRACE G-747 TONEARM AND F-9E SUPER CARTRIDGE

Manufacturer's Specifications

Tonearm

Overall Length: 11-9/16 in. to 12⅝ in. (293 mm to 321 mm), depending on counterweight position.
Effective Length: 9-5/16 in. (237 mm).
Angle of Rotation: Approximately 80°.
Balance and Tracking-Force Adjustment: Static balance; tracking force adjustable in 0.1-gram steps.
Output Cable: Plug-in, molded type.
Capacitance: 86 pF, including cable.
Headshell: Plug-in, lightweight (approximately 6 grams).
Range of Usable Cartridge Weights: 4 to 10 grams; 10 to 17 grams with optional J weight.
Price: $300; J weight, $12.

Phono Cartridge

Type: Moving magnet.
Frequency Response: 10 Hz to 47 kHz, ±2 dB.
Output: 3.75 mV at 5 cm/S at 1 kHz.
Separation: 30 dB at 1 kHz.
Stylus Force Range: 0.5 to 2 grams; recommended stylus force, 1.5 grams.
Compliance: 20 × 10^{-6} cm/dyne.
Impedance: 1.7 kilohms at 1 kHz.
Suggested Load Resistance: 47 kilohms.
Recommended Total Load Capacitance: 200 pF.
Price: $200; replacement stylus, $100.

Company Address: c/o Sumiko, P.O. Box 5046, Berkeley, Cal. 94705.
For literature, circle No. 93

In the early 1970s, when CD-4 discrete four-channel records were being produced, much work was done by cartridge and tonearm manufacturers, including Grace, to extend high-frequency response so that the carrier system used for the rear-channel information could be transduced properly. This led to many improvements in phono cartridges and tonearms. The CD-4 system is no longer with us, but the research that was done for it continues to yield sonic benefits. The ability to reproduce wide-band signals has resulted in more transparent sound, as evidenced by the Grace G-747 tonearm.

The G-747 has been a favorite of many audiophiles, for very good reasons: It uses simple, proven design principles and high-quality materials, and in this era of very expensive tonearms, it offers an alternative to taking out a second mortgage on your house. The G-747 is a good choice for use with many of the excellent moving-magnet cartridges offered by various manufacturers. Since the Grace F-9E Super cartridge is particularly well matched to the G-747 tonearm, I used this cartridge for most tests of the G-747. Other cartridges were also used during the evaluation, with good results.

Grace has been making moving-magnet cartridges for some time, and a few years ago, the audiophile community became aware that the company's F-9E was an outstanding example of the type. The F-9E Super is an upgraded version of this cartridge. The damping material has been improved so that tracking is better at the lower and middle frequencies, without a sacrifice of high-frequency performance. The inductance of the coils has been reduced; this is good because it raises the electrical high-frequency resonance (when loaded by the same capacitance as the earlier model), giving the F-9E Super more extended high-end response. Reducing the number of turns of wire in the coils (to lower the cartridge's inductance and resistance) also reduces the output; to compensate, a samarium cobalt magnet, with greater magnetic force for a given mass than Alnico V, is used.

The stylus has been improved as well. Like previous Grace cartridges, the F-9E Super uses Ogura Vital diamonds, made from rectangular rather than square blocks of diamond, to reduce tip mass. In the F-9E, the diamond's grain has been reoriented so that the hardest part of the stylus contacts the record groove. This should yield even longer stylus life.

The first thing I noticed about the G-747 arm was that the mounting system requires only a single hole in the mounting board; the tonearm pillar is locked to the bottom of the mounting board by a single, large hex nut. This makes installation very easy. A template is supplied to ensure accurate positioning of the tonearm with respect to the turntable's center spindle.

The G-747 has precision-jewelled gimbals for both vertical and lateral pivots. When I tried to push and pull the tonearm pipe to see if there was any looseness in the bearings, I couldn't feel any at all, and this is as it should be.

The tonearm pipe, counterweight, pillar and special-alloy headshell are finished in black. The calibration marks on the rotatable counterweight are white, with a red reference line on the fixed tube. The armrest and sidethrust compensator

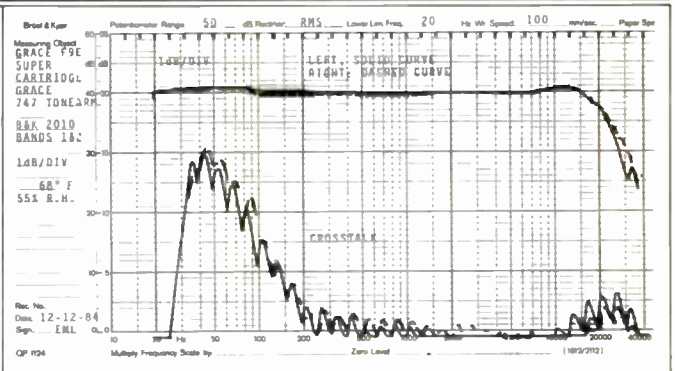

Fig. 1—Frequency response and interchannel crosstalk of arm and cartridge, using B & K 2010 test record. Note unusually close matching between channels.

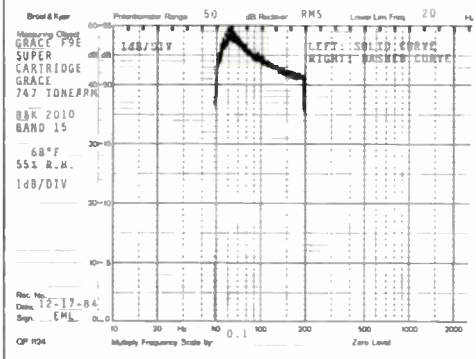

Fig. 2—Low-frequency tonearm/cartridge resonance is at 6 Hz, with a Q of 4.6, using B & K 2010 test record.

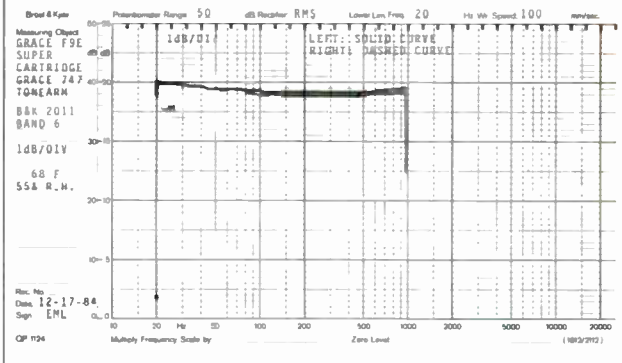

Fig. 3—Tonearm resonance check, using slow sweep from 20 Hz to 1 kHz.

The F-9E Super cartridge and G-747 arm reproduce stereo spaciousness and imaging exactly as they are recorded.

are on a small platform which encircles the main pillar. The thin, straight tonearm pipe has very little sound of its own when tapped. A separate headshell makes mounting and adjusting different cartridges easy; when changing cartridges, only the tracking force must be reset.

The G-747 is statically balanced. The same counterweight is used to balance the arm and to set the tracking force; the tonearm's dynamic mass seems low enough to employ this method with good results. After the arm is balanced for a given cartridge by adjusting the counterweight, a calibrated ring on the weight is adjusted until its zero mark is at the red reference line on the arm tube. The tracking force is then set by rotating the counterweight toward the pillar until the number on the ring that represents the desired tracking force is lined up with the red mark. I found the calibration to be very accurate, with an error of no more than 0.1 gram. The height of the main arm pillar is adjustable over a range of about 1.8 inches to accommodate turntable platters and cartridges of varying heights.

The sidethrust compensation is set by moving a counterweight on a small lever which is attached to the rear of the arm pipe by a thread. The lever, which has calibration marks, is pivoted so that as the tonearm moves toward the center of the record, the weight is slowly raised. The integral

MEASURED DATA

Grace G-747 Tonearm

Parameter	Measurements/ Comments
Pivot to Stylus	9.33 in. (237 mm)
Pivot to Rear of Arm	2.25 in. (64 mm) maximum
Overall Height Adjustment	1.25 in. (32 mm)
Tracking Force Adjustment	0 to 2.5 grams
Tracking Force Calibration	0.1-gram divisions
Cartridge Weight Range	4 to 10 grams (optional J weight, to 17 grams)
Counterweights	One (89.3 grams); J weight optional
Counterweight Mounting	Rubber damped
Sidethrust Correction	Lever-and-thread system, calibrated weight
Pivot Damping	None
Lifting Device	Damped lever plus finger lift on headshell
Headshell Offset	23°
Overhang Adjustment	Slots in headshell
Bearing Alignment	Excellent
Bearing Friction	Less than 40 mg
Bearing Type	Gimbals with jewelled pivots, vertical and horizontal
Lead Torque	Negligible
Arm Lead Capacity, pF	45 (arm tube) + 75 (cable); 120 total
Arm Lead Resistance, Ohms	0.91 (arm) + 0.14 (cable); 1.05 total
External Lead Length	44 in. (110 cm)
Structural Resonances	Slight "klock" sound (see Figs. 4 and 5)
Base Mounting	Single hole, threaded post, hex nut

Grace F-9E Super Cartridge

Parameter	Measurements/ Comments
Coil Inductance	410 mH
Coil Resistance	735 ohms
Output Voltage	0.78 mV/cm/S
Tracking Force	1.3 to 1.8 grams
Cartridge Mass	6.9 grams
Microphony	Very low
Hum Rejection	Excellent
High-Frequency Resonance	34.5 kHz
Rise-Time	18 μS
Low-Frequency Resonance	6.0 Hz
Low-Frequency Q	4.6
Recommended Load Resistance	47 kilohms
Recommended Load Capacitance	180 pF
Recommended Tracking Force	1.5 grams

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The F-9E Super's response is actually flat to 20 kHz, with smooth, gradual roll-off above that frequency.

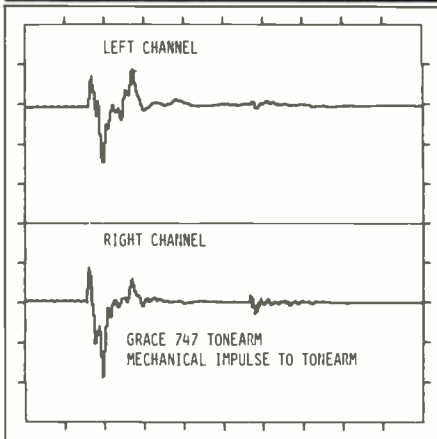

Fig. 4—Output of tonearm due to mechanical impulse applied to arm tube, with arm on rest but not locked. Total time period is 20.47 mS.

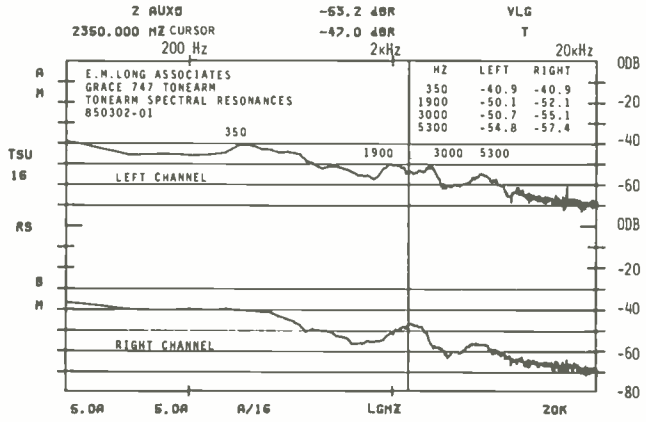

Fig. 5—Spectral analysis of tonearm output due to mechanical impulses, with 16 impulses applied and averaged. Output in the 1.9 to 3-kHz region could make the sound seem "forward."

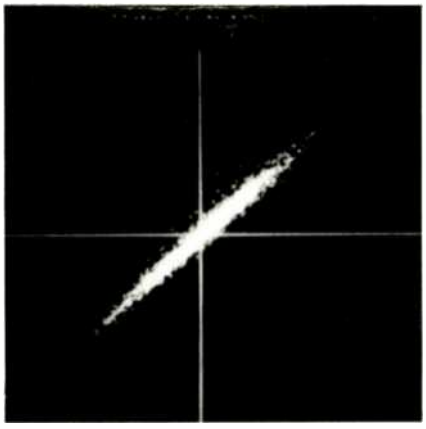

Fig. 6—Interchannel phase of cartridge, using B & K 2011 test record, band 7, pink noise.

armrest has a friction-fit clamp which holds the tonearm pipe securely. The cueing mechanism, used to lower and raise the tonearm, is damped; if the arm is dropped accidentally, it will not damage a record.

The headshell is made of lightweight aluminum—a good choice, because it is rigid as well as very low in mass. Since the cartridge and headshell are at the end of the tonearm, their mass affects performance greatly. For best performance, any necessary mass should be as near the pivots as possible. This can be achieved with the counterweight, but the cartridge and headshell must be at a distance from the pivots and so should be as light as possible. The F-9E Super cartridge weighs 6.9 grams, which is moderate for a moving-magnet type.

Measurements and Listening Tests

The smooth, open sound quality of the F-9E Super cartridge is verified by the data for amplitude versus frequency response, shown in Fig. 1. The results are for the B & K 2010 test record, which has a top frequency of 45 kHz. I use this record because it has extended response above 20 kHz and very low crosstalk above 200 Hz; however, it has a slight droop above 15 kHz, which accounts for some of the roll-off shown. I also used the JVC TRS-1007 sweep test record, which has a very uniform response up to 20 kHz. With this disc, the F-9E Super's output is actually flat to 20 kHz, but the important thing to note is the smooth, gradual roll-off. This is a characteristic of excellent *practical* high-frequency amplitude and phase response; more extended response could cause problems for some preamps. Some of the comments made by the listening panel, while not mentioning it directly, could be related to the smooth, extended high-frequency response of this Grace combination. For instance, it was felt that the sound of brushes on drums was very realistic.

The extremely low crosstalk between channels, especially at the higher frequencies, is amazing. I think this has much to do with the cartridge's clarity. While Fig. 1 does not show this, due to the B & K test record's roll-off, tests made with the JVC record show that the small amount of crosstalk above 20 kHz centers around 34.5 kHz; this is the usual high-frequency resonance caused by the stylus mass interacting with the compliance of the record material. The crosstalk in the low-frequency range seems to be an artifact of the test record itself, since it appears in every test I have ever done with that record. (With the other test records I use, low-frequency crosstalk is at a much lower level. Figure 1 does, however, allow comparison with other cartridge/tonearm combinations which I have tested in the past.)

The low-frequency resonance caused by the interaction of the tonearm's dynamic mass and the cartridge's compliance is shown in Fig. 2. This resonance is at 6 Hz, lower than some experts recommend, but I think it would only be a problem with badly warped or off-center records, since it appears to be fairly well controlled. Except for occasional problem records like these, such low-frequency extension is an advantage, since it gives the bass, in the audible band, a more uniform frequency and phase response. The bass was considered very good by the listening panel, albeit a bit less damped than the reference system's. The sound of guitar,

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The ability of the Grace arm and cartridge to reproduce a 30-cm/S tone burst indicates that high-level overtones will cause few problems.

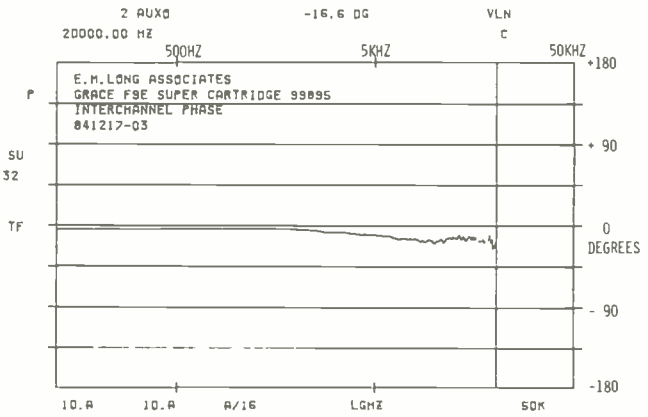

Fig. 7—Interchannel phase of tonearm and cartridge as a function of frequency (B & K 2011, band 7, pink noise). Phase difference at 20 kHz is 16.6° (2.3 μS).

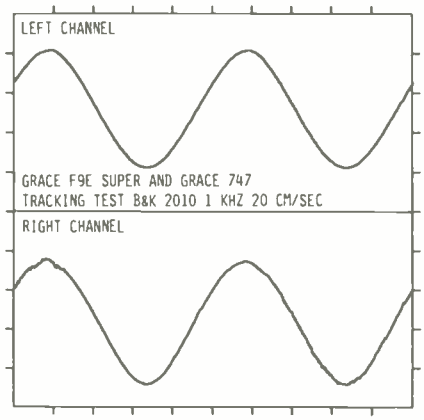

Fig. 8—Tracking of arm and cartridge at 1 kHz, 20 cm/S. Note slight mistracking at this level.

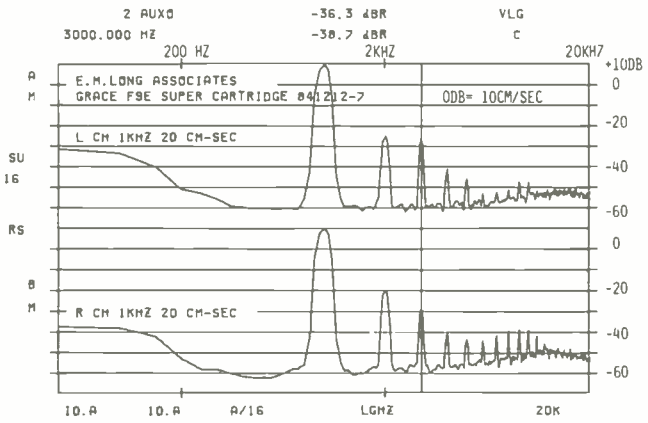

Fig. 9—Spectral components of 1-kHz signal shown in Fig. 8. Level of third harmonic (3 kHz) is 1.6% in the left channel and 1.1% in the right (1.0% equals −40 dB).

for example, was thought to be a bit "fuller" than on the reference system.

Figure 3 shows the results of a slow sweep from 20 Hz to 1 kHz and is meant to reveal any tonearm resonances. This is an excellent result for a system with a detachable headshell. The fit of the headshell to the arm pipe is very good, and the locking screw appears to do a good job. There are slight discontinuities in the response of the right channel at 80 Hz and 120 Hz. It seems a small price to pay for the convenience of being able to use different cartridges.

Another indication of the way the tonearm deals with mechanical energy is shown in Figs. 4 and 5. The amplitude-versus-time trace of Fig. 4 shows that when a mechanical impulse is applied to the tonearm, the vibrations produced are damped very quickly. A tiny replica of the initial impulse appears as delayed energy later on the trace. While the total energy of this delayed signal is very low, it is possible that it could reduce clarity or increase brightness. This is because delayed signals tend to stand out unless they are covered up by other signals loud enough to mask them. A spectral analysis of the arm's response to mechanical impulses (Fig. 5) reveals energy between 1.9 and 3 kHz, which would tend to make the sound a bit brighter or more forward. In both Figs. 4 and 5, the mechanical impulse to the tonearm is being picked up by the cartridge directly, not through the stylus. The energy shown in Fig. 5 is at least 40 dB below the 10-cm/S reference level. This level is much higher than what would actually be produced by even the most heavily cut record. The graph should be used only as an *indication* of the relative levels of spectral energy and not as a measurement of absolute level. Figure 4 shows that the energy is well controlled by the G-747 tonearm, and that there is no tendency to vibrate at any particular frequency. Figure 5 confirms this, since the spectrum is relatively uniform, with no spikes of energy.

The ability of the F-9E Super cartridge and G-747 tonearm to reproduce stereo spaciousness and imaging exactly as it was recorded, without adding or subtracting anything, is demonstrated by the data shown in Figs. 6 and 7. The listening panel's comments about the excellent stereo image tended toward the conclusion that there wasn't much difference between that of the Grace combination and the reference system. If there was any indication of a difference, it was at the highest frequencies, where the sound of the Grace combination seemed a little bit less smeared between the speakers. This was apparent only on rare occasions, however.

The F-9E Super and G-747 did very well when playing highly modulated recordings, especially those with big bass-drum sounds. The data in Fig. 8 shows the output waveform produced by a 1-kHz tone from the B & K 2010 test recording. The level was 20 cm/S, which is the second highest on the record. This is a very good waveform, and the distortion spectrum shown in Fig. 9 confirms this. The third-harmonic distortion for this 20-cm/S level is 1.6% in the left channel and 1.1% in the right channel. The level of the ninth and tenth harmonics is almost 50 dB down from the reference level of 10 cm/S. The slight increase of output at these harmonics might add a tiny bit of "sizzle" to the sound, and indeed, one panel member commented to that

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200 Williams Drive, Ramsey, N.J. 07446

This arm and cartridge's combination of moderate cost along with high performance is a strong reason to audition them.

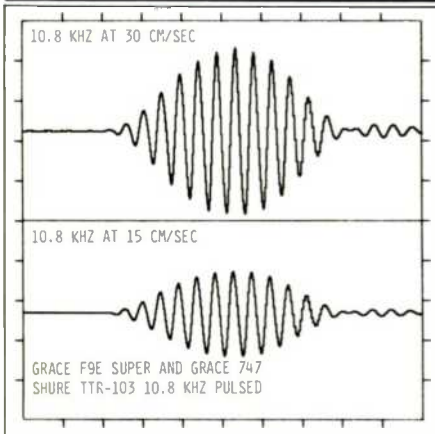

Fig. 10—Arm/cartridge output at 30 and 15 cm/S, 10.8-kHz pulse test. Note the small amount of asymmetry and absence of compression even at 30 cm/S, a very high level.

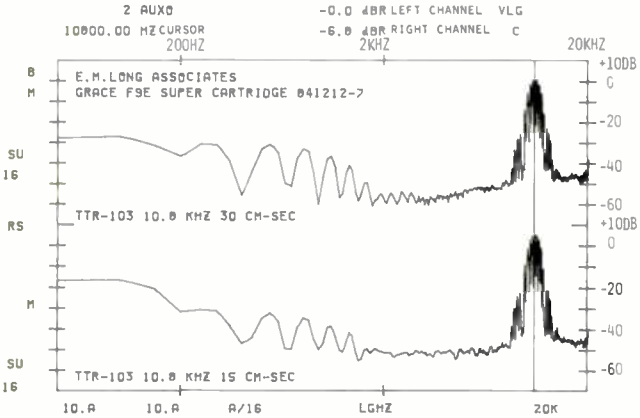

Fig. 11—Spectrum of distortion products for 30- and 15-cm/S signals shown in Fig. 10. Level at 250 Hz is about 30 dB down for 30-cm/S signal, representing distortion of about 3%.

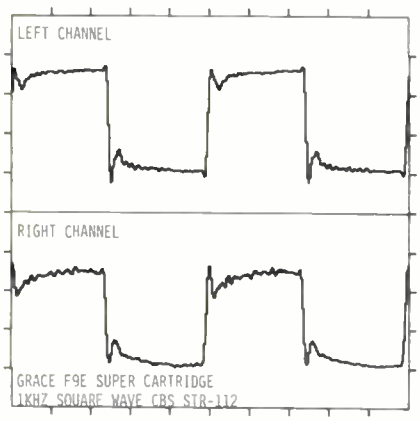

Fig. 12—Arm/cartridge output for 1-kHz square wave, CBS STR-112 test record.

effect when comparing the sound of the Grace arm and cartridge with that of the reference system.

The response of the Grace combination to the 10.8-kHz tone-burst signal of the Shure TTR-103 test record can be seen in Fig. 10. This also shows very good performance, with only a small amount of asymmetry and no indication of compression. This means that the Grace combination will reproduce the dynamic peaks of music without making them sound muted. The slight asymmetry is responsible for the lower frequency spectral components shown in Fig. 11. The upper waveform of Fig. 10 is related to the upper spectrum of Fig. 11, and the lower waveform of Fig. 10 is related to the lower spectrum of Fig. 11. The upper spectrum of Fig. 11 shows that the output at 250 Hz is down about 30 dB, which represents 3% distortion. The level of the 10.8-kHz signal which produced the data in the upper parts of Figs. 10 and 11 is 30 cm/S, which is the highest level on the Shure TTR-103 test record. The ability of the Grace combination to accurately trace this signal indicates that high-level musical overtones will cause very few problems. Any mistracking in this region would tend to cause coloration in lower parts of the spectrum. The comments by the listening panel didn't indicate any problems due to such high-frequency mistracking.

The output of the Grace combination for the 1-kHz square wave of the CBS STR-112 test record is shown by the digital storage oscilloscope trace of Fig. 12. The slight dip near the start of the top of the square wave correlates with the high-frequency roll-off shown in Fig. 1. The shape of the square wave compares favorably with that from other top-quality cartridges. Tests for absolute polarity indicate that the Grace combination follows the convention adopted for CD-4 four-channel recordings. This calls for the cartridge to produce a positive output when the groove wall is modulated toward the outside of the record. Most cartridges seem to follow this convention.

The G-747's pivots have very low friction, well below the 40-mg limit of my measuring system. I did note that the G-747 allowed the F-9E Super cartridge to do a good job of reproducing some warped records, at a maximum tracking force of 1.8 grams.

Conclusions

The Grace F-9E Super cartridge and G-747 tonearm make an excellent combination and compare favorably to my reference system—especially in the high-frequency range, where the Grace system was a bit better. The stereo presentation was as good as any combination I've tested; comments from the listening panel confirmed this. The moderate cost for such high performance is another strong reason for me to recommend that you audition this cartridge and tonearm.

The G-747 tonearm is suitable for use with most moving-magnet or moving-coil cartridges of moderate weight and compliance. The fact that it has a lightweight, removable headshell may also be a strong consideration for people who would like to interchange cartridges from time to time. The ease of rebalancing and resetting the tracking force for different cartridges makes the G-747 a good choice.

Edward M. Long

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5

UHER CR 160 AV PORTABLE CASSETTE RECORDER

Manufacturer's Specifications
Frequency Response: 30 Hz to 16 kHz.
Signal/Noise Ratio: 57 dBA; 73 dBA with Dolby C NR.
Separation: 45 dB.
Crosstalk: −70 dB.
Erasure: 70 dB.
Input Sensitivity: Mike, 0.35 mV; line, 30 mV; tuner, 2.5 mV; phono, 180 mV.
Output Level: Line, 775 mV; tuner, 775 mV; speaker, 3 watts/channel internal, 2 watts/channel external.
Flutter: ±0.20% wtd. peak.
Speed Variation: ±1.5% maximum.
Fast-Wind Time: 60 S for C-60.
Dimensions: 9⅛ in. W × 2¼ in. H × 7⅝ in. D (235 mm × 59 mm × 185 mm).
Weight: 6 lbs. (2.7 kg).
Price: $998.
Company Address: 7067 Vineland Ave., North Hollywood, Cal. 91605.
For literature, circle No. 94

The Uher CR 160 AV portable stereo cassette recorder packs a number of important features—including provisions for synchronizing movie soundtracks—into a compact, rugged unit. As is traditional with Uher portables, it can be powered by dry batteries (C cells), a rechargeable battery, a.c. line power (from an adaptor which can be used outside the recorder or placed in the battery compartment), or, with an optional adaptor, by car batteries. Such flexibility is nearly essential in order to deal with the various conditions of remote recording.

Since portables are often used to record live sound, it's also useful to have the extra dynamic range provided by Dolby C noise reduction, as well as Dolby B NR for compatibility with other cassette decks. For additional help in dealing with the vagaries of live sound, the Uher recorder has switchable automatic level control (ALC) with a choice of time constants—fast for speech and slow for music. It is usually desirable to record without ALC, but when there's a good chance of sudden and unpredictable level increases, ALC can prevent overload and distortion from ruining an otherwise good recording.

Portables also need built-in playback monitoring facilities. In addition to a DIN headphone jack on its side panel, the CR 160 AV has three built-in speakers—a small woofer for mono reproduction of the lower frequencies, plus separate tweeters to project the stereo image created by the upper frequencies. The bass and treble tone controls affect both the speaker and headphone outputs, but not the recording.

The CR 160 AV comes with a handy carrying case, with both hand and shoulder straps, but it is best examined out of the case. The two recording level meters are at the upper left of the front panel, with the left meter showing the acceptable battery voltage range by a green stripe above the −1 to +5 dB calibrations. Uher states that the meters are "peak reading," but confirmation of this was left for later tests. The two input-level pots, with small but well-knurled knobs, are to the right of the meters; they have medium friction, and adjustment is easy. The off position at 9 o'clock is puzzling but not annoying.

Below the meters are the playback volume, bass, and treble controls. The unit's power switch is on the volume control, and at first check it seemed to switch with too little pressure—more on this later. The tone controls added a little more puzzlement: "Treble" is on the left and "Bass" is on the right, with both giving maximum cut at 9 o'clock and maximum boost at 7 o'clock. At first, I thought the flat-response setting would be straight up, but when I checked, it was at about the 3 o'clock position.

The cassette insertion slot is at the upper right of the front panel. When the tape is about three-quarters of the way in, there is some gentle spring loading; then, as its outermost edge is drawn even with the front panel, the cassette jumps into its "ready-to-play" position. A firm push down on the lever at the far right, and the tape is latched down into position for play or any other transport function. In a row under the input-level pots, from left to right, are "Start," "Pause," "Stop" and "Rec." buttons. "Start" is the same as "Play" on most decks, and it has a bright green LED above it; "Rec." has a bright red one.

Pressing "Rec." puts the CR 160 AV into record-pause mode, which is useful in setting levels; pressing "Start" begins the recording. The "Pause" button can be used to interrupt record or play, with "Start" used to resume operation. I was quite impressed by the quiet and apparently shock-free action of the solenoid, whose clunk was very soft, whether entering record from start or pause modes. The CR 160 AV does not allow punch-in recording, but I don't consider this too detrimental for a portable, since such machines are usually used far more for original recording than for editing.

Fast winding is controlled with a switch to the right of the tape-transport buttons. The switch is pushed to the left for rewinding and to the right for fast forward. It can be pushed partway for short winds; a push all the way will make it latch for continued winding. Under it, a yellow LED illuminates during winding; it flashes during play or record modes.

To the right of the fast-wind control, and below the cassette insertion slot, are the three-digit counter (with its reset button) and five slide switches, with three positions each. The switches for Dolby NR ("Off/B/C") and tape selection ("Cr/FeCr/Fe") are just above the counter. It was surprising to see this tape selection; FeCr (Type III) tapes may still be available, but I suspect most users will not go to the trouble of seeking them out. Further, there is no provision for metal-particle (Type IV) tapes, which are widely available.

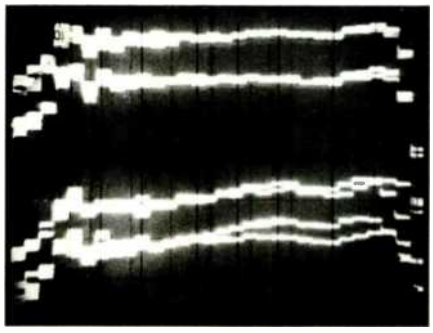

Fig. 1—Record/playback responses for two tapes, at two levels; response with Dolby C NR is superimposed on response without NR in each case (the upper trace of each overlapped pair is with NR). From top to bottom: Maxell UD-XL I (Type I) at Dolby level, TDK SA (Type II) at Dolby level, Maxell UD-XL I at −20 dB, and TDK SA at −20 dB. Note the close match between responses with and without Dolby C NR at Dolby level, and the less close match at −20 dB. See text. (Scale: 5 dB/div.)

When I gave the deck a tough shake-and-movement test, including rotations around its axes, there was no effect on flutter or on tape speed.

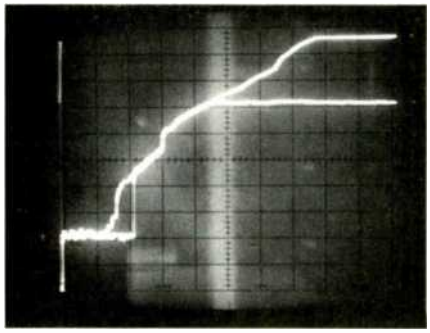

Fig. 2—Effect of a sudden increase in the level of a 1-kHz input signal, with ALC (fast mode) and without it. Note how ALC limits the signal at 50 dB above the tape noise level, while, without ALC, the signal rises 25 dB further. See text. (Scales: Vertical, 10 dB/div.; horizontal, 2 S/div.)

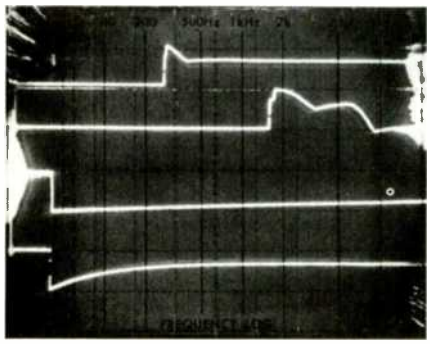

Fig. 3—Response of ALC to sudden 10-dB level changes. Upper two traces show reaction of ALC to 10-dB rise in slow (top) and fast modes; displacement of fast-mode curve to the right is a triggering error, not a delay in ALC action. (Scales: Horizontal, 0.1 S/div.; vertical, 10 dB/div.) Lower two traces show reaction of ALC to 10-dB drop in slow and fast (bottom) modes; note the very gradual recovery rate in slow mode. See text. (Scales: Horizontal, 5 S/div.; vertical, same as upper traces.)

To the left of these controls and the counter are switches for the battery checker and meter light, for ALC ("Off/Slow/Fast"), and for the speakers ("Off/On/−20 dB"). Anyone who has done remote recording with a portable knows the value of the battery-status indicator, and appreciates being able to turn the meter lights on when needed and off, to save the battery, at other times. The meters also illuminate in the battery-check mode; this demonstrates good thinking on Uher's part since portables are so often used in dim light.

The speaker switch shows more good thinking. It's vital to shut off the speakers when the microphone is nearby, but useful to be able to monitor through them when the microphone is farther away. Having the option of muting the speakers by 20 dB makes it easier to control low-level monitoring. (I recently startled myself and several other people when I inadvertently switched on another portable with its speaker volume accidentally turned wide open.)

The top of the recorder has three perforated speaker openings: One for a woofer, and two smaller ones, separated by several inches, for stereo tweeters. A small plastic door over the cassette compartment can be slid toward the back and removed to gain access for cleaning and demagnetizing the two heads and other elements. These tasks are fairly straightforward, but some care and attention are needed in order to clean the entire tape path properly.

Along the left side of the CR 160 AV are five sockets for connections to the outside world. The one nearest the front is the microphone input; it matches the Uher mono/stereo microphone Set M650A and other microphones with standard DIN plugs. (Microphones with other plugs can be adapted.) Further back along the side panel are sockets for "Radio/Phono" (DIN), headphones (stereo phone jack), headphones or loudspeakers (DIN), and one labelled "Access" (DIN). This ast socket is for connecting accessory equipment when synchronizing sound and film via the double-track interlock method. Quoting from the CR 160 AV manual: "When recording sound by this method, synchronization of sound and picture may be achieved by controlling either the speed of the film projector (called in professional film recording 'forward control') or that of the open-reel or cassette tape recorder ('backward control')." Speed may be regulated by 1-kHz pulses that occur at every picture or every fourth picture, depending upon the system used. The Uher recorder has a special AV record/playback head, and the connections made to the "Access" socket make both forward and backward control possible.

On the back of the recorder are stereo pairs of line in/out phono jacks. There is also a DIN socket for connecting the output of a line-power source or a 12-V car battery (which requires an optional accessory adaptor.) This jack also includes stereo line outputs and start/stop switching connections for use with other accessories. Uher's manual does not specify what those accessories are, but it does say what pins these signals are on, perhaps for those who wish to build their own accessories.

The door to the battery compartment is located at the rear of the right side panel. The carefully designed space will hold six C cells, the Uher Z215 rechargeable nickel-cadmium battery, or the Z135 power supply/battery recharging unit. (Both the battery and the recharger are supplied with

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In recording, the meters measure the signal after it is equalized. I prefer this practice, as it gives better warning against tape saturation.

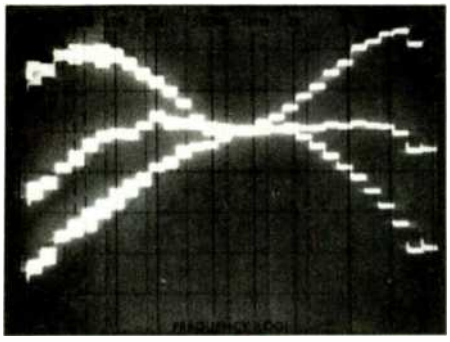

Fig. 4—Range of playback tone controls, showing maximum boost (top trace), maximum cut (bottom trace), and "flat" (middle trace). Response of playback speaker/ headphone amp could not be flattened further than shown. See text. (Scale: 5 dB/div.)

the recorder.) When the battery compartment is occupied by the Z215 rechargeable battery pack, the Z135 can be plugged into the back-panel socket to charge the battery or operate the recorder from the a.c. line. The Z215 can also be recharged from any source, including a car's battery, and is insensitive to overcharging or overdischarging—problems which have caused many nickel-cadmium failures in other equipment I have used.

Taking off the recorder's top cover revealed the component side of the p.c. board. High-quality parts were there in abundance, including some ICs but quite a few discrete components. The cassette-loading system is simple but effective. The transport has a rugged, die-cast metal base and dual contra-rotating flywheels, and it was very quiet in play and record modes. In fast wind, it was quiet (and somewhat slow) with battery power, but rather loud (and fast) with line power. Removal of the bottom cover exposed the foil side of the p.c. board, where all of the soldering was excellent. No fuse was noted inside the recorder, but the Z135 power supply is fused.

Measurements

The playback responses of the CR 160 AV were quite good for both equalizations, with most points within ±1.5 dB. The highest frequencies were off slightly more, and the lowest frequency for each EQ was about 3 dB down. Dolby level from a calibration tape was indicated at +0.5 dB on both meters. Tape play speed was 2.0% low, a greater deviation than desired. This would probably be noticeable by listeners with critical pitch sense if they heard tapes made on this machine played back on a deck with correct speed regulation.

Record/playback responses were checked, with and without Dolby C NR, for a number of tapes, primarily Type I and Type II. The results were quite good with many formulations but were not acceptable with either low-bias, nonpremium tapes or such "hot" ones as Maxell XL I-S and TDK SA-X, which were too peaked at the high end when Dolby C NR was used. The responses were good with one of the Type III (ferrichrome) tapes on hand, but further testing was not performed with this unpopular tape type.

Maxell UD-XL I (Type I) and TDK SA (Type II) were chosen for use in my detailed testing, on the basis of their good record/playback responses (Fig. 1). These were measured using what I call "PN/Music," which is pink noise rolled off above 2 kHz to be more like music. In playback, I compensate for this roll-off, for flat display on an RTA. The traces shown in Fig. 1 are for response both with and without Dolby C NR. The top set of traces are at Dolby level. They are very flat except at the frequency extremes, and the results with and without NR match each other very closely. The bottom set of traces were made at the −20 dB level. These show a rising high-frequency response; with Dolby C NR, this rise is almost excessive.

The response limits (the −3 dB points) obtained using test tones are listed in Table I. They show a useful increase in the high-end saturation limit with Dolby C NR. They also show the same high-frequency limits at the −20 dB level for both Type I and Type II tapes, both with and without Dolby C NR; I suspect this means a multiplex filter is always on.

Table II lists a number of measured record/playback characteristics. The results are all very good. Note that I measured erasure, as I usually do, at 100 Hz, obtaining a figure of 72 dB; at 1 kHz, the frequency for which Uher specifies erasure, I measured well over 80 dB, considerably better than the manufacturer's specification. Bias in the output during recording was very low.

Table III lists third-harmonic distortion for both tapes, using Dolby C NR. Measurements were made over a range of levels, starting at 10 dB below Dolby level, with the input increasing until the 3% distortion point was reached. With Maxell UD-XL I, there was less distortion at 0 dB, together with a higher maximum recorded level, but at the lowest levels, distortion was much lower with TDK SA, the Type II tape. Second-harmonic distortion (HDL_2) was high for both tapes at all recorded levels. At the lowest levels, HDL_2 was several times higher than HDL_3, but at the higher levels HDL_3 was predominant, fortunately; otherwise, the maximum recording level would have been lower. Table IV shows HDL_3 versus frequency from 50 Hz to 4 kHz at −10 dB below Dolby level, on TDK SA, using Dolby C NR. These figures are all excellent, but the applause must be muted because of HDL_2, which was a minimum of 0.36% at 400 Hz, 0.67% at 50 Hz, and 1.0% at 2 and 4 kHz. The record/playback head was demagnetized four times during the testing, but there was no reduction in the level of HDL_2.

Signal-to-noise ratios were measured for both tapes, with and without Dolby C NR, using both IEC A and CCIR/ARM weightings. The results in Table V are very good, but the numbers obtained with Dolby C NR are not a match for those I've obtained with a number of other decks. This is quite consistent with the fact that the level at which the Uher reached the 3% distortion limit was not terribly high.

Table VI presents input and output characteristics measured at 1 kHz. The headphone output level was very high

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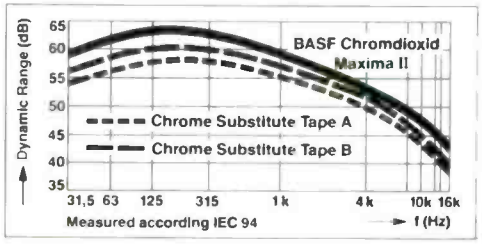

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Sound from the built-in stereo speakers wasn't broad, but detailing was much better than that of a monaural version.

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

	With Dolby C NR				Without NR			
	Dolby Lvl		−20 dB		Dolby Lvl		−20 dB	
Tape Type	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Maxell UD-XL I	32	11.0	32	16.3	32	9.0	33	16.3
TDK SA	33	11.4	34	16.3	32	7.7	33	16.4

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	
72 dB	45 dB	−72 dB	12°	10°	−31.9 dB

Table III—400-Hz HDL_3 (%) vs. output level (0 dB = 200 nWb/m).

		Record Level					HDL_3 =
Tape Type	NR	−10	−8	−4	0	+4	3%
Maxell UD-XL I	Dolby C	0.14	0.14	0.32	0.45	2.0	+5.1 dB
TDK SA	Dolby C	0.03	0.11	0.45	1.8		+1.6 dB

and could generate more than very high sound levels with all of the headphones tried. The 1.42-V line-input overload point will not be a problem in most cases, but it *is* low enough for the input to possibly clip when fed the full output of some equipment (such as CD players). DIN-socket input and output levels were checked, and were all found to be in accordance with specifications.

Next I took a look at the ALC circuit. To check its action and threshold on a signal with slowly increasing level, I manually increased the level of a 1-kHz tone while recording from the beginning of a cassette. Figure 2 shows that the limiting threshold was reached at 50 dB above the tape noise, and that there was no change in the recorded level as I further increased input level over a range of more than 25 dB. Figure 3 shows how the ALC's slow and fast modes differ in their response to sudden 10-dB level changes. Note that the initial response time to a fast 10-dB rise is very nearly the same in both modes (ignore the fast-mode trace's displacement to the right, and compare the shapes of the two traces). With a fast 10-dB decrease, however, it is obvious that the recovery time in the slow mode is much longer than in the fast one. Do not confuse this ALC circuit with the type found on inexpensive recorders. The chief difference (aside from its two-speed operation, which even some inexpensive models have) is that the Uher's ALC works only on signals above a threshold level. As a result, it does not fill pauses in the program material with background noise that has been suddenly raised by the ALC to full program level.

The level meters reached close to full response with a tone burst of 100-mS duration, and the decay time was 450 mS; the meters might be classified as "fast responding," but not "peak reading" as Uher states. Meter scale calibrations were very accurate over their entire range, among the best I've measured. In recording, the meters measure the signal after it is equalized, a common practice on European recorders. I much prefer this post-EQ metering, as it measures the signal actually being fed to the tape, and gives better warning against tape saturation. Measured meter responses in recording, therefore, were up by 4.5 dB at 28.5 Hz, were flat from 250 Hz to 3 kHz, then rose to +6 dB at 8.5 kHz and reached a maximum of +11 dB at 14.8 kHz before sharply dropping off.

The bass and treble controls usefully improved the monitored sound, both through headphones and over the built-in speakers. Figure 4 shows the range of these controls. Note that flat response could not be obtained through the speaker/headphone amp (which does not, of course, affect the recording or the line outputs). Trying to flatten the middle curve in Fig. 4 by boosting bass or treble, which would bring the frequency extremes back up to zero level, would have caused undesired boosts at the bottom and top of the midrange.

Flutter was a satisfactorily low 0.09% wtd. rms and ±0.15% wtd. peak, consistently from one end of a C-90 cassette to the other. (There was, however, a slow, random speed variation of ±0.1%.) I gave the Uher a vigorous shake-and-movement test, including rotations around all three axes, but there was no effect on flutter or speed. Changing line voltage did affect speed slightly: It increased 0.1% when the line voltage was reduced to 110 V and decreased by the same amount at 130 V. With line power and a C-60 tape, the fast-wind time was 60 S, faster than most decks. All changes in mode were accomplished in about 1 S, even if initiated manually.

Table IV—HDL_3 (%) vs. frequency at 10 dB below Dolby level.

		Frequency (Hz)					
Tape Type	NR	50	100	400	1k	2k	4k
TDK SA	Dolby C	0.3	0.10	0.03	0.02	0.10	0.19

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

	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		Without NR		W/Dolby C NR		Without NR	
Tape Type	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%	@ DL	HD = 3%
Maxell UD-XL I	65.7	70.8	51.3	56.4	64.5	69.6	46.7	51.8
TDK SA	67.7	69.3	53.0	54.6	65.8	67.4	49.5	51.1

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	12.1 mV	1.42 V	68	Line	800 mV	754 mV	894	+8.6 dB
				Hdphn.	5.39 V	2.8 V	46	

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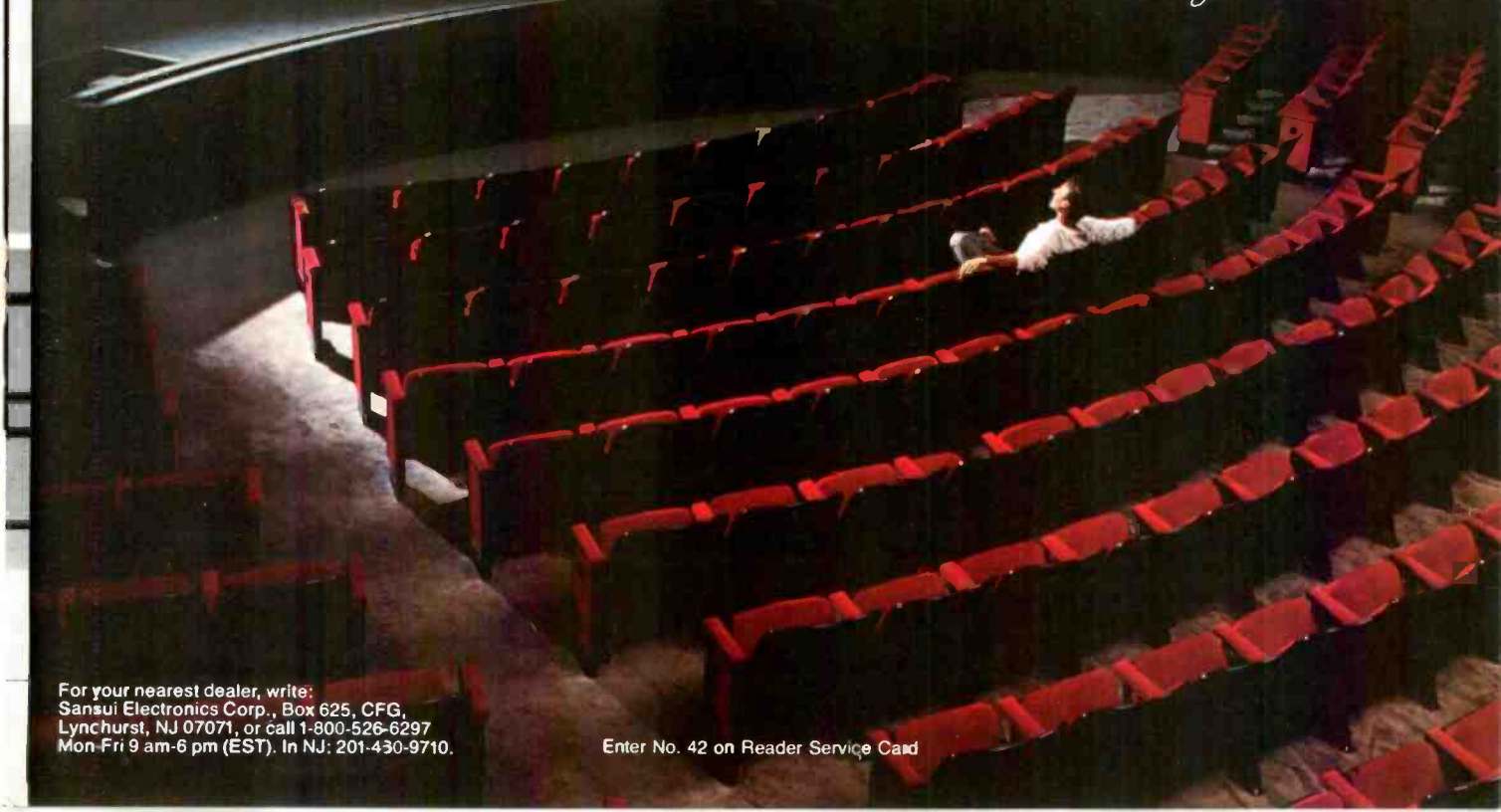

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The Uher recorder's price is high, compared to typical units, but the CR 160 AV is not a typical machine. It may well be a good investment.

Use and Listening Tests

The owner's manual presents considerable detail with excellent instructions on powering and connections. The ALC guidelines were incomplete in that there were no statements on the meter indications that one could expect—it is possible to overdrive the input while ALC keeps meter indications from being excessive. An excellent schematic is provided, along with a board layout *and* basic service and alignment instructions—quite valuable to the careful user.

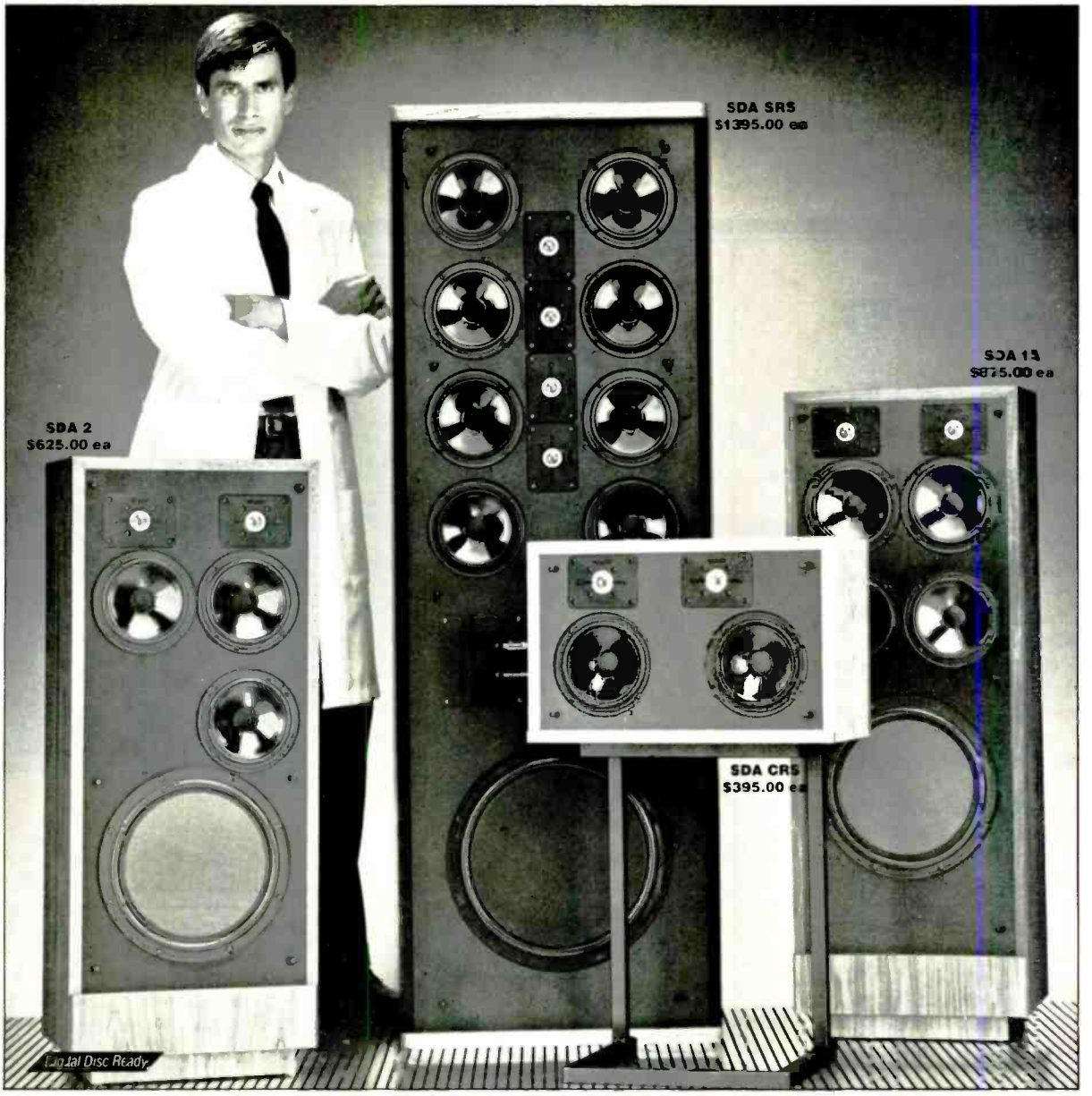
All controls and functions were completely reliable during the testing. I did feel that too little force was needed on the volume control to turn the unit off, and I missed having a counter memory. Just about everything else became quite natural with use. The record click was small, there was hardly a sound from "Pause," and "Stop" got a double click, all just above the tape noise level with Dolby C NR.

For my listening tests, I recorded a number of LPs, most of them dbx-encoded, played through a dbx decoder to obtain a signal of wide dynamic range. The sound of the piano was really very good on Chaminade's "Concertstück for Piano and Orchestra," with James Johnson, pianist, and Paul Freeman conducting the Royal Philharmonic Orchestra (Orion ORS78296, dbx GS-2005), even while I moved the CR 160 AV in many different ways. This, more than anything else, convinced me of the excellence of Uher's contra-rotating-flywheel drive system. To check the ALC function, I recorded *Baroque Brass* by the Empire Brass Quintet (Sine Qua Non SQN-SA2014, dbx SS-3001), constantly increasing the input level and switching the ALC on and off every few seconds. As the level rose, the improvement made by the ALC was emphatically obvious, turning the sound from horrendously overloaded to quite good.

I spent some time listening to sound from the built-in speakers. Although there was not what one would call a broad stereo image at 2 or 3 feet, the great improvement in the detailing was very apparent when comparison was made to a monaural version. The tone controls were a definite contributor to the quality of sound during this listening. A headphone check showed that there was a slight increase in noise level with Dolby C NR, in comparison with the dbx-encoded original, but it was usually not detectable.

The Uher CR 160 AV offers at least very good performance in most areas, with the puzzling exception of the relatively high second-harmonic distortion. Such distortion is notorious for being caused by leaky coupling capacitors, and so may be due to such a defect in my sample, and not typical of the model, I trust. The CR 160 AV has great flexibility in powering and for synchronization with film systems. Its price is high, compared to typical cassette recorders, but it is not a typical machine. The unique combination it offers may very well make for a good investment.

Howard A. Roberson



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ELECTRO-COMPANIET MC-2 PRE-PREAMP

Manufacturer's Specifications
Gain: 40 dB, maximum.
Input Impedance: Equal to cartridge impedance.
Output Impedance: Less than 1 ohm.
Overload Margin (1 kHz, 0.008% THD): More than 100 mV.
THD (Referred to 50 mV Out, 1 kHz): 0.0001%.
Noise (Referred to 2 mV): −80 dB, unweighted.
Frequency Response: D.c. to 1 MHz, −3 dB.
Company Address: c/o Transparent Audio Marketing, P.O. Box 117, Hollis, Maine 04042.
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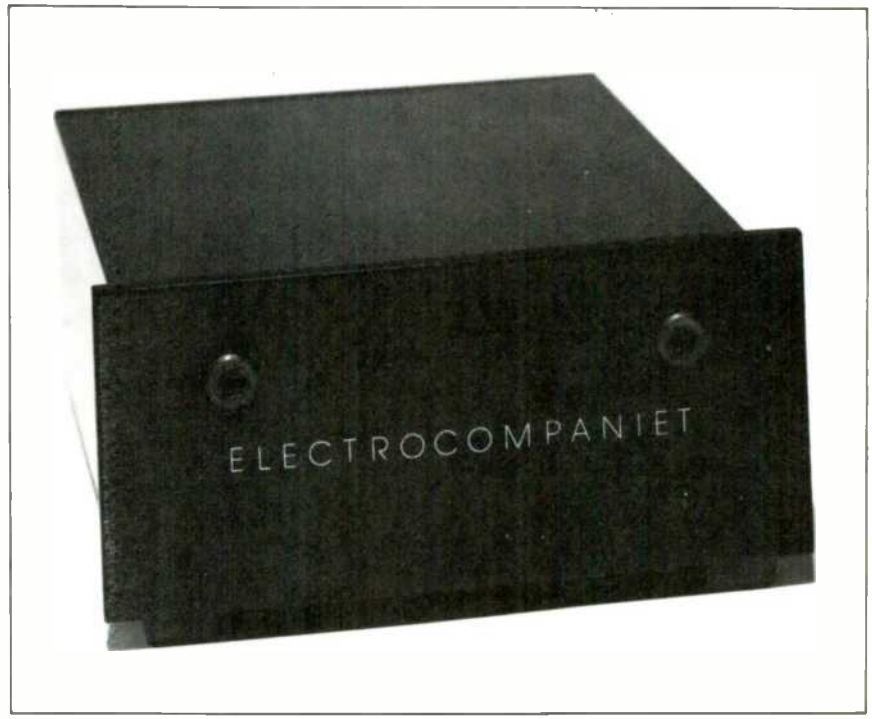

The moving-coil phono cartridge was commercially introduced by Ortofon in 1948. Since then, there has been a continuous search for the ideal device to amplify the cartridge's output signal, which is usually very low, to a usable level without introducing noise, coloration, distortion, high-frequency ringing, etc. Most often, an "audio" transformer has been used for this purpose, but such devices have been considered to be frequency restrictive, noisy, and distorting. Continued research has brought about major improvements in the moving-coil cartridge step-up transformer, e.g., oxygen-free copper wire, silver wire, better transformer laminations, toroidal windings, improved frequency response and phase linearity, and almost total elimination of noise.

During this period an audio revolution was started: Bell Laboratories introduced the transistor, and the world of audio was inundated with transistorized equipment. It was not long before a spate of devices loosely classed as high-gain, transistorized phono sections for preamplifiers and pre-preamps were made available to amplify the low-output signals from moving-coil cartridges. With such excellent

step-up devices available, the moving-coil cartridge was usually touted as being superior to the moving-magnet and moving-iron types. Finally, a cult developed that even today insists the moving-coil cartridge provides superior reproduction of recorded music. Meanwhile, further research has brought forth superior transformers and pre-preamplifiers, but at prices ($1,000 and up) that few audiophiles can afford.

In my laboratory, the reference MC phono cartridge transformer is the Technics SH-305MC, and the reference pre-preamplifier is the Audio Standards MX-10A. Recently the MX-10A was bested by the relatively new Electrocompaniet MC-2 moving-coil pre-preamplifier, which has maximum gain of 40 dB and is priced at only $495. The Electrocompaniet is an outboard device with a separate power supply that plugs into a 110-V receptacle. The pre-preamplifier measures 5¾ in. by 4 in. by 2 in., and the power supply, which provides 24 V at 35 mA, measures 2½ in. by 1¾ in. by 1⅝ in. It is connected to the MC-2 power input by a long wire.

The MC-2 is usually sold for use with moving-coil cartridges that have an internal impedance (d.c. resistance) of 10 ohms or less. It is generally agreed that the best moving-coil cartridges are those that have low internal impedance, but their low impedance makes them the most difficult cartridges to match to an amplification stage. Since other MC cartridges have internal resistance greater than 10 ohms, the MC-2 design has been made more flexible. It can now be used with almost any MC cartridge whose internal impedance does not exceed 50 ohms.

The MC-2 has more gain than any pre-preamplifier or transformer that I know of. It is not a step-up device in the usual sense of the term, but is more

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In more than a year of listening, I've found the MC-2 superior to any other transformer or pre-preamp that I know of—and the price is right, too.

accurately described as a current-sensing moving-coil interface and step-up device. The circuit is differential-symmetrical with floating ground, and is d.c.-coupled (see Fig. 1).

To keep distortion to a minimum, the MC-2's current-sensing front-end actually adjusts its input impedance to match the fluctuating impedance of a moving-coil cartridge as it turns groove information into an electrical signal. To further reduce distortion, noise and high-frequency ringing, a very slight amount (about 1.5 dB) of closed-loop parallel feedback is employed, which is controlled by resistor R2 (Fig. 1). This feedback would normally reduce the input impedance nearly to zero ohms, so a series resistor (R1) is added to bring the impedance back to more useful values. In combination with capacitor C1, R1 also determines the open-loop cutoff frequency and the so-called input lag. The MC-2 is unsurpassed in its ability to reduce noise and distortion in the first amplification stage to levels that are nearly undetectable by common methods of laboratory measurement.

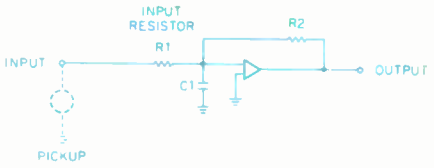

Fig. 1—Partial circuit diagram of the MC-2 pre-preamp.

The earlier version of the MC-2, which was designed for cartridges with impedances of 10 ohms or less, had a 16-position selector switch in place of R2 in the parallel feedback loop. Listening tests showed that this earlier MC-2 performed best in selector-switch position 4. The newer version of the MC-2 does not have a selector switch. With this version, cartridge matching is optimized by changing R1 and R2, which are mounted in sockets for easy removal and replacement. The value of R1 is selected according to the phono cartridge's internal impedance. The value of R2, which controls the amount of parallel closed-loop feedback, should be approximately 20 times that of R1. The resistors must be changed in both channels at once, and only 1% metal-film resistors are to be used. (Transparent Audio Marketing, Electrocompaniet's importer, will retrofit this modification to the older model for a charge of $45.)

In view of the sensitivity of the MC-2, I do not recommend that the audiophile perform any measurements on it unless special test equipment is used. Measurements must be made with a generator that is able to drive a 10-ohm load without the slightest stress. Noise can be measured at the output terminal by coupling a 5 to 10-ohm metal-film resistor between input and ground. I was unable to measure any noise at the output of the MC-2. (Discrete Technology's silver interconnects were used throughout my tests and listening evaluations.)

A word of caution is in order: The MC-2 inverts absolute phase. If your system is in correct phase, hot and ground leads will have to be reversed at some point, either at the cartridge or at one end of each speaker-wire pair, so that the system will remain in phase when playing records via the MC-2. Since there may be all sorts of audio equipment in the tape loop, it is preferable to correct the phase inversion at the cartridge. To accomplish this, invert the leads at the cartridge so that the red wire goes to the green pin and the green wire goes to the red pin. Then perform the same operation on the left side—connect the white wire to the blue pin and the blue wire to the white pin. Wiring the phono cartridge in this manner permits any other audio equipment connected to the preamplifier to remain in phase all the time. If the MC-2 is ever replaced with a noninverting type, the original wiring at the cartridge will have to be restored.

I have used the Electrocompaniet MC-2 pre-preamplifier for over a year and found it to be superior to any transformer or pre-preamplifier with which I am familiar. It produced no noise, distortion, or coloration with any moving-coil phono cartridge, but it did improve the imaging more than I would have expected. Of all the virtues of the Model MC-2, the most important is that the price is right for what I consider to be the finest pre-preamplifier available today. *B. V. Pisha*

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Ten years ago, four audiophiles (including myself) got together for an experiment. Someone had written that a new wire sounded better than the standard cable of the day. That night, the four of us made 24 pairs of "homemade" audio interconnects from this new wire. Everything we had read was true: That new wire did indeed make a difference.

Only in the last few years have such differences in connectors and wires become widely discussed. Today, there are many types of speaker wire, component interconnects, and jacks that are supposed to affect a stereo's sound.

I recently followed up my experiment of 10 years back with another change in my system's connections. I had been using large spade lugs on my speaker wires, but they never really fit properly on the speakers or the amplifier. My speakers have five-way binding posts, which accept bare wires, spade lugs or banana plugs. I decided to replace the spade lugs with banana plugs to ensure maximum contact, and to get the best bananas I could find on the market.

What I found were Monster Cable's X-Terminators, oversized, high-tech, gold-plated banana plugs that lock into place. X-Terminators are also expensive—$25 for a pack of two, one red and one black, enough for one end of a speaker cable.

Unlike regular banana plugs, X-Terminators do not accept bare wires easily, save for the very thin wires that are currently all the rage in some circles. Spade lugs, the size for #10 screws, work much better, and luckily I had Monster's own on my wires to begin with. These gold-plated lugs, which cost 75¢ each, can be crimped or soldered onto wire as thin as AWG 16 or as thick as AWG 10. They are about twice the size of regular spade lugs, so they won't fit into narrow barrier strips or spring-contact connectors. Nor will you be able to use them on closely spaced screw terminals.

The X-Terminator has two locking features that make all the difference: First, a twist of the X-Terminator body locks the spade lugs into place; a set screw (tightened with a supplied Allen wrench) ensures the spade-lug fit. Second, a twist of the locking knob expands the banana prongs, which are split lengthwise into quarters for expansion. This locks the plug in place to ensure the tightest possible connection, secure even when plugged into the bottom of a speaker (as many subwoofers require) or when people accidentally step on or trip over the speaker wires.

Describing how they sound is quite a bit different from describing how they work, because this is a passive device and, technically, has no sound of its own. Instead, connectors allow sound to pass through, and if they do anything, they do it in a negative fashion; that is, they degrade the sound. Now, I had been happy with the sound of my system when using spade lugs, but I was even happier with it when using the X-Terminators. With the help of a friend, a series of single-blind tests were run, and I was able to pick out the X-Terminators, which I preferred. They are worth every penny, I'd say.

The manufacturer recommends that the plugs be treated with a contact-conditioning chemical, such as Cramolin or Tweek, before use. The sound was the same, to me, whether the plugs were treated with the chemical conditioners or not.

Monster Cable's X-Terminators are the largest, most elaborate banana plugs available in this country for stereo connections. And although they require special connectors, adding slightly to the cost, they are worth the trouble and expense. *Gary Krakow*

(*Editor's Note*: X-Terminators are also available with black-anodized, insulated barrels for $25 per pair, and in a lower cost version, the Powerconnect II, priced at $17 per pair. The Powerconnect II requires a screwdriver to lock the banana barrel, and it has a female jack for piggybacking other banana plugs.—*I.B.*)

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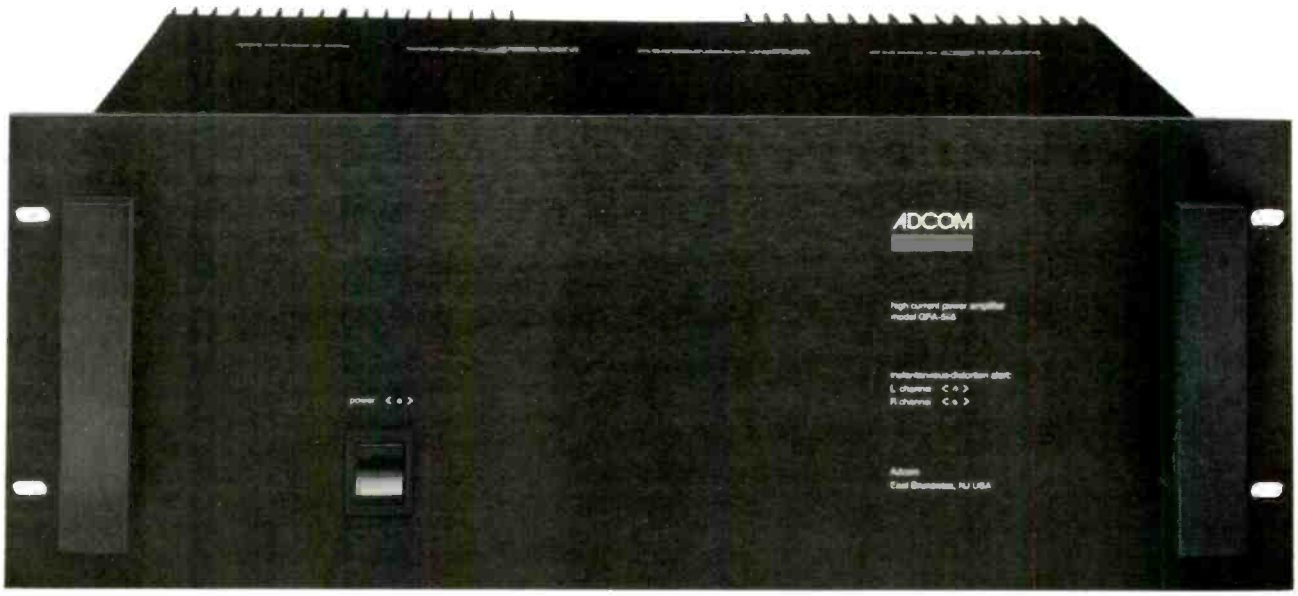

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I can't help wonder what the average person shopping for a Compact Disc player would say if he or she were suddenly exposed to one of the little hi-fi magazines which talk about the average CD player in terms of "digititis" and describe the sound as capable of driving a reviewer out of the room. I suspect that if he or she happened to own an average moving-magnet cartridge, automatic turntable, mid-fi transistor electronics and box speakers, the reaction would be a deserved incredulity.

Even the worst-sounding Compact Disc players I have heard, the very early ones, were not bad enough to justify reviewers' tantrums. In fact, our average listener might well have found such players to be flatter, more dynamic, and more musical than a combination of the average low-cost cartridge, turntable, and extra gain stage required for the phono input. Chances are, too, that a low-cost mid-fi receiver or amplifier would have been sufficiently hard and lacking in detail in the upper midrange and highs to mask many of the problems in a mediocre CD player. And most low-cost, American-made speakers would have been sufficiently slow and rolled off in the highs to further disguise a player's problems.

At the same time, it is all too clear that today's Compact Disc players are not perfect. They may do a wonderful job of eliminating most forms of noise and distortion we have come to recognize in phono records and analog tapes, but they also introduce new ones. This is clearly reflected by the effort manufacturers have put into improving the better third-generation players. There are good sonic reasons why manufacturers have rushed to upgrade the laser, drive system, loading system, filters, phase response, immunity to shock, output stages, and virtually every other aspect of their original machines.

However, even the best CD players now available still have audible problems that offset many of their advantages. While these problems may not be all that apparent on the average mid-fi system, they are audible on top-grade transistor or tube electronics and on top-grade electrostatic, ribbon, or cone speakers. Although the best current Compact Disc players are far better than the first generation, they are just beginning to be competitive with the kind of top-grade phono system that can cost well over $1,000.

Admittedly, any Compact Disc player is superior to the best home turntable or tape deck in some important areas. The CD player has virtually flat frequency response, and this response stays constant over a wider range of signal levels than does a tape or LP system. There is no resonance, wow and flutter or speed error, so timbre and pitch are more exact; no non-digital or frequency-modulated system has been able to avoid audible problems in these areas. There are no major setup problems of the kind that are inevitable in a phono or tape system, and no inherent problems in geometry of the kind that limit even the best straight-line tracking tonearms and cartridge designs. Properly manufactured CD players also have a higher "ceiling" in terms of maximum dynamic range, far better (and more consistent) separation between stereo channels, and less inherent noise. These are all very real and audible merits of the Compact Disc format.

At the same time, every CD player I have heard to date suffers from problems which show up all too clearly on a top-quality sound system. These include an inability to resolve low-level musical detail, harmonics, and "air" as naturally as the very best record-playing systems and tape decks. In the frequencies above about 3 kHz, all CD players exhibit at least some "hardness" or lack of realistic musicality that is not apparent on a top-quality record-playing system or tape deck. On most, but not all, CD players there is also a loss of smoothness or musical coherence from top to bottom that is most often reflected in slight problems in the consistency of imaging, and in a slight leanness and lack of coherence in the midrange. Even on the best players, there is at least a slight tendency to reduce the width and depth of the sound stage.

These problems may or may not be the result of phase distortion. There are other potential causes, and I suspect that the problems are more likely to be an interactive combination of faults—beginning in the recording studio and continuing on to the output jacks of the CD player—than the result of any single cause. They are not, however, imaginary, and they are recognized by most manufacturers of CD players. I have talked to the importers and manufacturers of several top models, including Denon, Meridian, Mission and Ya-

maha. All admit that today's CD players have sonic weaknesses, although all are a bit irritated at the extent to which these faults have been exaggerated in some of the little audiophile magazines.

Individual CD players also sound very different from one another, and some sound distinctly mediocre. A CD player does, after all, employ an exceedingly complicated chain of mechanical, optical, digital and analog technologies. This chain involves a wide range of parts and components, and even the most expensive home CD player is forced to make some compromises to integrate them into a single unit. Every design problem and technical compromise in the chain contributes to what operations analysts sometimes call the "error budget," the full list of variables which can cause distortion.

Many of these errors cannot yet be fully detected or measured by today's technical methods, although serious audiophiles may wish to look at the November 1984 issue of the French *Son* magazine and the first issue of the new British *Which Compact Disc*.

Son tested nine different Compact Disc players and found significantly different performance with regard to separation, distortion, and phase, pulse and square-wave response. The machines with the worst measurements, all of which use the 16-bit process developed by Sony, had well over 80° of phase shift, poor 1-kHz square-wave performance and a considerable amount of ringing.

Which Compact Disc tested 23 CD players and revealed some very different capabilities to resolve information according to level. None of the players under survey proved able to resolve at the ideal 16-bit sampling rate, and several of the machines rarely went much beyond 14 bits.

Further, the word "digital" does not mean that CD players do not need complex and high-gain analog output stages. I have taken the cover off a number of CD players and often found analog output stages that have the defects of those in a $20 portable radio. Some manufacturers make many of their cost compromises at this point in their designs, and some use circuitry that is normally unacceptable in even a bargain-basement receiver. These compromises include the use of the kind of high-gain op-amps that are notorious for poor sound character and the kind of integrated circuits which have been recognized by many audiophiles as a major source of sound problems for years.

Denon DCD-1800

Discrete Technology LS I

Some manufacturers also use multiplex circuits that switch back and forth between channels every 11.3 µS, and while this switching is not audible, it may lead to problems in other areas. Some players have low-grade, unbypassed electrolytics in the output stage. Many players have low-cost power supplies, minimal-quality grounding, and too much feedback.

The irony is that the analog audio stages in CD players may well be the primary source of many of the sound problems that some reviewers claim are caused by "digititis." These problems are so bad, in fact, that the British magazine *Hi-Fi News & Record Review* published a long article in its December 1984 issue which explained how the analog circuits in digital players ought to be fixed.

This brings us to the bottom-line subject of this review: If CD players are not perfect, how well do they compare to alternative sources of sound and how do they differ by model? I recently had the opportunity to listen to a wide range of Compact Disc players for at least several days at a time, using a system with Audio Research SP10 and D250-II electronics driving Infinity RS IB, Quad ESL-63 and JBL 250Ti speak-

Today's CD players may do a great job of eliminating most forms of distortion we recognize, but they also introduce new ones.

Magnavox FD3040SL

Meridian MCD

ers, and the Stax Lambda Pro earspeaker system.

I was able to compare Compact Discs on these players to analog records on several turntable and tonearm systems. These included a range of top-quality cartridges on combinations of the SAEC WE-407/23, Dynavector, and Eminent Technology arms on the VPI turntable; the revised Alphason arm on the Oracle Delphi Mk II, and Sumiko's The Arm on the SOTA Sapphire turntable. I also used a Tandberg TD-20A SE tape deck, and two second-generation dubs from the master tapes of recordings which I also had in LP and CD form. Since I was conducting separate cartridge and cable surveys during my listening to CD players, I was able to go to great lengths to get the best sound out of each record-playing system.

You may not have a similar system, but you can repeat many of my musical comparisons. I made heavy use of several CD and record combinations. These included *Jazz at the Pawnshop* and *Cantante Domino* on the Proprius label; Dave Grusin's *Discovered Again* on Sheffield and his *Mountain Dance* on GRP and Nimbus; Willie Nelson's *Stardust* on CBS; the Sheffield *Track* and *Drum* records; Vivaldi's *Four Seasons* on Telarc; Michala Petri's *Recorder Concertos* on Philips, and *Däfos* and *Popular Masterworks of the Baroque* on the Reference Recordings label. I particularly recommend *Jazz at the Pawnshop* as the best demonstration I have yet heard of the sound-stage potential of CD. The results of my listening comparisons are below.

Denon DCD-1800

The $800 Denon DCD-1800 has an excellent mechanical feel, good programming features, good ease of operation, relatively low vulnerability to shock, and exceptional ability to resolve low-level detail on test discs. It is marred, however, by a relatively hard or aggressive upper midrange and treble. It fails to provide the low-level musical detail, air, open sound stage, and depth of a top-quality record-playing system or tape deck. The overall sound is quite listenable, however, and most of the sonic problems in the upper midrange and treble are no worse than those that result when records are played through my daughter's mid-fi Denon receiver.

Discrete Technology LS I

The Discrete Technology is a heavily modified Philips deck. The exact details of the modifications are proprietary, but the sonic result is a distinct improvement in the detailing and natural musical character of the upper midrange and treble. Imaging and depth are distinctly more open than the standard Philips and most Sony-process machines. The bass is also a bit more extended than usual, but the LS I does not have the power, natural timbre, or distinction between bass notes of the Meridian players (discussed below). As is the case with all of the better new players, the Discrete Technology, at $1,195, seems to "lock in" with some discs and not with others.

These differences have led one British manufacturer, Cambridge Audio, to develop an $1,800 machine which has the equivalent of switchable phono equalization to adapt the player to different "types" of CDs. I have not heard the production version of this machine, but it illuminates a problem in rating CD players. Unless you listen to a very wide mix of CDs, you may prefer one machine over another for the wrong reasons. A different set of reference CDs might well make another player seem preferable.

Magnavox FD3040SL

This Philips-made machine, typical of that company's current players, is

Every design problem and technical compromise contributes to a player's "error budget," the full list of variables that can cause distortion.

sweeter and more musical in the upper octaves than earlier Philips models and most of the first- and second-generation Sony-process machines. It is notably less musical and less harmonically natural, however, than the Discrete Technology, Mission, Meridian MCD or Meridian Professional players I listened to. This $449 unit definitely has the character of low- or medium-priced transistor equipment, with a loss of natural lower-midrange energy and typical transistor sound. The deep bass is also curiously lacking in natural force, and notes are a bit blurred and unnaturally hollow. It's not bad in comparison with most mid-fi electronics, but not quite competitive, in terms of realism, with the more natural musical sound available from a good turntable, like the AR, and a reasonably priced Grado, Adcom, or similar cartridge.

Meridian MCD

The $699 Meridian MCD is one of several British modifications of a Philips player, and is the machine that took Bert Whyte's fancy in a previous issue of *Audio* (see "Behind the Scenes," December 1984). It is an upgrade of the Philips CD-101, which was the first Compact Disc player Philips made, a top-loading machine sold in the U.S. under the Magnavox and Marantz brand names. (Incidentally, Magnavox's version, the FD1000SL, is now available in the Washington, D.C. area for about $200. Not only is it still musically superior to most second-generation CD players using the Sony 16-bit sampling process—although not to the latest third-generation Sony machines—but I know of no $200 record-playing system that is the equal of the FD1000SL.)

The Meridian version has an improved laser-drive interface, an improved filter, and high-quality analog electronics. It also deliberately emphasizes sound quality over features. It is the one machine under review that does not provide a digital display or a wide range of programming features—none of which I have ever found to be of more than the most passing interest. (Even my daughter cannot expand her interest in programming her Commodore 64 to programming the bands on her Duran Duran CDs.)

The sound is generally excellent, but still lacks the air and detail available with the best cartridges used with the best turntables and tonearms. The Meridian MCD provided a more musical midrange and more air than any of the other CD players under test, but still suffered from a slight trace of hardness and lack of low-level harmonic detail. The sound stage is wide and high but slightly lacking in depth.

The Meridian also has more bass than any other CD player I have listened to; this bass is sometimes exaggerated and a bit less controlled than on the better competition. With the CD format in general, I am more impressed with bass power than with bass control and definition, and this is particularly true of the Meridian in the case of complex percussion. Organ music, however, sounds much better, and the separation between low bass fundamentals is clearer on the Meridian MCD—and all of the other CD players under review—than on either the VPI or SOTA turntables.

I would still give a top-quality record-playing system the overall edge, but the Meridian MCD is definitely a "crossover" product that goes beyond mid-fi and at least edges into the high end. The best record-playing systems cost at least 50% more than the Meridian, and many cost far more than twice as much. I know of no current record-playing system that can surpass the Meridian at its price, or of any CD player that can provide so many of the advantages of the CD format with so few of the deficiencies.

Meridian Professional

Mission DAD-7000R

Manufacturers admit that CD players have sonic weaknesses, but they are a bit irritated at the extent to which some have exaggerated these faults.

Nakamichi OMS-5

NEC CD-705E

Meridian Professional

The Meridian Professional carries all of the improvements found in the Meridian MCD several steps forward, although at what may be a painfully high price: $1,400. It also is something of a transitional product, since Meridian is developing a new transport that they are planning to have out soon. The Professional is, however, important because it is still better than the MCD in resolving both the bass and the upper octaves. In fact, it begins to challenge even the very best phono systems in natural musicality, although I would argue that cartridge/arm/turntable combinations in the $1,800-plus range are still "sweeter" than the Professional, and capable of producing more natural musical harmonics.

The Professional is also interesting in that it has the bass power of the Meridian MCD, but without any indication of a slightly swollen bass or any lack of bass detail. The Professional also approaches even the best moving coils in terms of depth, imaging, and soundstage width—although it is not a direct rival. Equally important is that it seems far less sensitive to differences between CDs than most players.

This machine will be of immediate interest only to audiophiles with considerable money to spend, but it also gives an impressive indication that less costly, fourth-generation CD players will be even better than the more affordable machines now on the market. It also indicates, I think, that CD may yet be able to equal or outperform analog discs even in the areas where LPs now retain superiority.

Mission DAD-7000R

The latest Mission I have listened to is a modification of both the Mission 7000 and the original 7000R, and is still something of an interim product. The 7000 series was originally expected to use a new 16-bit chip being developed by Philips to overcome increased quantization noise. Unfortunately, large-scale delivery of the chip has been delayed to 1986-87, and Mission has had to settle for the older, 14-bit chip which has been standard with all Philips Compact Disc players, including the Meridian.

However, the Mission DAD-7000R incorporates many of the same types of improvements that are found in the Discrete Technology and both Meridian players, and comes very close in sound quality to the Meridian MCD and the best record players. The Mission's bass, in fact, seems slightly better controlled and more natural than the Meridian's, although it still seems to be a bit lacking in natural force or power. The Mission's weakness in comparison to the Meridian players is that it still retains a slight upper-midrange emphasis or hardness. This emphasis is similar to that of the Discrete Technology player. It may initially appear as more detail, but eventually it shows up as a less detailed and less harmonically natural rendition of low-level passages and harmonics.

The DAD-7000R, a reworked version of the Philips CD-104, also looks and feels a bit cheaply made. The loading-drawer mechanism is not impressive, the programming features are a bit more awkward than those of most other players, and the control buttons are tiny and anything but positive in handling and feel.

The Mission is somewhat more sensitive to shock, floor vibration, and acoustic breakthrough than most of the other Compact Disc players I have tested, although using Mission's Isoplat isolating platform ($59) will reduce most of these problems to the same level as those of other players. The DAD-7000R does not provide RCA jacks, and the hard-wired interconnect cable provided as a substitute is sonically adequate, but scarcely top-quali-

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Ironically, it is the analog stage of a CD player that may cause the sound problems that are often blamed on "digititis."

Revox B225

Sony D-5

ty and too short for many component systems. At $749, the DAD-7000R is one of the best CD players I've heard, but it does give the appearance of having engineering compromises.

Nakamichi OMS-5

The Nakamichi OMS-5 is a beautifully styled machine that uses the Philips sampling process and high-grade filters and output stages. It lacks the usual keyboard-worth of useless programming features, and it has no remote control; these are available for more money in the OMS-7. (But again, who uses all those pushbuttons? For what purpose?)

The $995 OMS-5 is sonically interesting in that it has an excellent capability to resolve musical detail on percussion and chamber music; arguably, it outperforms the Denon in this regard. The overall sound quality is roughly equal to that of the Mission and Meridian MCD in most respects, but the OMS-5 does not succeed in resolving detail in the upper octaves as well as it does in the bass and midrange. The treble is slightly lean and hard, and there is less depth.

The Nakamichi ranks close to the top but is surpassed by the Mission, Meridian Pro, and Meridian MCD. It also does not have quite the natural musical life of the best record-playing systems. Nevertheless, I doubt if anyone is going to be disappointed by this machine. It handles discs beautifully and was the only machine I auditioned where loading a second disc on top of the one being played (to ensure better tracking) did not give an occasional improvement in sound quality.

NEC CD-705E

The NEC CD-705E produces generally pleasant sound and seems to be exceptionally soundly built. The $749 unit has all the usual advanced pushbutton programming features, a nice remote control (with its own place for storage inside the machine), and very good ergonomics. The tonal balance in the midrange and highs is a bit softer than many other CD players, and the sound is good on medium- to high-level passages. The NEC does not, however, provide the air or harmonic detail of a top-quality record player and has notably less depth. Soundstage size is slightly collapsed, low-level passages are not quite as clean as on the Mission, both Meridians and the Nakamichi, and the NEC does not have quite the others' ability to handle massed strings, or transients like those produced by the triangle.

The NEC is not at the top of my list, but I should stress that it is a very musical machine. Its accuracy of pitch and timbre was sometimes audibly superior to that of the reference record players, and its excellent separation sometimes resulted in better imaging. I suspect these differences owed more to weaknesses in record production and quality control, however, than to any inherent weaknesses in the SOTA, VPI, and Oracle turntables. The NEC-705E otherwise had the usual problems that seem to emerge in most CD sound, and it was not sonically competitive with the best record-playing systems and tape decks. This model is far more musical than the earlier NEC CD-803, which was relatively irritating and hard. It is certainly competitive with many record-playing systems available in the same price bracket.

Revox B225

The Revox B225 is beautifully made and has all sorts of complex programming features. Sonically, however, it ranks between the Denon and the NEC, and below the Mission and both Meridians. The upper octaves of this $1,150 player are a bit too hard, and resolution of low-level musical detail is only adequate. Two samples also re-

If the best CD players do not represent the ultimate evolution of hi-fi, they still are able to provide excellent high-end sound.

vealed a somewhat odd sound stage. Depth was better than in many earlier CD players, but width and height seemed to collapse to a marked and undesirable degree.

Sony D-5

This portable CD player, which costs $299.95 (plus $49.95 for the optional battery pack/carrying case), is noticeably more musical than the most expensive first- and second-generation Sony machines, and outperforms many models, from other companies, that are much more expensive. It is further evidence that Sony's 16-bit process can overcome its initial inferiority to the Philips technology. The D-5 scarcely competes in sound quality with Sony's newest top-of-the-line machines, or even the Magnavox FD3040SL. The sound is slightly unfocused and sweet, however, rather than hard, and the imaging and sound stage are acceptable, even if the D-5 sounds slightly compressed and less accurate in instrument placement than the best CD players. Most competitive low-cost players are far less musical in the highs and much more fatiguing.

Yamaha CD-2

The Yamaha CD-X1 and CD-2 sound almost exactly alike, and are sonically close to the Denon DCD-1800. The Yamaha CD-2 reproduces slightly less low-level musical detail than the Denon, but is softer in the upper midrange and highs. This makes it a very listenable mid-fi machine with a more forgiving character than that of many other CD players.

The $599 CD-2's controls are also well thought-out. It has an excellent set of readouts and programming features, and a good remote control. The Yamaha CD-2 does not rank with the Mission or Meridians, but, like the NEC, it is a pleasant mid-level machine.

Yamaha CD-3

The Yamaha CD-3, priced at $499, is a warning that newer is not necessarily better. Like many CD players which attempt to keep prices to an absolute minimum, the CD-3 has highs that are a bit hard and fatiguing, and its general sound character seems to mix that of an inexpensive receiver with the general upper-octave problems described earlier. This Yamaha is a good reminder to listen closely to any CD player before buying, and not to buy on the bas s of price alone.

Yamaha CD-2

Yamaha CD-3

CD Players vs. Record-Playing Systems

To sum up, the best record players, to my mind, still retain a slight edge over CD players (or, in sonic terms, lack one). The best CD players, however, are already directly competitive with, or superior to, most record players in their price range and are far superior to the initial generation of CD players. If they do not represent the ultimate evolution of high fidelity, they certainly can provide excellent high-end sound The Mission and the two Meridian units also indicate that future generations may yet surpass even the very best record players

I also should note that the Mission, Meridian MCD, and Meridian Professional players are already good enough to help me evaluate the best turntables. Their ability to provide a flat response and dynamic range in loud passages helped me confirm, for instance that the latest VPI HW-19 could produce a slightly flatter mid-bass and more midrange detail than the SOTA Sapphire, and also that the VPI was slightly more prone to certain kinds of low-frequency acoustic breakthrough. Whatever the weaknesses of today's CD players, they already expose some of the deficiencies in even the very best record-playing components.

Anthony H. Cordesman

THE MIDAS TOUCH

Love Over Gold: Dire Straits
Warner Bros. 9 23728-2.

Dire Straits' head honcho, Mark Knopfler, is a musical genius. There—I've fallen into the cliché trap once again—knowingly this time, however, because genius seems the only term that adequately describes the man's talents. His limpid, trademark guitar floats along and shines above the rock axe heap; his moving, erudite lyrics come across beautifully with or without music; his melodic sense is impressive. Under his guidance, Dire Straits has achieved here the most soulful, seamless interplay of acoustic and synthesized sounds on record. And Knopfler is no slouch in the production department either.

The 1982 *Love Over Gold* was Dire Straits' fourth album, an ambitious recording that contained *not one* single-length cut. This Compact Disc version is a model of clear, accurate sound reproduction of the original analog recording. I'm particularly fond of the way Knopfler sets up a muted, atmospheric, synthesized intro and pierces it with an achingly beautiful sliver of acoustic guitar and/or piano. He does this to perfection on the 14-minute-long introductory epic, "Telegraph Road." The first few heart-stopping notes from acoustic guitar and piano appear luminously over a background of extended high synthesizer sounds, a muted crash of thunder, and a big, deep bass pool spreading languorously from a single synth bass note.

The digital cleanup exposes Knopfler's extraordinary and subtle production values. Layers of instrumentation are cleanly defined, and individual instruments are perfectly articulated. The quick thrill of a bongo run in the right channel on "Telegraph Road," every catch and tear in Knopfler's distinctive, near-adenoidal voice, and the brief echo of footsteps on bare floor in "Private Investigations" all have a lit-from-behind clarity that speaks of excellence in the studio.

These five extended cuts are, by turn, soothing, electrifying, rocking, and thought-provoking. It's a splendid CD and a gorgeous recording—drop your gold on the shop counter for the love of it. *Paulette Weiss*

Monk's Moods: The Great Jazz Trio
Denon 38C38-7323.

Sound: B+ Performance: B

How can you go wrong with a CD full of classic Thelonious Monk compositions? You can't, but while the Great Jazz Trio turns in a solid performance, they add little to the many classic recordings of these tunes. The Great Jazz Trio is essentially pianist Hank Jones and whoever he has in the rhythm section; on *Monk's Moods* it's the stalwart bass of Eddie Gomez and the lesser known drummer Jimmy Cobb.

Jones is a pianist in the Monk mold, sparse and methodical; there's never a stray note or errant burst of sentiment. He's been here before, and on this recording he sometimes sounds like it. He gives "Blue Monk" a hesitant, perfunctory reading, and "Ruby My Dear" is saved by a bending read of the melody from Gomez.

Trumpeter Terumasa Hino guests on "'Round About Midnight" with a witty, acerbic run on Monk's classically melancholy tune. But the reverb on his

Jimmy Cobb, Hank Jones and Eddie Gomez

trumpet is unnatural and distracting next to the dry recording that the trio receives. On "Jackie-ing" Jones uses a Yamaha DX-7 synthesizer to emulate the organ and xylophone of a circus band, but these synthesized sounds are buried in the mix of marching drum rolls and then abandoned once Jones takes off on his solo.

Jones does rise to the occasion for the rousing "Bemsha Swing," with Cobb's churning African polyrhythm underpinning the pianist's stabbing percolations on top. "Misterioso" lives up to its name with a wash of cymbals revealing the Möbius-strip melody played by Jones in split octaves. Hino returns for "I Mean You," firing up the group with a glistening, pointed solo and then trading fours all around in the most spontaneous moment on the entire disc.

Overall, however, *Monk's Moods* is flat. It exists at a level below which great artists and state-of-the-art technology rarely fall, but it never approaches the heights, either.

John Diliberto

Born in the U.S.A.: Bruce Springsteen
Columbia CK38653.

The drums on the opening (and title) cut of *Born in the U.S.A.* slam out of the speakers with the wallop of a Mack truck hitting a concrete road divider at 80 mph. Hot on its tail comes the Boss' voice, tough as an 18-wheeler's tires and sounding like it's seen just about as much mileage. This intro sets the pace and tone of the song that has become the American rock anthem of the decade. This cut is also one of the six (!) Number One singles from a remarkable LP which has been at or near the top of the charts for well over a year now.

Bruce's images of the open road, desolation, smoldering passion, and the working-class life with its lost dreams, lost loves and lost youth are quite straightforwardly produced. Like the man himself, there's no gimmickry here, just good, solid craftsmanship and an emphasis on communication. Bruce's pipes are almost always treated with some reverb, and occasionally an instrument is strategically located in one channel or split for greater effect, like the guitar running clear and steady, like raindrops, in the right channel of "I'm on Fire" or the split left-right percussion in "Darlington County." But in general, this is an uncluttered production geared to let you hear Bruce and the faithful E Street Band with nothing in the way.

This Compact Disc version of the original analog recording does full justice to the rock-steady production, providing a deep, bottomless between-cut silence out of which Max Weinberg's signature drum intros burst forth, and an extended dynamic range to handle the sudden volume transitions. Weinberg's intros lead off most of the 12 cuts, sometimes sounding dry and tight, as on "Born in the U.S.A.," sometimes sounding full-bodied and tubby, as on "Cover Me."

Bruce's voice, whether presented in the foreground or shoved back into the mix, is always the focal point. The deliberately muddy quality of "Darlington County" pulls Bruce inward and makes him one of the boys, all joining in to sing the raucous "sha la la" vocal chorus with infectious good humor. It's all Bruce up front, though, on "I'm on Fire." He speaks straight to the soul with his barely restrained passion. The sense of intimacy is positively moisture-producing. His freight-train hoot cuts into the senses like the knife described in the song.

"Dancing in the Dark," "Cover Me," "Glory Days," "I'm Going Down"—by now, you know all this stuff by heart. It will suffice to say that this CD version of *Born in the U.S.A.* is a must-have rock album in a nearly perfect format.

Paulette Weiss

Swept Away: Diana Ross
RCA PCD1-5009.

Diana Ross glitters in her sleep. It's true. My friend Eddie swears she does, and he should know; he's her Number One Fan, and he knows *everything* about her.

I don't know about Ms. Ross' sleeping habits, but I *do* know that this shimmering CD version of *Swept Away* bears the special glow that the sophisticated singer brings to most projects in her ken. Ross has assembled the glitterati of the pop music world to assist her in the production, performance, and writing of this 10-cut disc. Lionel Richie, Daryl Hall, Jeff Beck, Julio Iglesias, Nile Rodgers, Arthur Bak-

Bruce Springsteen and the E Street Band

Diana Ross' technically superb CD of *Swept Away* offers outstanding clarity as well as a firm sense of depth and breadth.

er, Karla De Vito, Robby Benson (yes, *the* Robby Benson), Richard Perry and Bob Dylan are just a few of the artists who have contributed to *Swept Away*. Although the disc is far from perfect (weak cuts like Ross' lethargic version of the rousing oldie "Rescue Me" sit like lumps of coal among the diamonds), when the material suits the singer, the glow can be seen from Kansas to Georgia—Georgia in the U.S.S.R., that is.

Such is the case with the opening selection, "Missing You." This is Lionel Richie's touching remembrance of the late Marvin Gaye, written especially for Ross, Gaye's longtime friend and short-time collaborator. The sense of yearning, of loss and sorrow, is achingly apparent in the singer's voice, which weaves through the deceptively simple melody with grace and restraint.

The digital version of the original 1984 recording is breathtakingly clear. On the above cut it captures with stunning clarity the sweet chiming of the opening electric piano notes, the breathy, sad intimacy of Ross' voice, the almost subliminal accents of cymbal and maracas. The production work on "Missing You," by Richie and James Anthony Carmichael, is exquisite. Bernard Edwards, half of the famous Chic production duo (the other half, Nile Rodgers, is represented on this disc as well), has lent his talents to "Telephone," a spiffy cut with some superb special effects, like the magnified sound of a rotary telephone being dialed as though it were right next to your earbone. Daryl Hall and Arthur Baker polish up the title song with some hot percussion, channel shifting, and vocal echoes. Here, Jeff Beck's searing guitar burns a smoky hole right through the middle of the cut. Richard Perry and Raymond Arcusa pile on banks of strings and great swelling heaps of vocal choruses to highlight Julio Iglesias and Ross in their debut duet, "All of You." Ross' golden voice appears in the thick instrumental support like a river of hot honey, Julio's like a stream of warm milk. Together they make a nice blend in a song which, despite all the *Sturm und Drang* of the arrangement, comes off as rather lusterless.

Ross produced the rest of the disc, and proves herself no slouch in this department. Best of all, she's willing to take some risks. The quirky "Nobody Makes Me Crazy Like You Do" is a truly freaky little number, one I would not have expected the ultra-smooth Ross to have attempted. "Touch by Touch" has some unique percussion work, with a slight Caribbean cast and a definite flair for the unusual synthesizer accent.

Again, this Compact Disc is technically superb. Clarity is outstanding. There's a real sense of instrumental presence, and left-to-right and front-to-back shifts give a firm sense of depth and breadth. The extended dynamic range shows off the big orchestral guns brought out for the Iglesias/Ross extravaganza and captures the songstress' softest whisper with ease. A jewel-box setting for the glittering Diana Ross, night or day. *Paulette Weiss*

Echo Canyon: James Newton
Celestial Harmonies CD CEL 012.

Sound: A– Performance: A+

Improvisation and intuitive understanding are the hallmarks of great jazz. Nowhere are these qualities more evident than in the solo improvisation, where the musician is left entirely to his own devices and creative instincts without a written score or other performers to fall back on. Virtuoso flautist James Newton is one of the few artists who don't need a net.

Echo Canyon places Newton's improvisational skills between the forces of nature and technology, welding them together with his brilliant aerial displays. Playing in Carson National Forest in New Mexico, Newton uses the crisp echoes and reverberation of the Echo Amphitheatre to unveil a variety of moods and feelings. The flute is his baton, the canyon his orchestra, caught in all its resonance by skillful miking and digital recording.

Newton runs the range of flute techniques, with overblown notes on the squealing "Firebreath" and bluesy vocal interpolations on "Ise." "Kamakura" evokes the sounds of the Japanese shakuhachi, with subtle strokes like the brush of a feather.

"O'Keeffe," named for the desert artist Georgia O'Keeffe, is a maze of echoes, simultaneously ascending and descending, following the dazzling flights of Newton's improvisations. Newton can be playful, as on "Ritual Distance," where he taunts the echoes to follow him. He can also create ominous, layered waves of sound with the slow lament of his bass flute on "Land of Enchantment."

Throughout, Newton is accompanied by a choir of crickets and night birds, singing to their own secret arrangements. In listening to this seamless recording, with each piece connected by crickets, I sometimes got the feeling that the sounds of nature were artificially juiced, like the crowd noises of a live rock album, but that's the only drawback of this enchanting excursion.

Even in LP form this was a pristine recording, but the CD reveals a newer level of nuance and sound shaping and is the better way to travel through *Echo Canyon*. *John Diliberto*

JANUARY

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Jacques Van Oortmerssen is an exciting performer, and the historical organ he plays has considerable weight and power.

Historical Organ at the Waalse Kerk in Amsterdam. Jacques Van Oortmerssen, organ.
Denon 33C37-7376.

Denon has been recording many of the great historical organs in Europe. The latest in the series is this CD recording of the organ in the Waalse Kerk in Amsterdam.

Many of the old organs in Europe have had to be rebuilt or restored or revised. The organ in this recording was built in 1680; work was done on it in 1734 and again in 1965. At present, it is in excellent condition.

The church has a reverberation period just slightly over three seconds, and the organ sound is extremely brilliant, with great projection, clarity and articulation. The reeds are lovely, and there is a beautiful flute stop that organist Jacques Van Oortmerssen frequently employs. The low wind pressure of most of these old organs restricted pedal stops to 16 feet (32 Hz), but on this instrument a modern electric blower gives them considerable weight and power down to that limit.

Oortmerssen is an exciting organist, with gobs of technique. The "G Major Prelude," the "E Minor Sonata," the "Prelude and Fugue in D Major," and the "Partita Diverse" are given performances of considerable majesty.

Denon has made some very successful recordings of these great old organs and deserves credit for the superb digital sound. *Bert Whyte*

Debussy: Suite Bergamasque, Pour le Piano, Estampes, Images. Zoltán Kocsis, piano.
Philips 412 118-2.

If you like the piano music of Debussy, this CD is a real treasure. Pianist Zoltán Kocsis has a prodigious technique, witness his fleet-fingered, bravura performance of the toccata from "Pour le Piano" and the "Jardins Sous et Pluie" from "Estampes." He also knows how to be richly expressive and lyrical, as with his lovely playing of the famous "Clair de Lune" from the "Suite Bergamasque."

The piano has a high-definition, completely articulate sound, with ultrafast transient attack. Even in the most rapid passages, there is never any blurring or smearing of detail, and the sound remains exceptionally clean and transparent. Although the instrument is miked rather closely, it is furnished with a warm, spacious ambience that affords a natural-sounding perspective. Dynamic range is quite

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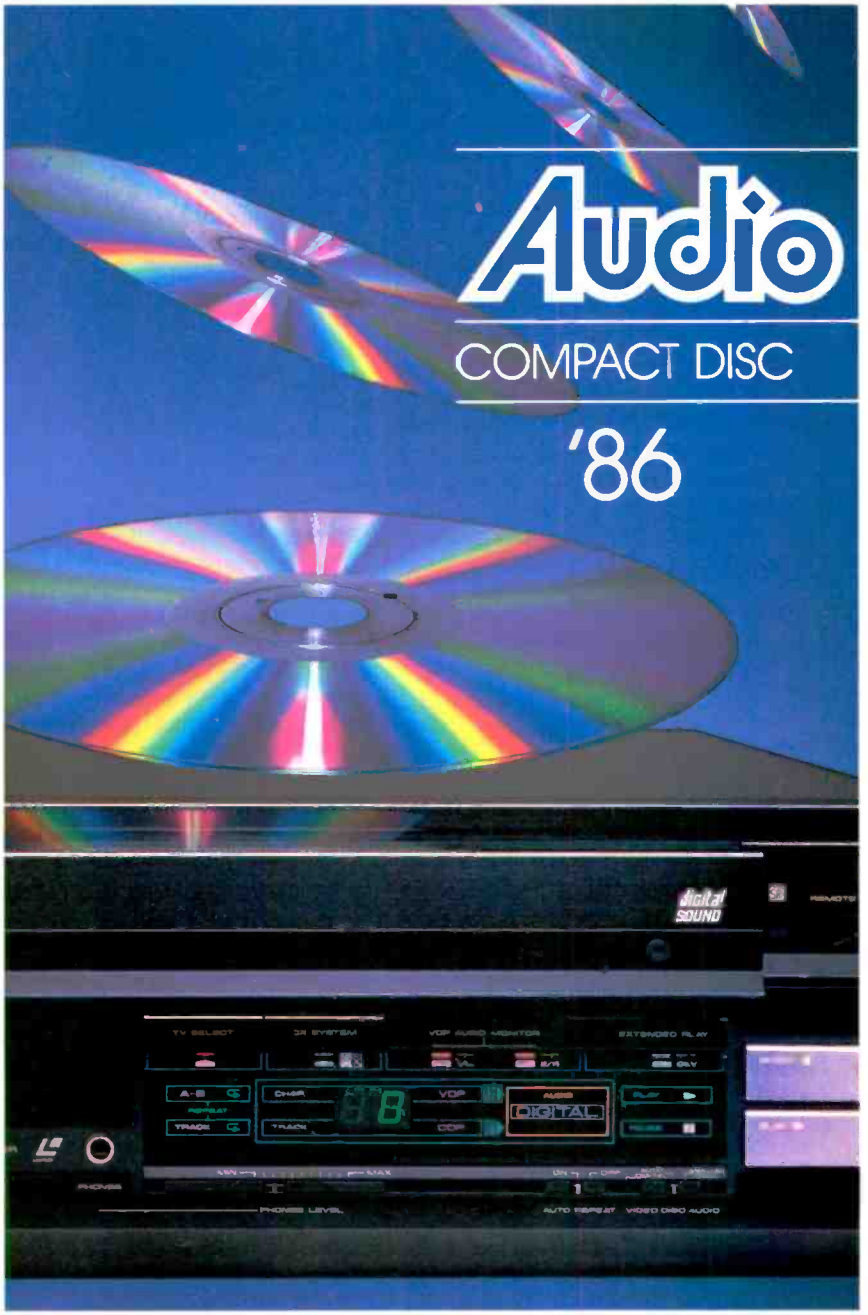

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Sade Adu

On *Diamond Life*, all of the instruments have been put in separate sonic cells, with plenty of space between them to reinforce a sense of isolation.

wide, and there are massively sonorous chords which can be very demanding of amplifier power. As always, the magic quiet of CD provides an extra measure of realism.

Bert Whyte

Diamond Life: Sade
Portrait RK 39581.

Despite the exterior wall surrounding Sade's (Shar-day's) world of fettered feelings, this group's music has a passionately emotional interior. The rather prison-like atmosphere is a political statement meant to show that we all suffer from the same afflictions. Living in the shadow of The Bomb, and in the social traps of life, all of us tend to put up a hard exterior to protect the vulnerable, sensitive person inside.

That's what Sade does musically. On the outside, their music is glossy, commercial disco/jazz, seemingly without substance. But that bland coating has been applied with a skill that betrays the value and intensity of what's inside. If you don't know what to look for—if you don't acknowledge and share some of Sade's feelings—you'll miss the point.

In decorating the sparse acoustical set on his imaginary sound stage, producer Robin Millar restricted himself to a small group of sounds. The ambience feels very close, but contained within a large space. Millar gets this effect with expansive reverb, with an unnaturally fast decay to emphasize the feeling of being trapped. Concrete and steel seem to be the predominant surfaces of this unfriendly environment; boosting the highs on the reverb unit's output does that. Millar puts each instrument in separate cells, with plenty of space between them, to reinforce the isolation.

Musically, Sade keeps the textures lean. Short, sharp percussion prevents clutter in the accompaniments. Sade always restrains the range of a dynamic swell or a change of timbre, conserving resources in their bleak, poverty-stricken world.

The sax solos that open two songs are similar, but different in important ways. In "Your Love Is King" Stuart Matthewman plays with a smooth sound, but he uses a rougher, slightly raunchy tone for "Frankie's First Affair." In the context of the style, that difference speaks volumes. Lead singer Sade Adu responds to the sax in "Frankie" with a breathy vocal.

Every song has a clear structure and a well-defined emotional and musical peak. The volume goes up, the texture becomes more complex, the performers become more openly expressive, and sounds not heard previously suddenly appear. Within the restricted dynamic range, Sade does not forget to use contrasts to highlight a climax. When it occurs in "Frankie," Andrew Hale adds an almost inaudible touch of string sounds on synthesizer.

An appropriately austere booklet complements the music with visual images and typefaces that prepare you for the musical experience. The four stark photo portraits of the musicians capture Sade's spirit effectively.

The question is whether Sade will break out of their self-imposed prison and show us the depth they really have. More of the same could degenerate into neurasthenia. What do they have to say when they drop the pseudo-shallow, punk/New Wave attitudes? If life is miserable, does Sade have any hope that society can change?

Steve Birchall

Afternoon in Paris: Stephane Grappelli
MPS 821 865-2.

Stephane Grappelli, the grand old man of the French jazz violin, carries on a tradition that flourished in the '30s. His jaunty, angular musical personality, suave style, and gentle humor pervade this disc.

"Chicago" is a good example of his charming, slightly irreverent approach. With his first note, he introduces those characteristic rhythmic discrepancies which are a basic part of his musical vocabulary. He plays games with the steady background beat, coyly holding a note too long or hesitating before starting a note, then jumping back onto the beat and continuing—with impish charm—as if nothing had happened.

Melodically, he likes to interpolate small leaps between the main notes of a familiar tune, gleefully confusing you, and then returning to the tune somewhere in the middle of a phrase.

In "Autumn Leaves," Grappelli uses an unexpectedly rapid tempo, which turns out to be just casually fast when he settles into a happy, shuffling pace. After about a minute, he begins to decorate the melody with rapidly swirling, scalar passages. His special trick is to give an extra little emphasis, off the beat, to individual notes in the main melody.

Later on, listen to Eberhard Weber's bass solo. You'll hear a few clues in this 1971 recording as to where Weber's musical development would go. Occasional pitch bends and sliding tones hint at the inventive musical mind that would emerge and bring us *Yellow Fields* in 1976. Sitar technique (i.e., a phrase of sliding notes after a single pluck of a string) already had started to influence him.

The sound quality on this disc is only average for the period. The piano transients have far too much overload distortion. In 1971, that amount of distortion was avoidable, and a mistake when it occurred. Also, the violin often interacts with the reverb, producing a harsh sound that could have been avoided. Producer Willi Fruth and engineer Rolf Donner get low marks for not taking greater care with this.

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Much of Dollar Brand's solo music occurs in the spaces between his notes, which are ample and truly silent on this CD.

Fruth keeps the ensemble nailed in place on his imaginary stage, as if he were recording a tableau, not a play. The drums are a single unit on the right, and the violin, bass, and piano are clustered together near the center, as they would appear in a live performance. The image has a slight sense of depth but seems basically two-dimensional—fairly typical for the period.

Whenever the music gets soft, Fruth's compressor moves in for a "close-up shot" that keeps the level constant. Listen to "Tangerine" when the violin drops out to let the piano take a solo. You'd expect the level to decrease, but it doesn't. Worse, the metallic distortion on the piano doesn't sound any better when it's closer.

The booklet includes photos of the four musicians, but there is nothing that might help younger listeners discover the elegant charm of Grappelli's playing. For those who already know, the disc is a nice document of his 1971 style. *Steve Birchall*

Anthem for the New Nations: Dollar Brand
Denon 38C38-7261.

Sound: A– Performance: B+

Dollar Brand, who also goes by the Muslim name Abdullah Ibrahim, is often described as an economical piano player. It's an expression that's meant to be praiseworthy, but I've always thought of it as a consumerist way of describing things. A Volkswagen is economical, generic detergent is economical, but not art and music. Instead, I'd say that Dollar Brand is discreet and tasteful, playing every note for its full meaning, with no loose ends or distracting bells and whistles.

Anthem for the New Nations is a solo piano outing digitally recorded back in 1978. These meditations offer the full spiritual range of Brand's music. "Biral" is a ritual dirge with a spacious, four-note ostinato played against a solemn blues refrain. "Liberation Dance" is one of those rousing, gospel-tinged anthems that Brand has mastered. This Compact Disc makes those charged, bass-note runs resonate with deft assurance.

This is a dry recording, with little if any post-production reverb added. So Brand's piano has a sometimes harsh presence as the recording plays fully on contrasts between his sparse, low-register stabs and rippling, high-register runs. This works well for the angular, jagged lines of "The Trial," reflecting Brand's misgivings about his homeland, South Africa. "Capetown" is rimmed with feelings of melancholy.

Much of Brand's solo music occurs in the spaces between notes, which are ample and, on this CD, truly silent. His austere style can become wearing, however, with pieces like "The Wedding Suite" bordering on Spartan self-denial. But the immediacy of Brand's emotions and the lack of florid sentiment that mars so many new solo piano recordings makes this a cleansing listening experience. *John Diliberto*

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MICHAEL TEARSON
JON & SALLY TIVEN

FAITH, HOPE AND CLARITY

Dog Eat Dog: Joni Mitchell
Geffen GHS-24074, $8.98.

Sound: B Performance: A–

In light of Joni Mitchell's earlier albums, where romance and introspection were usually framed by solid, expansive guitar, the most unusual things about *Dog Eat Dog* are the preponderance of synthesized and computer-processed sounds, and the main concern of its lyrics: Our declining culture.

Few artists have used the sound products of the technological revolution more appropriately or more significantly. Mitchell, synth-wiz/coproducer Thomas Dolby, and bassist/husband Larry Klein have created and quoted a wide range of exceptionally melodious and complex synthesizer sounds. The fact that electronic instruments can never sound as warm and alive as the real thing is neither ignored nor denied. The hollowness and coldness of the electronic instruments are made to represent, and to evoke, the same attributes of the troubled civilization about which Mitchell sings.

The album isn't devoid of the sort of confessional lyrics Mitchell is famous for; songs ostensibly about her personal relationships open and close the cycle. But at its heart, this album focuses on the corruption, decadence, heartlessness and stupidity of our culture.

Mitchell's voice—soaring, diving, cutting, peeking, poking and pushing above, behind and through the instrumental mix—is stronger, more versatile, and in some ways better then ever. She has added new vocal tones and inflections to an already formidable array; for instance, she ends some of her phrases by leaping down, melodically, and landing hard. Surely she got this from Sting, whose vocal trademark it is.

Seamless background vocals by James Taylor, Michael McDonald and Don Henley are lush ear candy, though not too sweet, because neither the harmonies nor the melodies are pure pop. They are simultaneously more complex and more natural than pop, with the sophistication and intelligence of jazz and the freshness and purity of folk.

Though Mitchell's lyrics depict our culture as being in a sorry state, the album itself is grounds for cautious optimism. There must be hope for any society that can produce an artist who gives us an album as good as this.

Susan Borey

In Square Circle: Stevie Wonder
Tamla 6134TL, digital, $9.98.

Sound: B Performance: B

Stevie Wonder's first full studio album in five years is a very pretty one. Stevie may not be much of an innovator here, but he is incapable of delivering anything inferior.

Side one is all love songs, opening with his hit, "Part-Time Lover." The song resembles "Easy Lover," the Phil Bailey/Phil Collins collaboration, more than a little, a resemblance enhanced by Bailey's presence in the song's backing vocals. Luther Vandross is here, too, singing the song's duet with Stevie. "I Love You Too Much" is another bouncy tweak of a song that leads directly to the sweet ballad, "Whereabouts," just the kind of heartfelt love song Wonder excels at. "Stranger on the Shore of Love" and "Never in Your Sun" complete the side.

Side two has the album's topical material. "Spiritual Walkers" is about door-to-door and airport evangelists, people trying to spread and share their particular inner lights, and the song is kindly and gentle to them. "Land of La La" is about the allure of Los Angeles as the place to make one's dreams come true and the hypocrisy that such dreams meet. "Go Home" is addressed to a runaway as it tries to convince her to return to her parents. "Overjoyed" is a love song about the pain you may find in the search for ecstasy. The closing song, "It's Wrong (Apartheid)," sizzles to an African beat as it rails against the inhuman injustice and brutality of the South African system. On the Compact Disc edition of *In Square Circle*, this last song will appear in an extended version.

Stevie's sound and production are, as usual, quite refreshing—bright and uncommonly clean and dry, thanks to digital recording and mixing. Although Stevie plays nearly everything except guitars, horns and one synthesizer part, the album does not suffer from a sterile, assembled-from-bits effect. Some of his touches are fun to pick out and listen to, such as the sounds of birds, crickets and nature in "Overjoyed," or the popping, percussive stereo effects in "It's Wrong (Apartheid)." And, as always, there is undeniable love and humanity in Stevie Wonder's music and performance.

In Square Circle may not be a landmark album on the order of *Talking Book* or *Innervisions* or *Songs in the Key of Life*, but it makes for very comfortable, relaxed and satisfying adult listening. Even when he isn't blazing new trails, Stevie Wonder is worth listening to. Just don't make us wait five

Stevie Wonder

more years for another album, Stevie.

One last note. The cover and enclosed booklet are gorgeous and help justify the premium price. But couldn't Tamla do better than the cheap, cut-corners, paper inner sleeve?

Michael Tearson

Cerulean: Fleetwood Mac
Shanghai 300, import, two-disc set, $9.98.

Sound: B– Performance: A

As incredible as it may seem, Fleetwood Mac was once a gut-busting, raw blues band that made some of the most intense nights of early-'70s British rock ever. Their membership included three killer guitar players, each of whom left the group, in quick succession, under peculiar circumstances; all departed on short notice (sometimes in mid-tour) to join an extreme religious order. Don't ask what would make these musicians leave one of the most promising bands to come out of the John Mayall axis in order to live mystical lives of self-denial, but some of the most devout believers come from the heathen life. In any case, the music on this album is definitely of the secular variety. Peter Green (formerly Greenbaum) is most assuredly getting down on *Cerulean*.

This is the long-rumored live Fleetwood Mac album, prepared for release about 15 years ago (when it was recorded) but shelved after Greenie left the band. The 24-minute version of "Rattlesnake Shake" is not only enjoyable in its entirety, but it doesn't even feel long until the rhythm section takes its solo. "The Green Manalishi" is one of the coolest cuts ever made, and this rendition stands with the studio version head to head.

The only real complaint one might have is that the vocals are mixed rather low, and the fidelity requires that you crank things up to hear the album properly. Given the density of sound this band provided on this particular gig, it's no wonder. This is British rock in all its glory, before half the bands exported to America fleshed out their shows with prerecorded tapes and slide shows to distract the audience from the fact that they couldn't play. Chalk another one up for progress, but stick this in your shopping cart next time you go out for something new.

Jon & Sally Tiven

What A Life!: Divinyls
Chrysalis CHR 41511, $8.98.

Sound: B Performance: A–

There was a time when The Pretenders were the most exciting nonmetallic rock band led by a woman but since Chrissie Hynde seems to be settling back into making "mature" records, the mantle has been passed. Divinyls claim the scepter on their own merits: They are not clones or a band whipped into shape by some Svengali, but instead come across as a unique blend of powerful pop and driving aggression. What's more, they are quite original in approach, although rooted in their native Aussie origins (they covered an Easybeats song on their debut album, and lead singer Christina Amphlett learned a thing or two about stage presence from AC/DC's Angus Young). Divinyls' second record dilutes none of the drive of their first, but seems far more likely to reach the mass audience with its quirky yet commercial appeal.

This record's popular potential owes partly to the guidance of studio veteran Mike Chapman, who's been known to fashion many a trendy silk purse out of sows' ears. The guy's no slouch at writing or arranging irresistible pop ditties. Now give him an accomplished bunch of players and a formidable front woman, and the results are sizzling indeed. The tension between the traditionally structured and pleasantly riff-filled vignettes and the growling-like-a-woman-possessed vocals creates a unique and exciting identity for this driving combo from Down Under. Christina generally sings like a hellion, but when she quiets down, as in "Dear Diary," you realize how spellbinding her powers can be. The band plays with a vengeance, and the songs are memorable ones.

The world is desperately in need of a fresh band of rockers; this is it. Don't go any further. Mass-market rock shouldn't be this good, so take advantage now!

Jon & Sally Tiven

Divinyls

Sounds fill every crack on Sheila E.'s *Romance 1600*: Be-bop bass, timbal rolls, background nattering and hot, hot percussion.

Romance 1600: Sheila E.
Warner Bros. 1-25317, $8.98.

Sound: B Performance: B

As insufferably affected as Sheila E. is (E.—what a great last name!), she's also got genuine guts. Not many performers would follow a gold-record debut with such a radio programmer's nightmare. Not strictly jazz or funk or rock 'n' roll, *Romance 1600* does ooze with all three. As percussionist/vocalist/producer Sheila Escovedo gaily suggests, the more the better.

At the same time, there's certainly a lot of romance going on in *Romance 1600*. In fact, it's a regular Harlequin paperback on vinyl, an album you could take to the beach. "Dear Michelangelo," for instance, is a period romance, with an Italian peasant fantasizing about the Renaissance man to the background of slithering tenor-sax lines. "A Love Bizarre," cowritten with Sheila's mentor, Prince, is a 12-minute ode to decadence—not real decadence, but the *Dallas/Dynasty* decadence Americans find so delicious. "Toy Box" sings the joys of female autoeroticism. "Yellow" gives the confessions of a high-school tease—with, heavens to Freud, male vocalists snapping out her interior monolog.

Sounds fill every crack: Be-bop bass lines, trademark timbal rolls, background nattering that sounds like stage actors in a crowd scene, and hot, hot percussion. Busy as it is, you can still make out individual instruments and virtuoso turns. For a self-produced album, there's a healthy sense of perspective.

Of course, endemic to anything self-produced is self-indulgence. Ms. Escovedo's voice, while adequate, is hardly the equal of her or her band's playing. Her occasional spoken-word bits are embarrassingly inept. Can't say she doesn't have her own sound, though, and her songwriting already shows signs of shedding its purple Prince-liness. Her second album is like some people's tenth. *Frank Lovece*

T. Rextasy: T. Rex
Warner Bros. 25333-1, $8.98.

Sound: B Presentation: A

This long-overdue retrospective, a 15-track anthology, adds up to a very concise and complete listen to the joys of T. Rex.

T. Rex dominated the English pop charts for several years at the beginning of the '70s; they were a nonstop hitmaking machine that produced some of the best cotton-candy rock music ever. Their one big American hit was the memorable "Get It On (Bang a Gong)," recently made a hit anew by The Power Station. The ride ended abruptly in September of '77 when Marc Bolan, the elflike singer/songwriter/guitarist/front man of the group, was killed in a car crash.

Marc Bolan of T. Rex

The material here is from 1969 to 1973, the period of T. Rex's fullest flowering. Songs like "Ride a White Swan," "Jeepster" (which I once named a parakeet after), "Telegram Sam," "Metal Guru," and, of course, "Get It On" sound as fresh now as when they were new—surprisingly so. Other equally fine cuts have never been on a U.S. album before, among them "Hot Love," "Raw Ramp," "Solid Gold Easy Action," "The Groover" and "Born to Boogie."

Tony Visconti produced everything here, and, more than a decade later, it sounds as vital, witty, clever, and up-to-date as ever. The simplicity of the songs wears very well over time.

T. Rextasy has the hits and more. Jim Bickhart has executed some superb and informative liner notes that place the group in the flow of pop-music history and give some sense of context to the songs.

T. Rex was about how much fun rock 'n' roll could be. Their music still is. *Michael Tearson*

Heart
Capitol ST-12410, $8.98.

Sound: C+ Performance: C–

When Heart began as a recording act, there weren't a whole lot of hard-rock bands with women in them. Ten years later they still have the capability of playing and singing but seem to be stricken with writer's block. Their new album features a preponderance of outside material, all of it weak, and singer Ann Wilson doesn't deliver a single vocal with even a shred of conviction. The result is a potpourri of dull, generic rock that sounds contrived and, ultimately, grating.

This wasn't always the case. When we last left the group, they were writing good songs ("Even It Up" was a terrific single), had control over the bulk of their repertoire, and seemed ready to drive forward in a straight-ahead, somewhat soulful direction. But their new record company seems content to turn them into a faceless, boring, and completely substandard corporate rock entity with no real character. *Jon & Sally Tiven*

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The new ADS CD3.

Aided by excellent digital mastering, The Whites' album sounds lovely, and everything has been kept pure and simple.

Whole New World: The Whites
MCA/Curb 5562, digital, $8.98.

Sound: B Performance: A

High Country Snows: Dan Fogelberg
Full Moon/Epic FE 39616, digital.

Sound: B Performance: A

On this pair of exemplary albums of very folky country music, performances are sure and confident, with lots of inspired picking and singing. Best of all, each has superb sound and excellent presence to allow the textures of the acoustic instruments to shine through. The start-to-finish digital technology used on the Fogelberg project gives it a bit of an edge in clarity, but The Whites' album sounds lovely as well, no doubt aided by Glenn Meadows' excellent digital mastering.

Each album is a case of one fine song after another, with no real low point on either one. *Whole New World* is the lower keyed of the two, with nothing but excellent singing, particularly by Sharon White, and flawless playing by Jerry Douglas on dobro and by a variety of fiddlers (including Mark O'Connor, Bobby Hicks and Ricky Skaggs, who also plays guitar and mandolin). Production is by Skaggs (who is Sharon White's husband) and engineer Marshall Morgan. It couldn't be better, as they keep things pure and simple.

So, too, do Dan Fogelberg and Marty Lewis in their production of *High Country Snows*, but they lean to flashier playing. Douglas again stands out on dobro. Other soloists include David Grisman on mandolin, Herb Pedersen on banjo, and Fogelberg on guitars. The instrumental "Wolf Creek" also has Doc Watson in for a cameo appearance and some amazing guitar playing. The prime vocal harmony with Fogelberg is provided by Pedersen, and they are joined on different tracks by Ricky Skaggs, Chris Hillman and Vince Gill. The grand result is a festival of hot licks and one terrific album.

In fact, make that a pair of terrific albums of sunny, satisfying country sounds. *Michael Tearson*

Low-life: New Order
Qwest 25289-1, $8.98.

Sound: B Performance: A–

They defy categorization, yet have influenced a whole new breed of performers from Paul Young to Dumptruck; they are a cult band without the stink of pretentiousness that usually accompanies such a tag; they are New Order. Without sounding like Big Country or a zillion metal-mongers, they are first and foremost a guitar band, gifted, unique, and classical in approach. Finally they have managed to garner an official American release on (of all places) the Qwest label, and the resulting music is appealing, belonging to a completely original aesthetic and yet somehow universal. New Order has arrived at last.

Gillian Gilbert of New Order

They've been around for a while, actually (eight years, but who's counting?), under monickers like Warsaw and Joy Division, but only recently have American record companies invested Yankee dollars in their productions. It's about time. This band is obviously important, and how they've eluded major stardom is quite the mystery—they have the gift of melody, and are danceable as well. Perhaps they are too intense for the majority of listeners, but once American rock radio gives them half a chance—and this is just starting—the music of New Order will find its following. *Low-life* is one of the best releases by a so-called New Wave band in quite some time. Buy it or be denied. *Jon & Sally Tiven*

Wide Awake in America: U2
Island 90279-1-A, $5.98.

Sound: B Performance: A

U2 is a fairly remarkable testament to the power of a singer to sell a band. The progressive music that this band produces is fairly obscure, but vocalist Bono makes the package relatively mainstream. He's got this sort of spacey, ethereal quality to him that makes him the Irish Robert Plant, or Sting without the photogenia. A lesser man couldn't bring it off, but now U2 is one of the biggest bands in the world. Who'd a thunk it?

As for this particular record, it's between-albums time for U2, so here's a collection of album outtakes and live recordings that are all of a very high standard. Tony Visconti produced one live track, and if this is a preview of forthcoming collaborations, we can't wait. As fine a piece of plastic as radio will bludgeon you to death with.

Jon & Sally Tiven

Your Eyes Have Ears

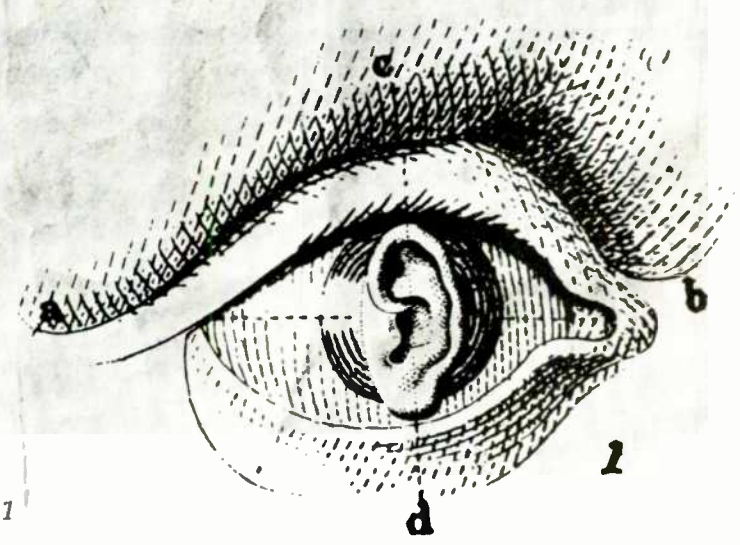

Figure 1

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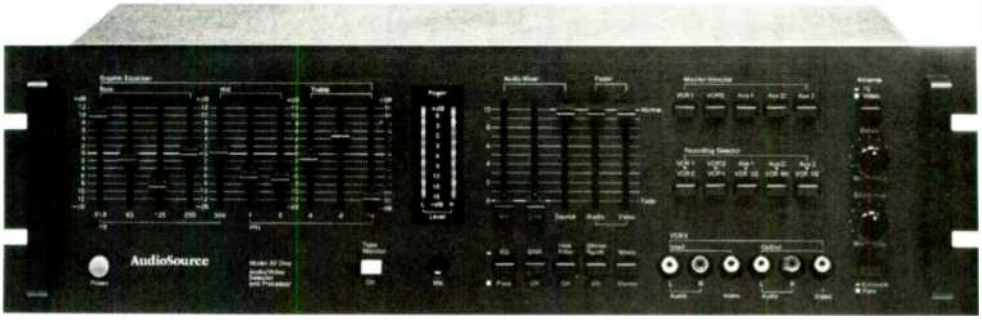

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EDWARD TATNALL CANBY

BACHX POPULI

Illustration: Rick Tulka

Bach on Wood: Brian Slawson
CBS M 39704, digital.

This gem of a light-classic LP really belongs in some high-level pop category—no matter; it came to me and I loved it. These are light and easy arrangements of a dozen classical movements, half of which are by our birthday composer of 1985, the Bach in the title. Others are by Vivaldi, Handel, Corelli, big names in late Baroque, and Pachelbel—that "Canon," of course. All are played basically by the one single percussionist, Brian Slawson, not a bang-bang type but the sort that Lionel Hampton is, basically a wood man, on the xylophone. He also plays metal: Those fascinating but always low-key instruments, the vibraphone and its sidekick, the marimba. It has its loud moments, this music, but mainly it features a liquid sound, unique to these instruments and unlike anything else in any music, that allows for great virtuosity and at the same time a *quietude,* if you will, that is also unusual.

The recording—definitely all Brian Slawson except for a couple of flutes in two numbers—is done, shall I say, in classic pop fashion, not classical at all. The basic music, vibes and marimba, was laid down "pure," and the rest was variously overdubbed. To my ear it simply sounds like a group, playing together.

What is extremely good, to a classical ear, is the intelligent and musical way in which these movements are set up for the pop sort of time scale that still exists with us (in spite of much lengthy new music in the larger pop area). Most such arrangements, frankly, are demeaning, an insult to the original composer. Usually no more than a catchy tune is borrowed, or a tuneful beginning; then the music abruptly ends or turns into pop nothingness, just at the point where the original began to take on real shape. That moment, all too often, is when the key begins to change and the music to migrate to new tonal levels. The pop versions just quit—we aren't supposed to have the brains to understand all *that.* Some of us don't. Many do.

The virtue of Mr. Slawson is that, while cutting out large segments of the longer pieces, he does understand how they are organized (if perhaps instinctively), and he somehow truncates the whole piece with a remarkably dignified and intelligent feeling for what a shorter version of the *whole music*—not just a tune or two—might encompass. In his adaptations of less lengthy pieces he shortens not at all, gives us the entire work. And all this with a lovely and happily irreverent vibe-type sound that makes not the slightest attempt to be other than exactly what it is! No fake Baroque here.

I even enjoyed the too-familiar "old standards," a movement from the Vivaldi "Four Seasons" and that outrageously overexploited Pachelbel "Canon," which I swore I would never listen to again. *Is this it?* What I heard, to my amusement, were the clattering wood blocks of Ferde Grofé's "Grand Canyon Suite" burros as they teeter down the trail. Charming idea. Pachelbel would be amazed. So would Ferde.

Is all this *really* Brian Slawson? The ways of pop music are sometimes mysterious. There is a perfectly huge number of credits given, to enough people to produce an opera or a large symphony. But what did they do? There are even two dedications. I only know that one musician, Amy K. Porter, played the flutes. Both of them—and at once. No, it isn't a right/mouth and a left/mouth pair. Overdubbing. And just read the list of instruments! There are hundreds, almost, ranging from timpani and bass drum to a 4 × 4-inch plywood sheet, "bowed" with a Stanley crosscut saw. There's also one alarm clock. No synthesizer—who would need one here?

J. S. Bach: Clavierübung, Part III, Vol. Three. Christa Rakich, organ, at Memorial Church, Harvard University.
Titantic TI-93, $10.

This super-Baroque organ, full of "screaming whistles," marks the extreme period of reaction to the old-fashioned, big, Romantic organ in its modern electrical form. Its location is incongruous, and unfortunate in both the acoustics and the atmosphere of this church, the ceremonial center of Harvard tradition. They should have kept the half-anonymous earlier organ that I vaguely remember, an instrument that did not get in the way and obtrude itself, as this one does with a vengeance! A well-intended mistake; they

Christa Rakich

probably didn't know what they were getting into until too late.

The album notes written by the maker of the organ are amusing. If you think engineers and architects have problems, read here: "An acoustically merciless building encloses the instrument, and, as if to compensate, the organ sometimes behaves like a caged animal. It can seem to fret, squabble and throw tantrums at times; it can also soothe, cheer and thrill beyond measure."

You bet. One squealing note—a resonance?—right at the beginning of side one had my hands to my ears in anguish. Ouch! The thing does snarl and hoot and screech and puff, and often sounds quite good, even so.

If I did not know the circumstance, I would say the mikes were much too close. All is nakedly revealed, even the holes between the notes. A faint reverb is audible only at the end die-away; the rest of the time you are in a large closet. Ugh. Having been in that space, all stuffy white and red plush in the best New England manner, I doubt if much better could be done.

Ms. Rakich's Bach is skillful and accurate but seems a bit academic here, in spite of all the prizes she has won for organ playing. I suspect that she, too, needs a different acoustic.

Mozart: Clarinet Quintet, K.581; Weber: Clarinet Quintet, Op. 34. Slovak Quartet; Jozef Luptáčik, clarinet. **Vanguard Mid-Line VMS 75003,** $5.98.

A strangely cryptic LP, this. It is another of Vanguard's recordings licensed from the Czechoslovakian label, Opus, offering two works that should go ideally together, except that the Weber is much less known than the Mozart. A Slovakian string quartet plays both, with a Czech clarinetist.

As in others of these Slovak recordings, this one strikes the ear immediately as somehow acoustically old-fashioned. Styles do change, and Eastern Europe, at least from our viewpoint, is a bit behind. The players are miked fairly close, but there is a very large reverberation, pushed into the background at a low level yet often blurring successive harmonies together. I remember plenty of early LPs out of the '50s that had this effect. The recording, it says, was done in the main Opus studio with an East-bloc recording team. Is the reverb maybe synthetic, to color a dead sound for Slovak tastes? Some of the playing absolutely ignores the effects of this reverb, suggesting to me that maybe the musicians were not aware of it. That could be the case.

The most curious aspect of this LP, both musically and technically, is the surprising difference between the two sides, although the same musicians were recorded in the very same place for each. I played the Weber quintet (side two) first, and found it sounded rather shrill and thin, lacking in presence and instrumental definition. The cutting level seemed unusually low, too. When I turned the album over, the Mozart piece jumped out, round and full, both the strings and the clarinet, and the level was up to normal.

The playing was somehow in line with the recording. The Weber was oddly strained, forced, very metronomic, without that genial and highly melodic ease which is so typical of the composer even in his most virtuosic moments. Twice, I stopped the record and went back, unable to follow the sense of a sudden change of harmony. *Did these players understand it?* Yes, the notes were right, but they were wholly mechanical—just notes, without meaning. I got the feeling that these performers, however expert, have only an imperfect idea of the early Romantic music of Western Europe (which, after all, included their own homeland for many centuries). The clarinetist was the same—marvelous finger dexterity, with unbelevably fast notes, but there was little musical flow and a rigid inflexibility. The high notes squealed—and hurt.

The performance of the Mozart "Quintet," a much more familiar and simpler work to play, came off well, to go along with its superior recorded acoustic. Suddenly, there was a nice fullness, a new access of bass in the cello, and even the clarinet was more human. Only occasionally was there a bit of that dogmatic, mechanical rigidity heard in the Weber piece. Not at all a bad version of the Mozart (though there is plenty of competition, worldwide). Don't ask me to explain.

PRESTIDIGITIZATION

Illustration: Rick Tulka

Magic Touch: Stanley Jordan
Blue Note BT-85101, digital, $8.98.

The album's title says it. Stanley Jordan is one guitarist who really has a magic touch. His style is so startling that the album carries a disclaimer to the effect that there is only one guitarist—and no guitar overdubs whatsoever—on this recording.

Jordan's dazzling technique, which results in separate and independent guitar lines simultaneously, derives from hammering on the fretboard so that he can play notes with both hands at once. This allows him to achieve a complexity that had previously only been possible on keyboards. In addition, he developed this technique with the guitar tuned in fourths to simplify the fretboard and extend chordal possibilities. He sounds like he has four hands—at least.

On *Magic Touch*, Jordan presents several originals and salutes to some of his musical heroes. There is a fascinating, extended version of "Eleanor Rigby" and a sweet reading of Jimi Hendrix's ballad, "Angel." There are Miles Davis' "Freddie Freeloader" and Thelonious Monk's classic, " 'Round Midnight," whose complexity he follows with his own bittersweet "All the Children." "The Lady in My Life," taken from Michael Jackson's recording, receives the most elaborate accompaniment of the set. It is the only selection with electric bass and keyboards, a lush counterpoint to the generally simple, bare-bones approach given the rest of the project by producer Al Di Meola, himself a guitarist of no small repute. Di Meola has properly made *Magic Touch* a showcase for the astonishing and original talent of Stanley Jordan.

Digital sound has made this a nearly noiseless recording. Coupled with the simple production and fine pressing (a hallmark of the initial releases from the recently revived Blue Note label), it makes *Magic Touch* a genuine listening pleasure.

Rarely have I been so certain that we will be hearing a whole lot more from a new artist as I am with the amazing Stanley Jordan. I'm still not completely sure that I believe what I hear here.

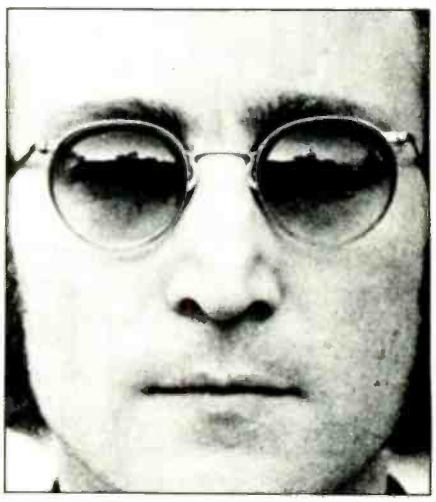
Michael Tearson

Imagine: John Lennon/Plastic Ono Band
Mobile Fidelity MFSL 1-153, $15.98.

Sound: B Performance: B+

Phil Spector, the producer of this disc, must have had the high end of his studio monitors cranked to the max when he mixed this album, because there's not much on this Mobile Fidelity version. The original pressing was a bit mid- and bass-heavy, but nothing to compare with this one—your tweeters barely move except for an occasional cymbal hit that breaks through. Of course, Spector usually pays very close attention to the mastering process and does massive equalizing in the cutting room; some would even call it post-production. But it's obvious no one consulted him on this one. It stands as it was originally put on tape, and there's a whole lot of frequencies missing. You'll practically feel like you're going deaf when you put it on your turntable, and then rush to your own home equalizer and expander to try to make something lifelike jump out of your system. Best of luck!

As for the performance itself, it isn't quite as sparse as the first Lennon/Plastic Ono Band album, which revelled in its starkness, but it doesn't rely on the wall of sound of *Rock 'n' Roll*, or the "swill of sound" present on the *Sometime in New York City* LP. The songs are of varying quality, from the obvious title track and "Jealous Guy" to the lesser known but certainly ace rockers like "It's So Hard" and "Give Me Some Truth." Then there's the clinkers, like the vitriolic anti-McCartneyisms of "How Do You Sleep?" or the bland "Oh Yoko!" But Lennon being mediocre is certainly interesting and even worth a second or third play, and obviously quite a few folks gave this particular platter more than a cursory listen. Rod Stewart and Roxy Mu-



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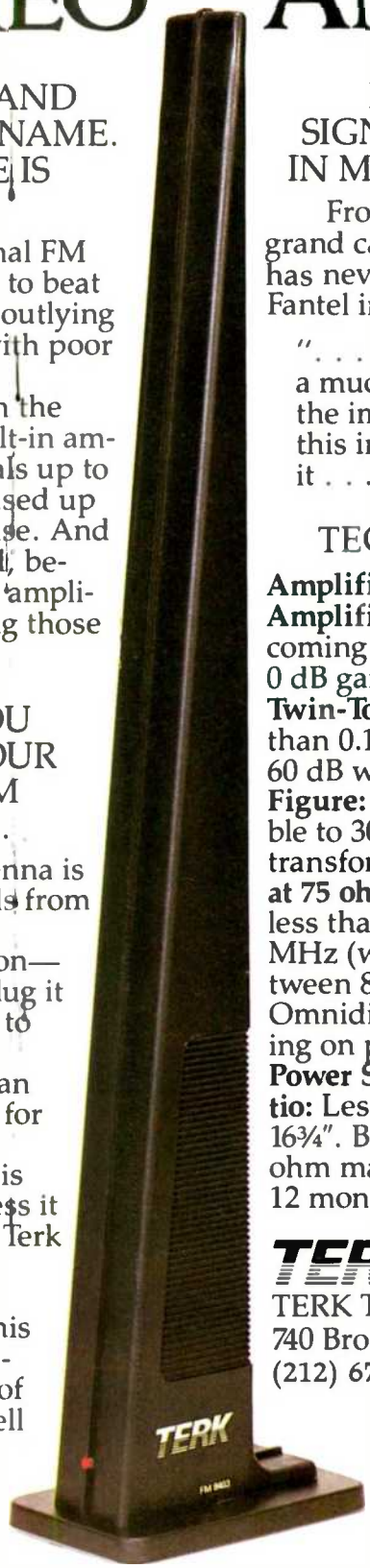

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The resonance of the hammered dulcimer and the immediacy of the guitar highlight Jim Miller's *Hills and Hollers*, an excellent recording.

sic cut "Jealous Guy," and "How?" bears more than a mild resemblance to some Electric Light Orchestra song about a telephone line.

The textures on this album are less extreme than on *Plastic Ono Band*, as if Lennon realized that the shock value of that earlier album wasn't as universally appealing (read: commercial) as McCartney's softer, sweetened productions. There is a very Beatles-like instrumentation to much of the production, undercut a bit by Spector's wild reverb experiments, but nevertheless revealing an attempt by Lennon to sell a few more pieces of vinyl.

One of the worst misfortunes of Lennon's passing is that the guy never really got into the knack of making a career in the studio, and all of his recordings are somewhat transitional works. The only time his recorded output exceeded one album every three years or so was the *Rock 'n' Roll/Walls & Bridges/Pussycats* period, which, when examined carefully, also contains our picks for his best songs and performances. *Imagine* is not the best John Lennon record, but it still stands as a good piece of work and deserves to be preserved in a quality pressing.

Jon & Sally Tiven

Hills and Hollers: Jim Miller
June Appal JA048, $8.98.

Sound: B Performance: B+

Jim Miller offers a dozen personal favorites in a program of instrumentals featuring his deft work on hammered dulcimer and guitar. He also plays bass, and is joined by Cheri Miller on mandolin and Dave Smith on fiddle.

The selections are mostly country chestnuts such as "San Antonio Rose," "Tennessee Waltz," and a medley of "Arkansas Traveler" and "Turkey in the Straw," plus a couple of rags and old favorites like "Sweet Georgia Brown." The performances are spirited yet homey, unpretentious and undeniably sincere.

The main attraction is the hammered dulcimer, an extraordinary instrument. With strings tuned in pairs it gives a surprisingly rich and orchestral sound.

The recording is excellent. The resonance of the hammered dulcimer and the immediacy of the guitar are highlights. Obviously, Miller has had to overdub his own instrumental parts—dulcimer, lead guitar, rhythm guitar, and bass—but the record still has the

feel of a live, living-room performance with the players facing each other in a tight circle.

Jim Miller's *Hills and Hollers* is a delightful, congenial record.

Michael Tearson

Respighi: Church Windows. The Pacific Symphony, Keith Clark.
Reference Recordings RR-15.

This is an all-out, all-analog recording, much along the same lines as the Berlioz *Symphonie Fantastique* issued by Reference Recordings a few years back. It is 45 rpm, with total playing time just shy of 30 minutes. The faster speed means that more of the musical detail, normally clouded at inner diameters, will be better reproduced, and such is the case here.

The playing is excellent and presents an orchestra and conductor perhaps new to many readers of *Audio*. The Pacific Symphony, the chief ensemble in Orange County, has already become a significant musical force in Southern California, just behind the Los Angeles Philharmonic and Los Angeles Chamber Orchestra.

The recording venue is the fairly resonant Santa Ana High School Auditorium, with its rather creaky old organ heard in the final movement of the work. The problem with the room is the stage; there is no solid orchestra shell, and the back of the orchestra is in a different acoustical environment than the front. This is a small enough problem, and engineer Keith Johnson handles it quite well.

Reference Recordings has been a rather uncompromising analog-oriented audiophile label over the years, and they recently brought out a group of CDs. Their commitment to analog, however, seems to be a strong one, and we may assume that they will continue to issue product in both formats.

There is a credit given on the back liner which acknowledges generous financial assistance from Harry Pearson and *The Absolute Sound* magazine. This I find amazing—and commendable. *The Absolute Sound* has been the most vocal opponent of digital recording in the audio press, but at least they have the dedication to put their checkbook where their mouth is.

John M. Eargle

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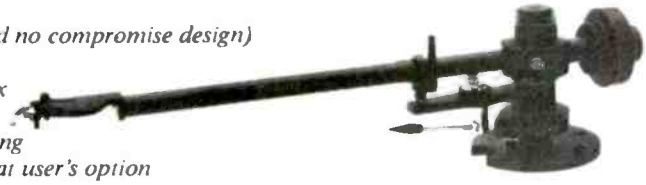

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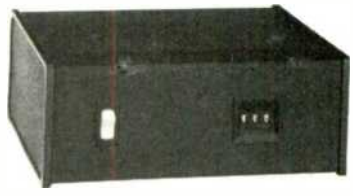

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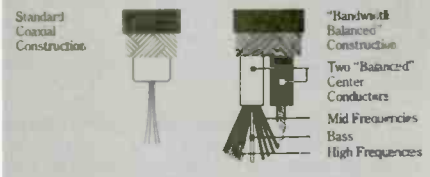

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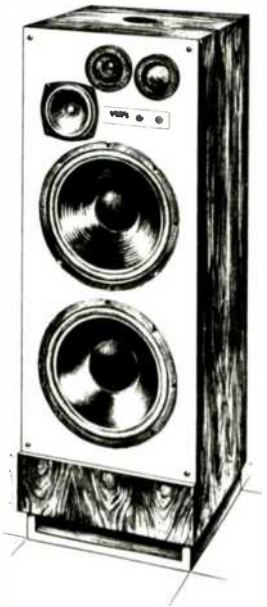

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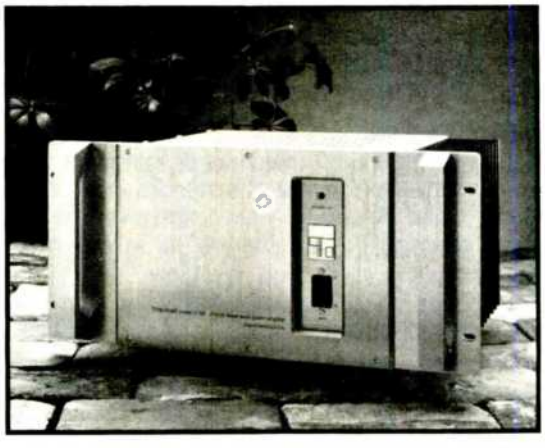

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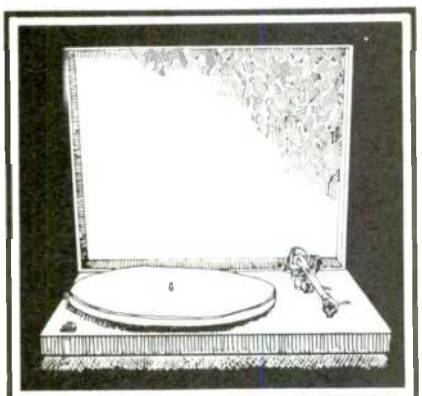

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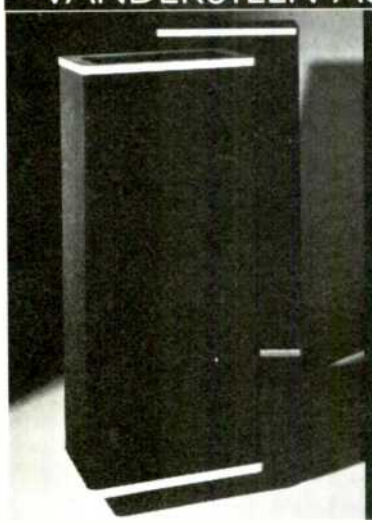

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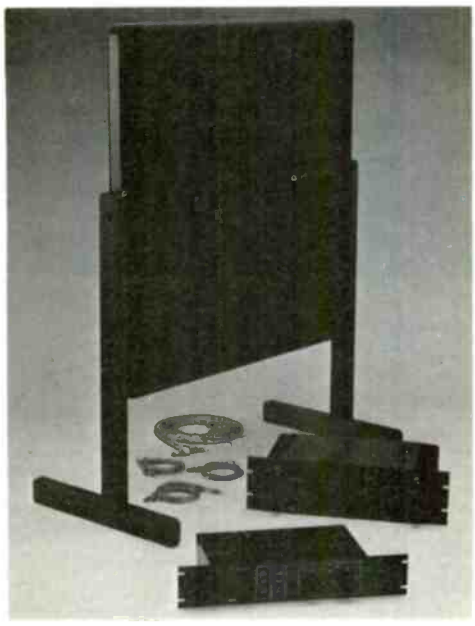

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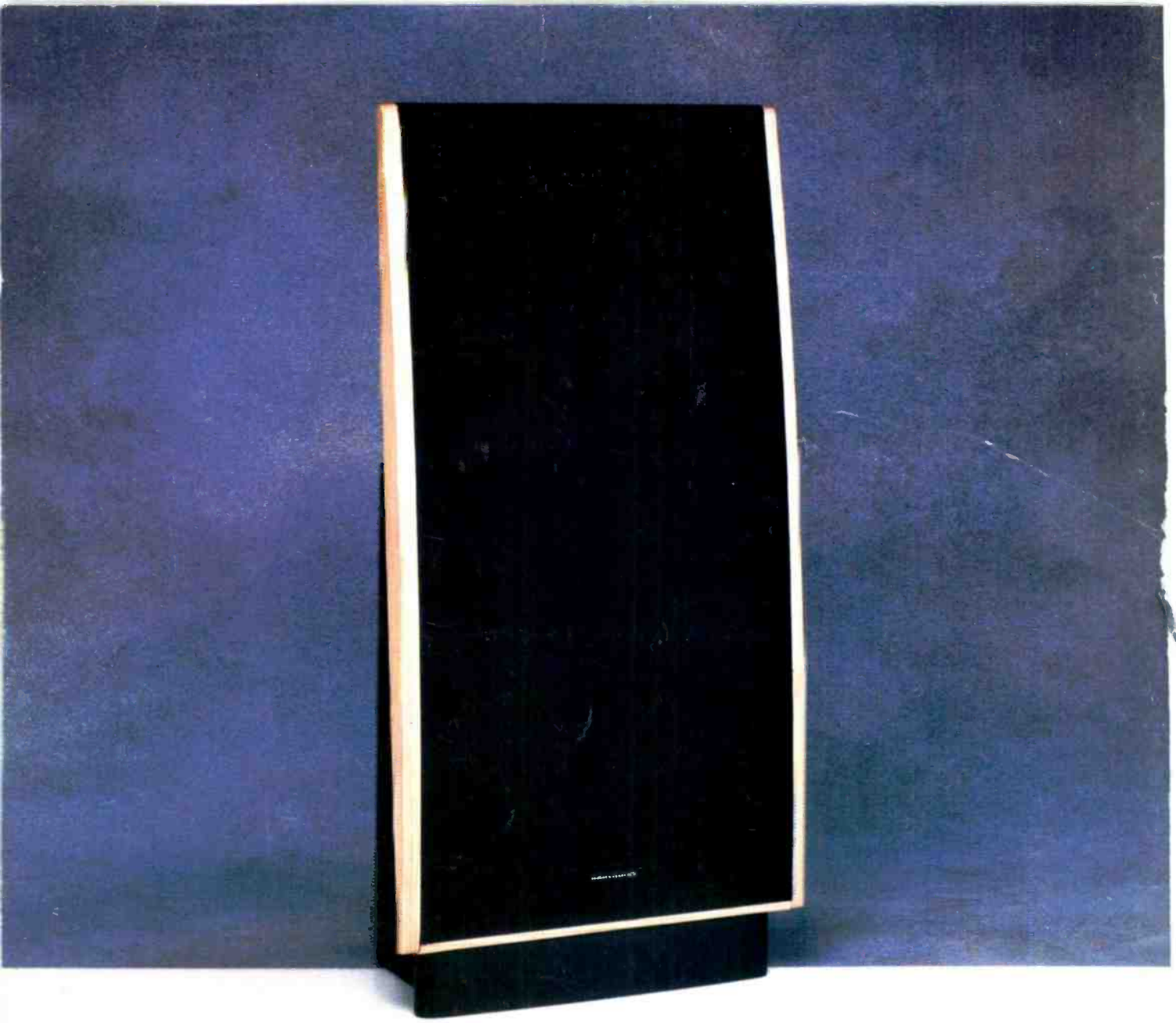

STATEMENT OF THE ART

Creating a truly musical loudspeaker is indeed an art—as much a product of mind, hands and heart as a painting or a piano sonata.

And, as in painting, there are different styles to this art: For example, there are "Impressionistic" speakers, where detail and focus are subordinated to a pursuit of atmosphere. Speakers that impose their vision of what we ought to hear through psycho-acoustic tricks and technological gimmicks can be thought of as Expressionistic. We at Dahlquist confess to being realists.

Realism is what the new DQ-20 Phased Array is all about. We believe that the ultimate realization of the loudspeaker art must not express nor suppress, only reveal—easily, naturally and transparently—the music put into it.

Realism means that, with the DQ-20, music retains its substance and form with precise, stable imaging and open, airy, in-depth presentation of each instrument. It means human voices that are natural, with no artificial colorations to get in the way of true communication of content or emotion. The DQ-20 leaves music free—to touch and to move the listener.

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