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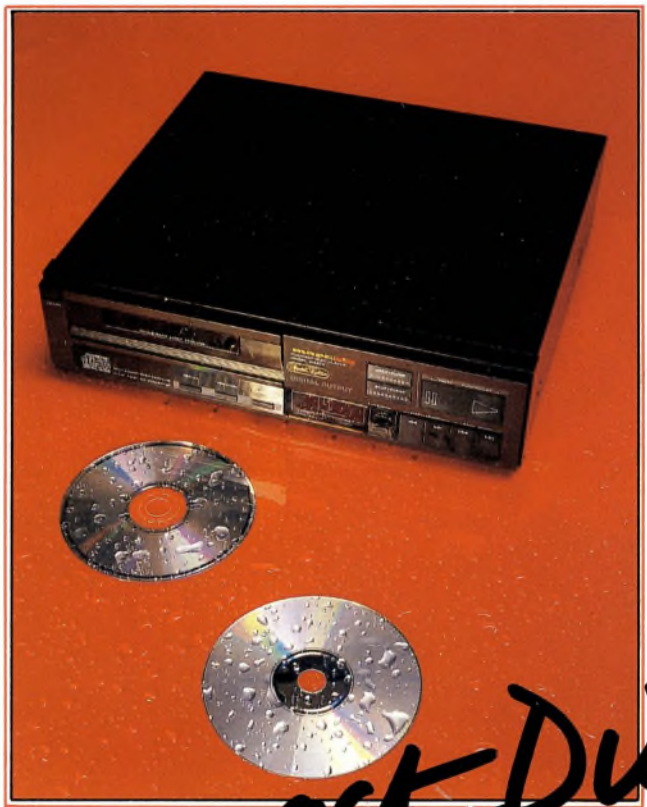

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No. 51

HI-FI CHOICE

COMPACT DISC PLAYERS 1987

BY MARTIN COLLOMS AND PAUL MESSENGER

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PUBLISHED *by Dennis Publishing Ltd, 14 Rathbone Place, London W1P 1DE. Tel: 01-631 1433.*
DISTRIBUTED *by Seymour Press Ltd, 334 Brixton Road, London SW9 7AG.*
TYPESET *by Paragraphics, 2-4 Rufus Street, London N1 6PE.*
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EDITORIAL INTRODUCTION

Embarking upon my second *Choice: CD Players*, I am forcefully reminded that a year is a very long time in this still developing market. Few of the machines from last year's edition are still available, so the obsolescence rate and learning curve steepness are both prodigious, if partly fashion and price-point led. (One might fairly question how much actual progress is being made, as one machine in particular has maintained its reference role with only marginal changes for some two years now.)

For this new edition, we have therefore assembled more than 50 new machines. Most are given full technical reviews, but for space reasons some are given shorter subjective assessments. One thing is immediately obvious: the range of choice now available across a broad price spectrum has expanded significantly.

Besides diversification, much manufacturer effort has gone into refining production techniques. For example, a low-cost plastics moulded laser-head assembly from a Japanese OEM supplier caused great excitement at this year's Las Vegas Show in January, with predictions of sub-$100 player prices soon.

However, CD players have not proved exceptionally price-sensitive in the UK, and internationally, sales have been more responsive to reductions in software rather than hardware prices — in which respect the UK has been severely disadvantaged. Our vinyl prices are amongst the cheapest in the world, and the CD price ratio is still nearly 2:1 — the equivalent gap is much narrower in the US and almost non-existent in Japan. And the fact that the same CDs which cost £10-12 in the UK may be purchased for around £3 equivalent in Saudi Arabia is little short of an obscenity perpetuated on the British consumer.

From the UK perspective CD still looks a 'will it, won't it?' situation. The total player population is due to reach one million in 1987, and 5-10% is the current share of software sales by volume (rather than by value, due to the inflated disc prices!). But from an international perspective, a comparatively sluggish Europe is of limited significance. CD looks pretty well set now, even though many hi-fi cognoscenti still regard it as an acronym for mere common denominator aspirations.

Two major new market factors are about to make their presence felt. The first is the shadow of DAT (digital audio tape) as a potential tape-based and record-capable rival to CD. The prospects of 'perfect piracy', plus the spectre of all the Japanese majors in full cry behind what is, in reality, their first home-developed consumer electronics format, has sent a shudder through various European boardrooms. But it is far too early to predict the likely market impact of an expensive, complicated and initially incompatible new format.

Perhaps responding to the DAT threat (expected in Europe before the end of 1987), Philips recently announced an extension of the CD system called CD Video, which adds pictures to CD sound in 'single' (5-inch, gold coloured), 'EP' (8-inch) and 'LP' (12-inch) variations. Cynics might regard this as 'microwaved Laservision', recalling the commercially unsuccessful videodisc system. But CD's enthusiastic support amongst software producers could help overcome the lack of programme variety that hampered Laservision.

Whether the public can be persuaded to purchase videodiscs with digital soundtracks, plus a new generation of A/V 'Combi' CD players, will still be an open question a year from now. CD Video will appear in European shops around the end of the year and much will depend on the software prices — not to mention the imminent threat of Super VHS as a formidable tape defence against this new optical disc video challenge.

Whatever else, 1987 looks an interesting year for CD. Hardware prices will continue to soften, but the pre-Christmas present that the industry will be looking for is a real cut in disc prices. The consumer should still approach CD with both expectations and scepticism: 'perfect sound forever' it's not, but it might just be your particular cup of tea.

Paul Messenger

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CD PLAYERS

Compact Disc is the first new music storage medium to stand a real chance of making it since the 20 year-old Compact Cassette. It has come a long way in five years, and is now starting to represent a significant percentage of hardware and disc sales (particularly by value). Rather surprisingly, the UK has proved one of the slower growing markets, though this partly reflects a greater difference in price between a CD and its LP or musicassette equivalent than in some overseas markets. Whereas disc prices have remained stable, player prices have dropped to a third of those charged when the system was first launched. £200 is now a typical budget price, some machines cost as little as £150, and cheap mechanisms are built into systems and portables, yet at the same time there is a healthy demand for upmarket players offering improved sound quality and/or unusual features.

If the music industry has its way, CD will steadily oust the LP and the musicassette, replacing them both with a durable, compact, all-digital replay-only medium with premium disc prices, suitable for home or portable use. However, the marketplace has yet to provide confirmation. Player prices are still a little above the level which the mass of consumers are prepared to pay, so hitherto discs have been sold to those already prepared to pay substantial prices for players. There is also the imminent threat of a rival digital tape format (DAT) which will offer record as well as replay capabilities, but the hardware is likely to be significantly more expensive.

The arrival of CD has been a great stimulus to the hi-fi trade, not only by creating substantial sales of CD players themselves, but also in refocusing attention on the various other parts of the hi-fi system. Visiting a hi-fi shop for the first time in years perhaps, customers are appreciating the steady advances which have taken place on all fronts, and are taking the opportunity for a general system upgrade. Even LP record players are selling well, sometimes after direct comparison with the new medium, as customers recognise the major investment they already have in vinyl discs and appreciate the fine quality now available from vinyl. Indeed, CD credibility was not helped by early claims for 'perfect sound forever', a perfection which has often fallen far short of the expectations of many hi-fi enthusiasts.

CD certainly has a number of advantages over its rivals. It is inherently rugged and unaffected by playing, free of surface and background noise and wow and flutter effects, while signals kept in digital form are theoretically immune from degradation. The addition of data channels allows complex pre-programming and accessing, and future CD applications under development include adding video (CD Video), interactive A/V (CD-I), and the CD-ROM computer software format. In-car, portable and personal players are in the shops, though there is still the nagging doubt that tape is inherently more immune to the shock and vibration of such applications, while the wide dynamic range and inaudible background noise can be almost an embarrassment in a noisy environment.

Doubters notwithstanding, the format could be said to have arrived, which is an achievement in itself.

THE DISCS

Only five inches in diameter and attractively silvered, the compact disc currently costs almost twice the price of an LP or musicassette (in the UK) but should resist damage or wear. It can carry more than an hour of music and comes packaged in an irritatingly fragile and awkwardly designed acrylic 'jewel case', containing additional printed 'sleeve' information.

An equivalent to the vinyl 45rpm 'single', containing a mixture of audio and video on a standard size disc, is about to be launched.

For record companies in particular, establish-

ing a brand new format is an exceedingly difficult task, in view of the vast inventory needed to represent a play-only format effectively, and in this instance the technical problems of pressing with necessarily great precision. Inevitably there was a learning curve in the disc manufacturing processes, and full quality potential is still not reached in many cases. Disc availability is still somewhat limited, helping to keep prices firm, but the range of titles now available on CD has grown spectacularly, particularly in the classical and jazz fields, emphasising the commitment of the record companies to the new format. And considerable extra disc production capacity will be coming on stream during 1987, so a shortage may turn into a glut and help bring prices down somewhat.

From the general consumer's point of view, price will still be a key factor. While early CD users are clearly prepared to pay a 100 per cent premium, it remains to be seen what sort of long term price premium compact discs can command over LP and musicassette rivals. History has shown that the broad base of recorded music sales is very price-sensitive but not especially quality conscious — musicassette purchasers who were attracted by the convenience of that medium were not deterred by quality substantially inferior to LP.

The Players

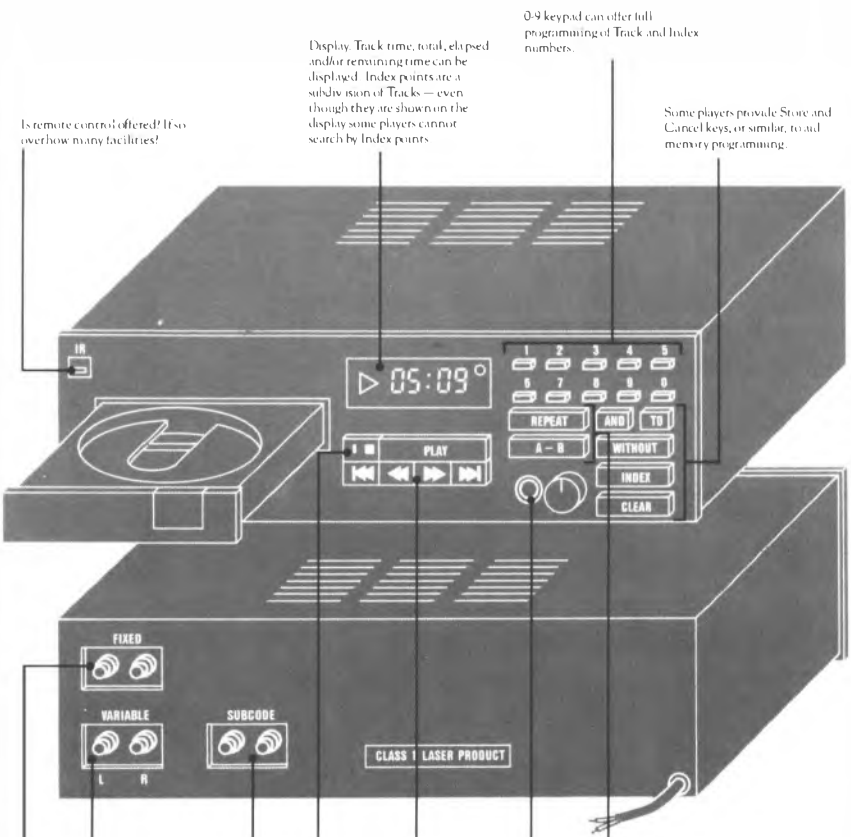
The conventional CD player may simply be plugged into any hi-fi system, as one would a tuner or cassette deck. The amplifier 'aux', or 'tape' inputs will be perfectly adequate, though the results might be a little loud through the speakers, and require a lower volume control setting than usual. Many more recent amplifiers have a 'CD' input, and this may have a more appropriate sensitivity. Some specialist amplifiers have taken the trouble to connect the CD input directly to the pre-amp volume control, so as to minimise the interference of the signal path.

There is also a mild risk that a CD user will find his amplifier no longer seems to go as loud. The reason for this is that the digital CD medium is better at preserving the high loudness peaks in music which analogue systems 'squash' downwards. Consequently for the same peak output, the mean (average) output from CD with the same recording will be slightly lower than before. One can of course compensate by cranking up the volume, but if an amplifier is already being used close to its limits, the CD peaks could cause premature 'clipping', for which the only solution is a bigger amplifier.

The prospective purchaser faces a wide range of choice at wildly varying prices, starting below £200 and going up to around £2,000. Players are available for in-car use, are incorporated in large portables, and exist as tiny personals, with some doubling as unconventional domestic machines. The mains models can be manual or remote controlled, and simple or complicated in terms of ergonomics and programmability. Autochanger variations can accept and play from a caddy of half a dozen discs, selected and programmed remotely.

Despite protestations of 'perfect' sound, CD players show significant audible and measurement differences, and these are discussed in detail in our reviews. That said, most machines measure very competently, showing occasional weakness at the cheapest end of the market and among low voltage portable machines. Though correlation with measurement still proves elusive, listening tests proved quite capable of consistently distinguishing between the different decks. While the poorer examples can make the new medium sound quite unpleasant, the best can provide eminently satisfactory results with refreshing repeatability and the promise of longevity. However, we would certainly advise any potential purchasers to make sure they themselves like the sound of CD before embarking upon a substantial commitment to new hardware and software.

ANATOMY OF A COMPACT DISC PLAYER



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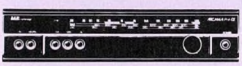
MIXIN GOLD, WHAT HIFI, APRIL 1985.



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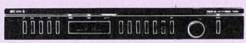
DAVID PRAKEL, NEW HIFI SOUND, DEC 1986.



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JIMMY HUGHES HIFI ANSWERS OCT 86.

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CD REVIEW, OCT 1986.

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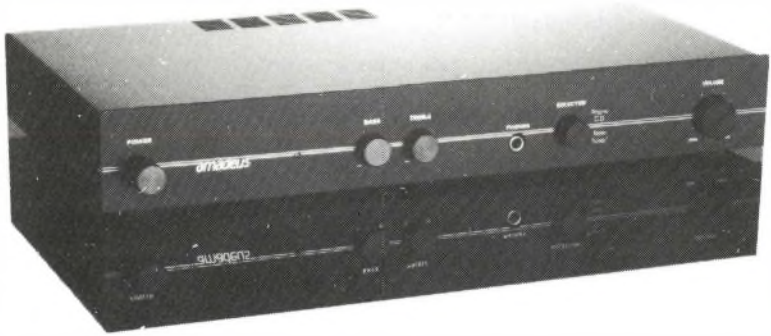

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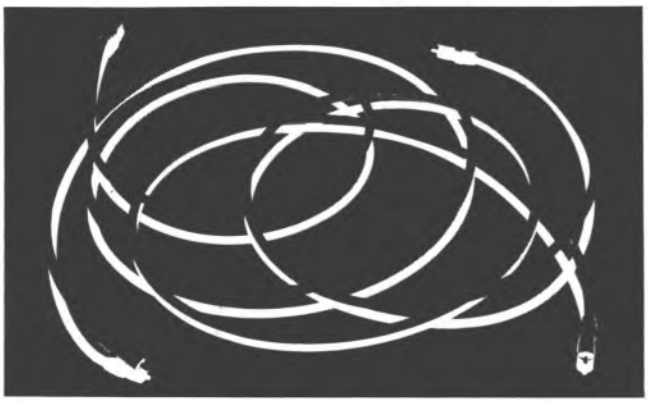

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TECHNICAL INTRODUCTION

Our test programme for this edition included complete laboratory analysis on all the different designs as well as thorough auditioning of each player. Here the author explains the review approach and test methods.

The sound quality of top quality black disc players remains beyond question, but CD players are winning more and more sales from analogue. Rather than buy a more expensive analogue system, some customers are opting instead for a CD player as an addition to existing equipment, and many new purchasers are getting into hi-fi for the first time with CD as a priority component. Portable and in-car CD players are are arousing further interest.

There has also been considerable progress in player performance since the original models appeared in 1983. Philips launched CD with the slogan 'perfect sound for ever', but if this were true, how then could the large price range for players be justified or the results of the listening tests be validated?

The general consensus seems to be that CD provides a reliably good baseline of audio quality, which is more than satisfactory for the majority of non-enthusiast applications. Given this baseline, the more critical listener, equipped with a more critical audio set-up, can discern significant and important differences in CD player sound quality. In context, a CD player can be auditioned much as one investigates an audio pre-amplifier; indeed many of the subjective effects may be described in amplifier sound parlance.

The advantages which are indisputably offered by Compact Disc players over vinyl disc playing equipment can be summed up as follows:

1) Up to 1 hour 15 minutes uninterrupted playing time.
2) Freedom from surface noise, clicks and pops.
3) Discs are comparatively damage and wear-proof (provided some care is taken).
4) No complications of stylus wear, contamination or alignment.
5) Full automatic facilities, track programming etc, many players having comprehensive remote control.
6) All the usual 'cheap turntable' problems such as pitch stability, wow and flutter etc, are absent.
7) CD players can be small.
8) High level 'flat response' output can obviate the pre-amplifier, and many players also have competent headphone outputs.
9) High lab specifications for distortion, balance, separation and signal-to-noise ratio.
10) Some immunity to acoustic feedback and reasonable levels of shock and vibration resistance.
11) The sound is relatively neutral, with a wide open frequency characteristic as well as notably good bass, since arm/cartridge subsonic resonances are avoided. Stereo is usually very stable and well focused, with much separate detail apparent.

That said, there remain enthusiasts who continue to prefer their music from vinyl LP sources, complaining of slightly 'electronic' quality about the sound of CD. The enormous new and secondhand repertoire and much lower disc prices remain further major vinyl incentives.

As regards the more subtle aspects of sound reproduction, CD players can vary in their stereo presentation — some have a more relaxed 'distanced' perspective while others seem more direct and 'up-front'. Differences can be found in the far space or depth region behind the frontal image plane, while some players may also show a softening of definition in the bass or treble extremes. The treble may also appear a touch 'grainy' and fatiguing. The mid can vary in tonal quality, with a thinner, 'harder' effect on some players, and a sweeter, more natural balance on others. Ultimately one can liken such distinctions to those seen between fine amplifiers, and it is therefore similarly possible to scale and grade CD sound quality.

Laboratory Tests

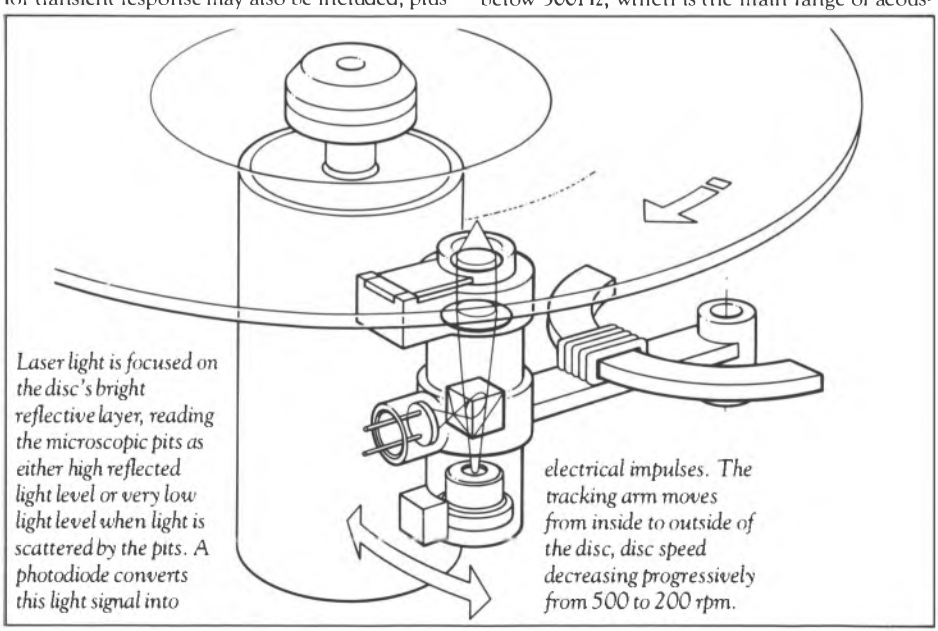
An established test programme was employed for the CD players. In general, these tests check whether the review samples were free from manufacturing defects and were up to spec. Further tests operating beyond the normal specifications seek to explore other aspects, many of which have been shown to correlate well with subjective sound quality factors.

In some respects CD testing is relatively straightforward. At the time of the first *'Choice* edition to include such machines (*Turntables and Tonearms, No 30*), no test discs were available, but now a good selection enables us to examine a wide range of performance factors. The test discs used here are made by Sony, Technics, Polygram and Denon, but others can also be obtained. As with the equivalent laboratory vinyl test discs, frequency response, channel separation, signal-to-noise ratio and distortion sections are all present, while special impulses for transient response may also be included, plus very low level tones for assessing linearity and quantisation errors.

Error Correction

Further tests examine the ability of a player to correct and conceal errors as well as disc faults. This tolerance of disc errors and damage is a key factor in CD's durability, and is further believed to exert a marginal effect on sound quality. A machine operating at a low internal error rate may sound better than one with a high error rate, even when the errors are fully corrected.

The effect of vibration is also important. Though CD players are normally considered to be both acoustic feedback- and vibration-proof, acoustic and vibrational energy can nonetheless find their way to the disc transport and disc itself. In theory the high speed of the laser head servos responsible for tracking renders them immune to energy at lower frequencies, say below 500Hz, which is the main range of acous-



Laser light is focused on the disc's bright reflective layer, reading the microscopic pits as either high reflected light level or very low light level when light is scattered by the pits. A photodiode converts this light signal into electrical impulses. The tracking arm moves from inside to outside of the disc, disc speed decreasing progressively from 500 to 200 rpm.

CD by DENON

A very good reason for NOT spending £199.95 on your first CD player.

For £199 you can buy any number of cheap CD players, most of them emanating from companies famous only for their low prices and slick advertising. Denon are famous for just one thing, that's making extremely good, reliable, musical Hi-Fi products and superb Compact Discs. After all we were making our own digital recordings back in 1972, long before the rest! We now make 55 million CD's a year and are into our 4th generation of CD players. When it comes to designing new products this unparalleled "digital" experience gives us that crucial advantage.

Like all Denon CD players the midi size DCD 300 incorporates our Hand-Tuned Super Linear Converter, a twin power supply, a damped chassis and DC audio stages. The resulting sound is crystal clear, sweet and dynamic from a CD player that looks good, feels good and is built to last. You won't find these qualities anywhere at £199, but add the price of just one compact disc and you will find them all in the DCD 300. Available only from your Denon dealer.

Most manufacturers build down to a price. Denon build up a standard.

DCD 300 – £209.95

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or write to: Hayden Laboratories Limited,
FREEPOST, Chalfont St. Peter, Bucks. SL9 9BS.

DENON
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tic excitation. In practice noise and vibration both increase the intrinsic error rates and thus may influence sound quality; furthermore players may be slightly microphonic, depending on their construction and circuitry.

Tests have shown that as with analogue turntables, although to a lesser extent, isolating shelves, platforms and tables can have a beneficial effect on CD. A small mat, placed over a disc to damp vibration can by implication help lower error rates — the early Meridian players incorporated such a device. Remember that CD operates with almost continuous errors which are subject to a powerful computed correction, and only at the ultimate error limit (almost never attained) will the machine fail to compute. In this case, it momentarily guesses or may even mute and then recover. In theory this can occur once or twice in 20 hours of programme, and generally passes unnoticed. With giant errors or gaps in the disc, a click can be heard as no correction or concealment is then possible, and usually the laser then sticks or misses a track. Discs which do this should be returned.

'Aliasing' And Spurious Tones

Due to aliasing, an effect where the higher audio frequencies may 'beat' or mix with the clock or sampling rate at 44.1kHz, various spurious tones may be produced, and their presence is likely to influence sound quality in the upper registers. Excessive spurious tones in the audible range may increase 'brittleness', 'glare' or 'hardness' in the sound. Excessive spuriae above audibility may give rise to problems in the audio stages following the CD, for example cassette or PCM recorders and amplifiers.

Ultrasonic tones may beat with further signals, producing more 'rubbish' and noise which by difference mixing may fold back into the audible range.

For this edition, the full reviews include a spectrogram from 100Hz to 100kHz, showing the spurious products resulting from a pair of high frequency tones at 19 and 20kHz, with peak level a reasonably fair −10dB.

Frequency Response

For frequency response, a high resolution graph has been used, to the same scale as the RIAA equalisation accuracy charts in the *HFC: Amplifiers* issues. Left and right channels are both assessed to ensure that no balance errors occur. Other tests include checking for correct de-emphasis; testing response alignment; output impedance (important when using passive control units); output level; track location speed (assessed as the time taken to access track 15 on the Sony test disc YEDS2). Weighted and unweighted signal-to-noise ratios were measured with and without pre-emphasis and each player's mechanical noise was also assessed.

Listening Tests

After a reasonable conditioning/warm-up period, each player was auditioned by a small group of experienced listeners using a wide range of source material, paying particular attention to establish consistency of rating against previous reviews by the author for *Hi-Fi Choice* and other magazines.

The basic reference system included special bi-wired Celestion *SL600* loudspeakers on Cliff Stone stands, driven via various exotic van den Hul cables from Krell *KMA100 II* power amplifiers, fed from a Cello *Audio Suite* pre-amplifier (Premium boards). Reference was made to vinyl reproduction from Pink Triangle *PTT00*/SME *Series V*/van den Hul *MC One*.

Acknowledgements

Thanks are due to Paul Crook and Chris Bryant, for general assistance on auditioning and measurement.

Here are some of the titles in our CD Selection, ranging from Rock, Pop and Jazz to Classical Music

CLASSICAL TITLES

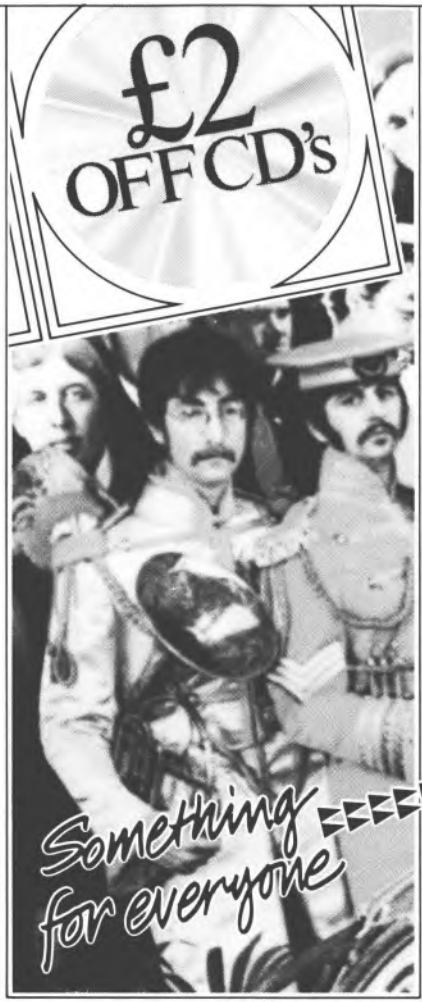
Aled Jones ..... Aled
Albinoni ..... Adagio – BPO/Karajan
Bach ..... Brandenberg Concerti 1-6 – ECO/Pinnock
Beethoven ..... Symphonies 5 & 6 – BPO/Karajan

Chopin ..... Piano Concerti 1 & 2 – Zimmerman/L.A PO/Giulini
Placido Domingo ..... The Collection
Dvorak ..... Symphony No 9 – VPO/Karajan
Elgar ..... Enigma Variations/Pomp & Circumstance – LPO/Boult
Handel ..... Watermusic – ECO/Pinnock
Holst ..... The Planets – BPO/Karajan
Hooked On Classics ..... Best Of
Kiri Te Kanawa ..... Collection
Mozart ..... Horn Concerti 1-4 – ECO/Tuckwell
Mozart ..... Piano Concerti 18 & 20 – PO/Ashkenazy
Orchestral Fireworks ..... Various
Carl Orff ..... Carmina Burana – LSO/Previn
Pavarotti ..... Collection

Rachmaninov ..... Piano Concerti 2 & 4 – Ashkenazy/Concertgebouw/Haitink
Ravel ..... Bolero – CSO/Solti
Strauss ..... Blue Danube – BPO/Karajan
Tchaikovsky ..... Ballet Suites – BPO/Karajan
Tchaikovsky ..... 1812 Overture Montreal SO/Dutoit
Telarc CD Sampler ..... Various
Vivaldi ..... Four Seasons – AAM/Hogwood
West Side Story ..... Best Of

ROCK, POP & JAZZ

Bryan Adams ..... Into The Fire
Bryan Ferry & Roxy Music ..... Streetlife
Beach Boys ..... Made In The USA
Beatles ..... Help
Beatles ..... Revolver
Beatles ..... Sgt. Pepper
Beatles ..... Rubber Soul



There are over 100 titles in W. H. Smith's 'CD Selection,' and with every CD purchased from this selection we'll give you a £2 voucher redeemable against any CD of your choice that costs £10 or over.

Bon Jovi ..... Slippery When Wet
David Bowie ..... Never Let Me Down
Elkie Brooks ..... No More The Fool
Chris De Burgh ..... Into The Light
Kate Bush ..... The Whole Story
Curiosity Killed The Cat ..... Keep Your Distance
Eric Clapton ..... August
Phil Collins ..... No Jacket Required
Culture Club ..... This Time: The First Four Years
Dire Straits ..... Brothers In Arms
Eurythmics ..... Revenge
Ella Fitzgerald ..... Compact Jazz
Five Star ..... Silk & Steel

Fleetwood Mac ..... Tango In The Night
Peter Gabriel ..... So
Genesis ..... Invisible Touch
Stephane Grappelli ..... Compact Jazz
Hall and Oates ..... Rock 'n' Soul Part 1
Hot Chocolate ..... The Very Best Of
Jean Michel Jarre ..... Rendezvous
Billy Joel ..... Greatest Hits
James Last ..... By Request
Level 42 ..... Running In The Family
Madonna ..... True Blue
Michael McDonald ..... Best Of
Glenn Miller ..... Digital Glenn Miller
Moody Blues ..... Days Of Future Past
Alison Moyet ..... Raindancing
Now 9 ..... Various
Phantom Of The Opera ..... Highlights

Pink Floyd ..... Dark Side Of The Moon
Police ..... The Singles
Queen ..... Live Magic
Rolling Stones ..... Rewind (Greatest Hits)
Sade ..... Diamond Life
Paul Simon ..... Graceland
Simon & Garfunkel ..... Collection
Simple Minds ..... Live In The City Of Light
Simply Red ..... Men And Women
Bruce Springsteen ..... Born In The USA
Squeeze ..... The Singles
Barbra Streisand ..... One Voice
Supertramp ..... Autobiography
Swing Out Sister ..... It's Better To Travel
Ultravox ..... Collection
U2 ..... The Joshua Tree
Suzanne Vega ..... Solitude Standing
Jeff Wayne ..... War Of The Worlds
Wham ..... The Final Album
Steve Winwood ..... Back In The High Life

WHSMITH

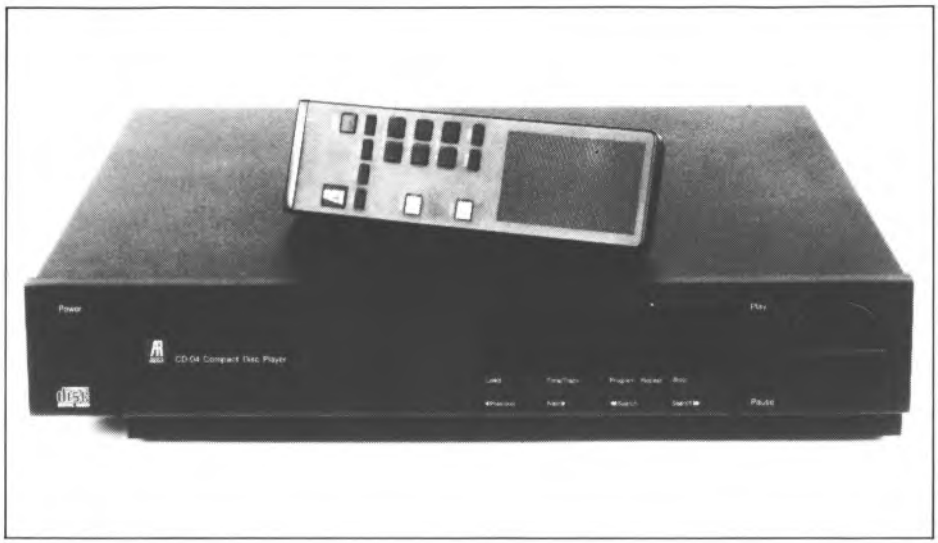
WHSMITH

Subject to availability. Offer ends 7th September. Vouchers must be redeemed by 30th September 1987. Available where you see this sign.

RECOMMENDED

ACOUSTIC RESEARCH CD-04

ACOUSTIC RESEARCH LTD, HIGH STREET, HOUGHTON REGIS, BEDFORDSHIRE LU5 5QJ.
TEL: (0582) 867777



It makes a refreshing change to encounter a CD player which doesn't look like an identikit clone from the parts bins of Philips or Japan Inc. Alternatives are rare, and usually pricey besides, which makes this slant-front full-width model from loudspeaker and turntable specialist Acoustic Research almost unique at £289, even though the stylish bodywork clothes a basically Philips mechanism.

AR in fact have a small range of separate electronic components, and the infra-red remote control supplied with the *CD-04* actually has the keys and functions to control such a complete system, in addition to the basic functions of the CD player. In a system, these visually compatible components may be stacked so that the slants overlap, giving a zig-zag profile, or with the slants faces aligned so the whole stack leans back for easy operation without stooping.

To preserve the visual effect, this CD player has a dummy volume/tuning control on the right hand side which acts as the switch for play and pause. The features and facilities are pretty basic, the corollary of which means that the machine is comparatively simple and straightforward to operate. A simple four-digit display indicates disc track or elapsed time, while other functions include skip and audible fast search, and programming of up to 20 tracks. The instruction manual is refreshingly accessible.

LAB REPORT

Based on the earlier Philips 14-bit 4× oversampling chip set but with dual DACs, the *CD-04*'s frequency response shows the expected characteristic high frequency ripple, but zero interchannel phase difference. Channel separation was excellent, harmonic distortion very good, and intermodulation good, though the spectrogram does show some ultrasonic output.

Mechanical noise was low, but shock and vibration resistance was only average and track access time an unexceptional 4 seconds. The output met specification level, from a usefully low impedance that ensures good compatibility. The error correction and tracking tests were passed without drama, and signal to noise ratios were particularly good. Low level resolution was pretty good, at around 15.5 bits, and overall it is difficult to pinpoint any meaningful weaknesses despite the use of 'older' 14-bit CD technology.

Sound Quality

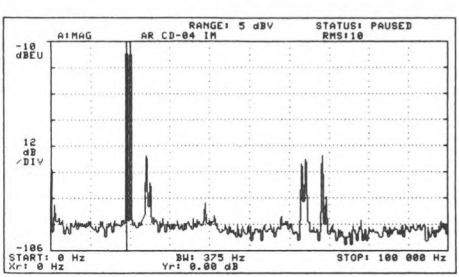
The AR turned in an above average performance in the listening tests, as befits a product from a company making energetic efforts to appeal to the enthusiast/specialist sector. The sound was described as neutral and tidy, with midrange in particular sounding clear, 'open' and well focused. Voice reproduction was dynamic, while depth was well reproduced and the stereo image gave good perspectives with a fair measure of ambience. However, the treble was described as a touch 'odd', and the bass showed some mild 'lumpiness'.

Conclusions

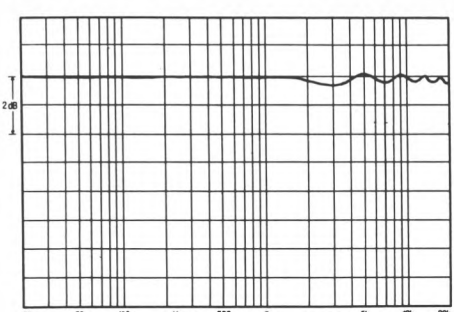
This simple, elegant if unusually styled CD player may be based upon the older generation of Philips '14-bit' technology, but in no way seems to suffer as a result. The lab performance showed no technical weakspots while the listening tests confirmed that AR have done a good job in 'tweaking' the sound to suit enthusiast tastes. Furthermore, bearing in mind the supplied remote control, the price is pretty competitive, so Recommendation is clearly appropriate.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.26dB	0.26dB	0.26dB
Stereo separation	1106dB	111dB	106dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−87dB	−85dB	−85dB
Total harmonic distortion, −10dB	—	−77dB	—
Total harmonic distortion, −60dB	—	−37dB	—
Total harmonic distortion, −80dB	—	−20dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−80dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−76dB	—
Frequency response, left channel	−0.86dB, 0, −0.49dB		
Frequency response, right channel	−0.86dB, 0, −0.49dB		
Signal-to-noise, 20Hz-20kHz unweighted	−110/−111dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	−105/−105dB		
Output level, 0dB, left/right	2.09V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.4dB; 5kHz, 4.7dB; 16kHz, 9.5dB		
Track access time	4.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−72dB		
Resolution at −90dB	−86.9/−86.5dB		
Headphone socket	no		
Dimensions (w×d×h)	43×33×8.5cm		
Estimated typical purchase price	£289		



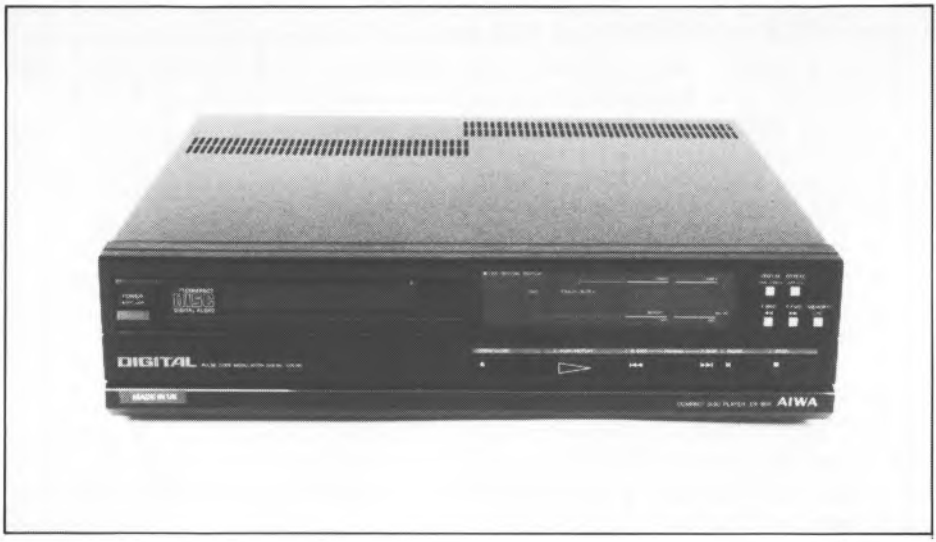
Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



RECOMMENDED

AIWA DX-660

AIWA (UK) LTD, UNIT 2, DUKES ESTATE, WESTERN AVENUE, LONDON W3 0SY.
—TEL: 01-993 1672—



Aiwa is one of Japan's smaller hi-fi companies. Owned by Sony, it operates quite autonomously, has a particularly strong reputation for cassette decks and is also well represented in the packaged system market. This midi-sized player is only one of several available, but it was part-sourced in Europe with UK assembly in mind and its budget price and attractive simple presentation suggest it should be amongst the most popular in the range. (European made decks save import duty, which should help.)

Fundamentally a thoroughly conventional manual control package, it may be remotely operated if interfaced to a matching Aiwa system, *via* a special rear panel connector, and is nicely presented with good ergonomics and standards of finish. The simple display has a single four-digit readout which may be switched between functions, plus a number of back-up status LEDs. The main operating controls — open/close, stop, pause, play and skip — are clearly labelled large buttons. Subsidiary functions are selected from a cluster of five small pushbuttons, comprising audible scan, display mode, repeat, and programming.

LAB REPORT

Despite the contrary assertions in the instruction manual (which suggests simple DAC 16-bit linear conversion), the '660 is clearly based on the last generation of Philips 14-bit 4× oversampling dual DACs (and none the worse for that), which eliminates any interchannel phase discrepancy at high frequencies. The response shows the classic Philips pattern, inherently flat overall but with a comparatively pronounced high frequency ripple. Channel balance was very close, and separation excellent, indicating good factory alignment. Harmonic distortion was pretty reasonable, likewise intermodulation, though a fair number of ultrasonic components may be seen on the spectrogram.

Track access times and mechanical noise were both moderate, while shock and vibration immunity was good. Error correction and tracking tests gave no difficulty, and signal-to-noise ratios were excellent. Once again the level of ultrasonic spuriae could be improved, but linearity was a respectable enough 15.3-bits, and the '660 can be seen to have acquitted itself pretty well in the laboratory.

Sound Quality

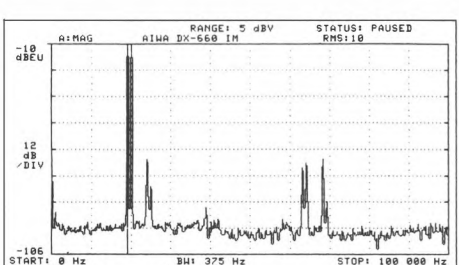
Rating a straight 'average' overall, which is a good result for such a low cost machine, the overall sound was considered dependable, neutral and solid. Dynamics and pace were both presentable, while the bass was essentially firm, if lacking a little 'slam' and weight. There was a slight treble 'haze', and some loss of low level detail and focus, but the stereo soundstage was reasonably convincing, with fair width and depth.

Conclusions

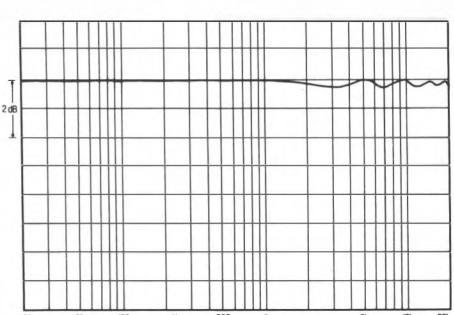
The technical mis-description in the manual is as surprising as finding a Sony-owned company buying mechanisms from Philips for UK manufacture. But the £200 *DX-660's* average sound quality, fine build and lab performance, plus decent ergonomics make a clear candidate for recommendation, even if its most obvious role is in an Aiwa system context where the remote-control capability can be exploited.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0dB	0dB	0dB
Stereo separation	110dB	111dB	105dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−86.5dB	−84dB	−87dB
Total harmonic distortion, −10dB	—	−80dB	—
Total harmonic distortion, −60dB	—	−34dB	—
Total harmonic distortion, −80dB	—	−17dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−88dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−88dB	—
Frequency response, left channel	0.05dB, 0, −0.46dB		
Frequency response, right channel	0.05dB, 0, −0.47dB		
Signal-to-noise, 20Hz-20kHz unweighted	110/111dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	106/107dB		
Output level, 0dB, left/right	2.09V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.4dB; 5kHz, 4.7dB; 16kHz, 9.2dB		
Track access time	5.0secs		
Error correction capability	>900µm gap, >800µm dor		
Mechanical noise	moderate		
Spuriae up to 100kHz	−72dB		
Resolution at −90dB	−85.2/−85.4dB		
Headphone socket	none		
Dimensions (w×d×h)	33×29.5×8.7cm		
Estimated typical purchase price	£199		



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



AIWA DX 770

AIWA (UK) LTD, UNIT 2, DUKES ESTATE, WESTERN AVENUE, LONDON W3 0SY.
TEL: 01-993 1672

The 770 is a compact drawer-loader, accepting the discs the normal way up. Well equipped in terms of operating facilities, it lacks a headphone socket or remote control. However, if installed as part of an Aiwa *V1200* midi system, a special connector allows the CD player to be controlled remotely *via* the main system handset. Up to 16 tracks can be programmed from the front panel in any order, with a repeat mode for one track only, for all tracks, or just the programmed tracks. Other features include fast track skip with audible music, forward and reverse cueing, and the accessing of index points on appropriately coded discs. No numeric keyboard is present, so track entry is by repeated depression of the skip button.

Technically this is a 16 bit linear design, not using oversampling, with a time-shared D/A convertor, and conventional 'brickwall' filtering preceding the output terminal.

LAB REPORT

The 770 gave a mild 0.2dB treble response loss, 5-12kHz, followed by a rolloff to −0.7dB at 20kHz; in practice such minor variations are unlikely to be audibly significant. Channel balance was very good, generally within 0.3dB over the whole frequency range, and perfectly aligned with the published graph. Considering that a shared D/A converter is used, the channel separation results were excellent — over 100dB throughout, and typically 110dB at mid and low frequencies. The inevitable time difference btween channels led to an 81° phase difference at 20kHz; this is considered harmless unless the machine is to be used in mono mode, when some loss of treble above 10kHz is to be expected.

Distortion was very low at low and mid frequencies and full modulation levels, typically measuring −93dB or 0.002%. This worsened at high frequencies: the down-band modulation products of the 20kHz fundamental were poorer than average at −68dB. But this marginal result was handsomely offset by fine measurements for high frequency intermodulation: at full modulation level an excellent −96dB difference tone was recorded, and the reading was a still very good −90dB at the −10dB mod. level. Mid frequency distortion results were well ordered at reducing signal levels, reaching 24dB down below the −60dB mod. level.

At −90dB modulation the level error was typically +3dB, indicating a good resolution of 15.2 bits. An output of 2 volts was generated from a higher than usual output impedance of 1.8kohms.

Error correction performance was fine, and the machine showed a fair resistance to shock. The signal-to-noise ratios were electrically very good by hi-fi standards, but unexceptional in a CD context: at 90dB for the worst case, no-one could complain about the results!

Sound Quality

Scoring a little below average, this machine was described as having an 'open', 'lively', and 'airy' sound, showing a high standard of definition and detail in the forward image plane. The treble was a touch 'bright', but remained quite tidy and controlled. Tonally the midrange seemed a touch 'thinned' and lightweight, while the bass was 'softened' in terms of power and weight. Some loss of stereo focus was also noted, and the ultimate rendition of depth and ambience was poorer than average. Overall, the *DX 770* met good commercial hi-fi standards, but could have shown a sweeter balance with more depth.

Conclusions

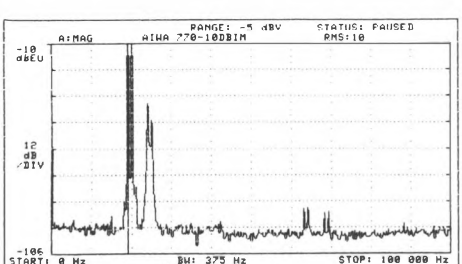
Here we have an average quality machine with a good technical performance but selling at a higher than average price. However, as part of an Aiwa music system it acquires a conveniently integrated remote control facility, so increasing the potential value; in this context it would be worth considering.

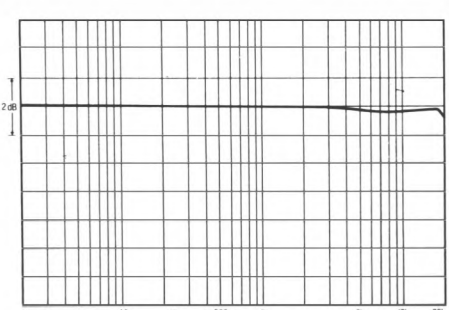
Test Results

	20Hz	1kHz	20kHz
Channel balance	0.30dB	0.30dB	0.27dB
Stereo separation	116.3dB	117.3dB	106.3dB*
Channel phase difference	0°	5°	81°
Total harmonic distortion, 0dB	−98.4dB	−94.2dB	−68.5dB
Total harmonic distortion, −10dB	—	−88.5dB	—
Total harmonic distortion, −60dB	—	−48.3dB	—
Total harmonic distortion, −80dB	—	−24.1dB	—
Intermodulation, 19kHz/20kHz, 0dB			−96.3dB
Intermodulation, 19kHz/20kHz, −10dB			−90.1dB
Frequency response, left channel			+0.08dB, −0.81dB
Frequency response, right channel			+0.08dB, −0.83dB
Signal-to-noise, 20Hz-20kHz unweighted			−94dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−90dB
Output level, 0dB, left/right			2.0V
Output impedance			1.8kohms
De-emphasis			correct
Track access time			4.5 secs
Error correction capability			>900μm gap, >800μm dot
Mechanical noise			low
Spuriae up to 100kHz			−78.1dB
Resolution at −90dB			left +3.30dB, right +2.92dB
Headphone socket			no
Dimensions (w×d×h)			33×30×7cm
Estimated typical purchase price			£300

**right channel −112.0dB, −110.2dB, −101.0dB*

First reviewed 1986

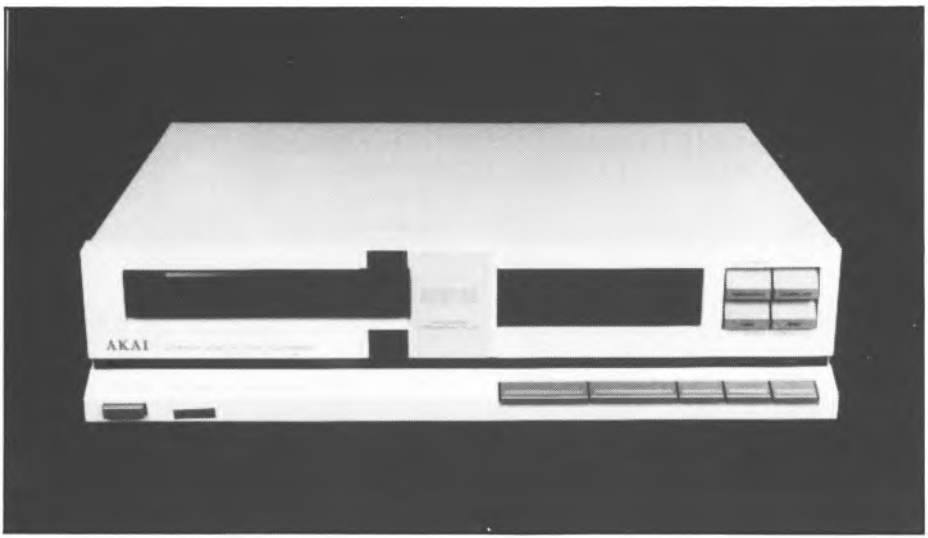




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

AKAI CD-M300

AKAI (UK) LTD, UNIT 12, HASLEMERE HEATHROW ESTATE, SILVER JUBILEE WAY,
HOUNSLOW, MIDDLESEX. TEL: 01-897 6388



It is something of a surprise to open a brown cardboard box and find a pure white CD player, but that is certainly one aspect of the £179 M300 that distinguishes it from the herd. Whether the ability to sit inconspicuously alongside the food processor and other small kitchen appliances will stimulate dramatic sales remains a moot point, however, as the colour only seems to emphasise the plasticity even though construction is as solid as most others of its ilk.

This is a simple basic midi-size machine with the bare minimum of facilities, and as such it is infinitely simpler to use than more pretentious designs. A straightforward, small three-function display provides minimal information, and basic programming is available.

The lack of a manual on this occasion was no serious handicap, though the true significance of the 'linear skate' disc loading system may therefore remain forever obscure. The front edge styling feature will tend to collect dust, which will be all the more obvious given the white finish. A mere flying lead equipped with phono plugs provides the only output.

SOUND QUALITY

Rated well below average, the M300 sounded different from most, with an overall blandness that might be considered euphonic, but which was not to the taste of the listening panel. The tonal balance sounded oddly 'shut in', but with some sibilance exaggeration nonetheless. Bass was softened, lacking definition and power; dynamics were compressed, low level detail was masked, and stereo depth reduced. The sound was not unpleasant in a fatiguing sense, yet it remained mildly defocused with some muddling on complex sections.

CONCLUSIONS

It is perhaps mildly fatuous to suggest that white does not make the best colour for CD Players, but possibly the unusual decor may have distracted the engineers. Certainly the M300 failed to measure up to standard sonically, despite its low selling price.

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AKAI CDM515

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The midi-size *CD-M515* reviewed here is a manual, low cost machine. One economy measure is seen in the lack of the usual line output RCA phono sockets, and instead, a short output cable is permanently fitted. This may well be convenient in the case of a matching stack system, but it prevents the use of audio cables of known quality.

An up-to-date feature is the liquid crystal display (LCD), and nicely backlit here. *Via* the appropriate buttons this visually restful display can show a comprehensive array of figures including residual track numbers, the track total and timings, indexing and the total play time.

Track programming of up to a total of 36 is provided, this permissible in sequence or in random order. Repeat is possible for the whole disc or over selected A-B start-stop points. The skip button provides rapid access to tracks and the cueing operates at two automatically-selected speeds with audible discontinuous music output. Unusually at this price level, the deck also includes indexing. All the controls were easy to operate.

While no headphone socket or remote control are present, the rear panel does carry a synchro-start terminal for operation with the matching Akai system stack, particularly for auto-start recording from disc. Another socket carries the sub-code data terminal for connection to video displays and information systems.

Inside, is a straightforward machine using 16 bit linear conversion with a time shared D/A converter followed by a standard 'brickwall' filter. The laser head has a fast access time, with reliable locking achieved by a tri-beam system for data read, tracking and focus.

LAB REPORT

Essentially flat, very careful listening would be required to identify the minor frequency response deviations. A mild 0.2dB lift can be seen in the low treble (the 'presence' range) while at 18kHz the two channels were out of step by just 1dB. Over most of the range the balance was held to 0.4dB while very good separation was achieved at low and mid frequencies, this deteriorating to a below-average result of 60dB, worst case, at 20kHz. The time shared converter showed the usual differential channel delay giving rise to a phase difference of 77° by 20kHz — only of significance if mono use is envisaged.

A decent 15 ¾ bit resolution was indicated

by the modest level error at −90dB modulation and the generally good distortion performance. At full modulation, mid-band distortion products were typically 0.007%, and even at 20kHz the downband modulation signals were better than 74dB down. However above 20kHz the 24kHz beat component was suppressed by just 24dB. At −80dB, 1kHz, the −25dB distortion figure was fine. The intermodulation was very good, though mild slewing was noted on full-level white noise.

Signal to noise ratios were fine, and the output level close to the standard 2V, derived from a low source impedance. No problems were encountered with error correction or pre-emphasis and track access was rapid. Mechanical noise was low.

Sound Quality

Performing well on audition, the bass was considered solid and dynamic, though the midrange was a little lightweight, even thin, but this did not detract from the performance since pleasing depth and detail was maintained in this region. The treble showed some brittleness and edge, but fair definition and perspective was still present in this range. It was lively with a stable confident stereo focus.

Conclusions

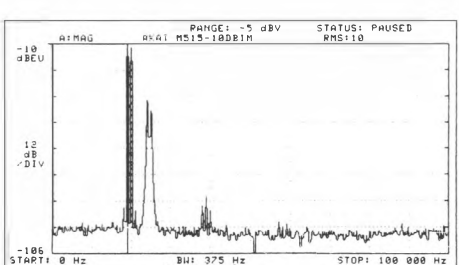
While I would have liked audio sockets on the rear I can't argue with the fine all round performance of this compact and tidy machine. It represents good value, and continues to deserve full recommendation.

Test Results

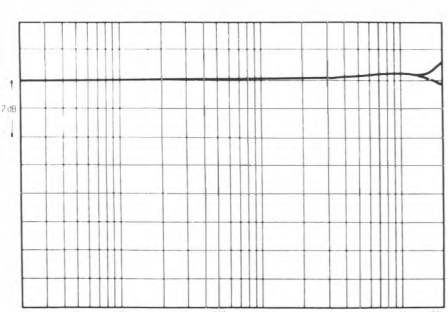
	20Hz	1kHz	20kHz
Channel balance	0.39dB	0.38dB	0.46dB
Stereo separation	92.3dB	89.6dB	62.5dB*
Channel phase difference	0°	5°	77°
Total harmonic distortion, 0dB	−90.7dB	−83.5dB	−73.8dB
Total harmonic distortion, −10dB	—	−87.4dB	—
Total harmonic distortion, −60dB	—	−50.0dB	—
Total harmonic distortion, −80dB	—	−25.3dB	—
Intermodulation, 19kHz/20kHz, 0dB			−89.1dB
Intermodulation, 19kHz/20kHz, −10dB			−90.5dB
Frequency response, left channel		+0.02dB,	−0.65dB
Frequency response, right channel		+0.02dB,	−0.64dB
Signal-to-noise, 20Hz-20kHz unweighted			−95dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−88dB
Output level, 0dB, left/right			1.9V
Output impedance			225ohms
De-emphasis			correct
Track access time			3.0secs
Error correction capability			>900µm gap, >800µm dot
Mechanical noise			moderate
Spuriae up to 100kHz			−104dB
Resolution at −90dB			left +3.25dB, right +2.57dB
Headphone socket			no
Dimensions (w × d × h)			35 × 26 × 7.5 cm
Estimated typical purchase price			£199

**Left channel −56dB separation, −93.1dB intermod*

First reviewed: 1986



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



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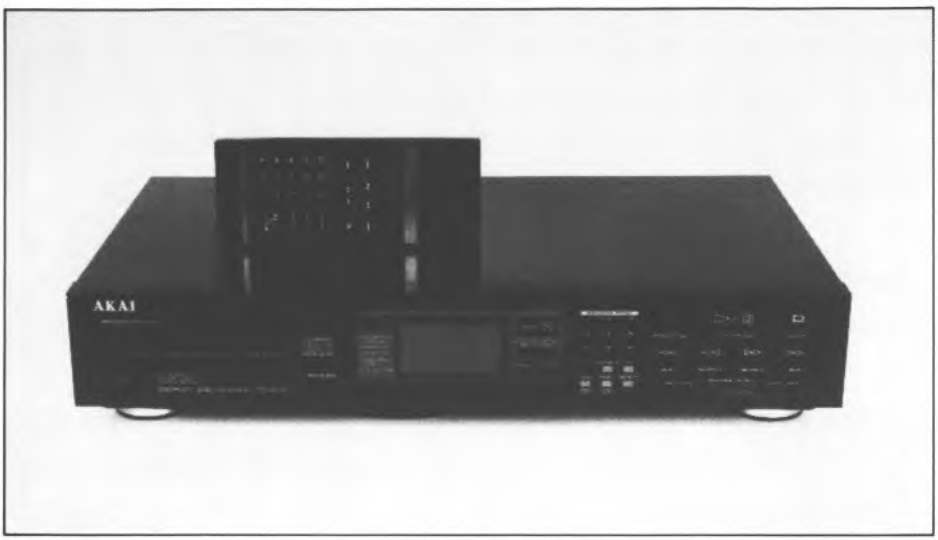
AKAI CD-A70

AKAI (UK) LTD, UNIT 12, 12 HASLEMERE HEATHROW ESTATE, SILVER JUBILEE WAY, HOUNSLOW, MIDDLESEX. TEL: 01-897 6388



This large £299 full-width remote-control player has a fine standard of finish and presentation, with plentiful legends and some complexity, plus five little blue programming buttons to relieve the black monotony. Construction is light in weight, the feet pretending (not too successfully) to offer a measure of environmental isolation, but an internal floating mechanism is claimed to improve resistance to exterior disturbance. The top plate is a metal/polymer sandwich to reduce unwanted resonance, though it still rings quite enthusiastically when struck.

A selling feature of this machine is its rapid track accessing particularly on 'repeat', while the programming function has the usual 1-0 keypad plus additional 'and', 'to' and 'without' keys to simplify selecting the required tracks of a particular disc. The liquid crystal display is large enough, covering the usual time/track parameters. A front panel headphone socket is fed *via* a volume slider, and the rear panel has conventional phono audio outputs plus a non-standard subcode for possible future applications.

LAB REPORT

Based on conventional enough 16-bit 2× oversampling technology with digital filtering and shared DAC, the A70 measurements were a little below par overall. Channel balance was nice and close, but stereo separation deteriorated markedly at high frequencies, as the phase difference due to the shared converter increased. Even though the expanded vertical scale exaggerates anomalies, the frequency response shows a number of distinct characteristics that are bound to influence the overall sound balance. The low frequencies droop slowly, while high frequencies show a ripple superimposed on both an early rolloff and late partial recovery, the whole giving rise to odd phase shifts between channels.

Distortions were reasonably low, but deteriorated markedly at low levels, presumably reflecting the rather poor low level resolution, amounting to a *de facto* 14.2 bits at −90dB. Ultrasonic spuriae and IM products were both well under control, error correction tests were passed without fuss, and electrical noise was reasonably low. The output level is on the low

side — sufficiently so as to risk misleading the unwary in comparative listening tests. Track access speed on our particular test was a rapid enough 3 seconds, mechanical noise was moderately low, while shock and vibration rejection was reasonable.

Sound Quality

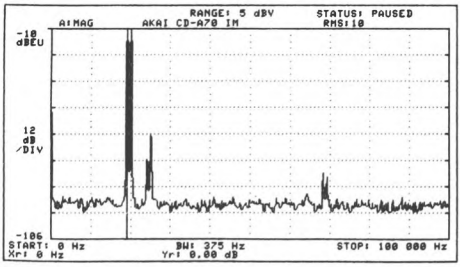
Tonally pleasantly 'laid back', the *'A70* nonetheless lacked some transparency, rating a firm 'average' overall. Dynamics sounded a little muted and the response was subjectively a little band-limited, presumably relating to the frequency response characteristics. There was a slight 'dulling' and loss of focus, which limited depth resolution, while both extreme bass and treble were considered qualitatively unexceptional, and the midrange possessed an almost 'creamy' texture.

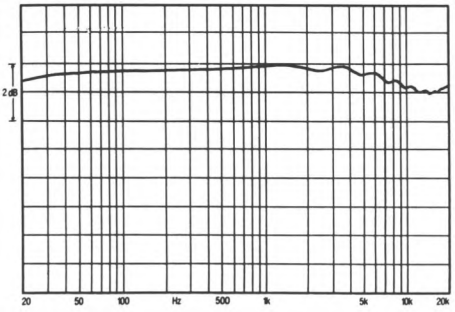
Conclusions

Possessing some interesting and convenient solutions to the problems of facilitating complex programming, the *A70* is well finished and nicely presented, giving a sound with its own distinctive qualities that is fair enough for the price. However, there were a number of technical oddities which could be improved and which mute our enthusiasm a little, so overall this is an unexceptional machine, albeit available at a reasonably competitive price.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.02dB	0.01dB
Stereo separation	100dB	87dB	53dB
Channel phase difference	0°	8°	130°
Total harmonic distortion, 0dB	−84dB	−84dB	−85dB
Total harmonic distortion, −10dB	—	−77dB	—
Total harmonic distortion, −60dB	—	−27dB	—
Total harmonic distortion, −80dB	—	−12dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−97dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−95dB	—
Frequency response, left channel	−1.33dB, 0, −0.86dB		
Frequency response, right channel	−1.32dB, 0, −0.87dB		
Signal-to-noise, 20Hz-20kHz unweighted	94/98dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	90/93dB		
Output level, 0dB, left/right	1.74V		
Output impedance	220ohms		
De-emphasis	1kHz, −0.41dB; 5kHz, 5.1dB; 16kHz, 9.6dB		
Track access time	3.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−95dB		
Resolution at −90dB	−79.7/−78.1dB		
Headphone socket	yes, 82ohms		
Dimensions (w×d×h)	44×25×9.2cm		
Estimated typical purchase price	£299		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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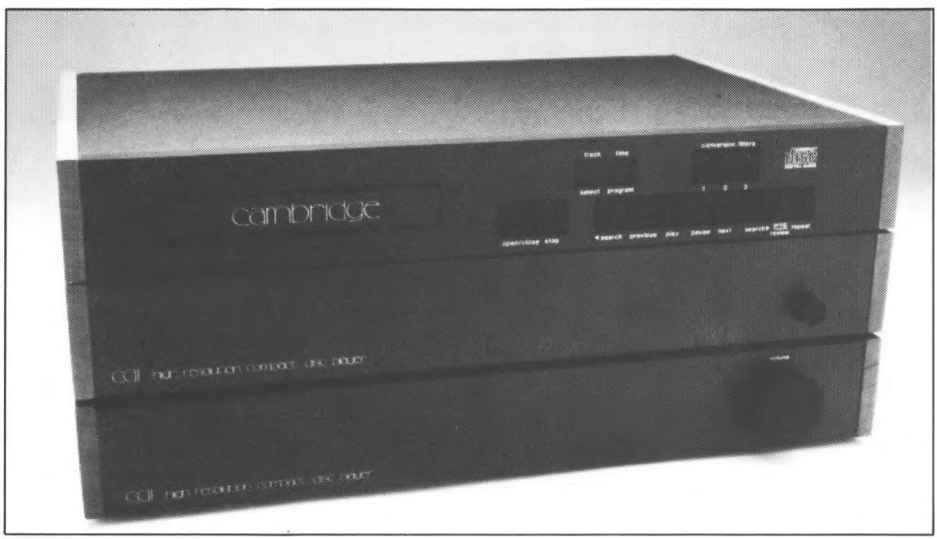


Now firmly established as a reference CD player, the Cambridge design is founded on the Philips system with its four times oversampling and digital filtering. The Philips '*104* chassis is the main building block, a solid cast metal structure with horizontal drawer loading mechanism. From this point onwards, however, the design of the *CD1* diverges from other machines. For example, while the D/A convertors are physically 14 bit Mullard Philips integrated circuits, no less than 6 are used, three per channel. On each channel two operate essentially in parallel, increasing the dynamic range, while the third acts as a high speed ranging element, assessing bit errors and offering correction. Before oversampling the theoretical resolution is some 18 bits, which is enhanced to 20 bits by oversampling. Dither is specifically applied to suppress high order errors, improve resolution and end up with a true 16 bit performance.

Changes have also been made to the Philips disc transport, notably to the laser head servo and to the tracking. The actuator responses have been adjusted to minimise the error rates, a factor held to affect sound quality.

Latest samples now have no less than three power supplies. The isolating suspension has also been modified, with an additional anti-vibration mounting which involves lead beams tuned to 1Hz. Two interconnect leads fitted with DIN plugs link the upper and the lower units, and the latter draws its power from the former. Specially selected components are used in the filtering and output circuitry to maximise audio quality.

Operating facilities are basic Philips '*104* including that machine's small fluorescent display illuminated in green. However, the pushbuttons are of instrumentation quality and should give a long life.

Three additional buttons can be used singly or in combination to offer a selection of seven audio filters. These filters provide subtle modifications to the upper frequency characteristic, altering amplitude and phase, being designed to complement some of the upper range charac-

teristics of available digital programme. On test these filters were experimented with and it was found that different settings could indeed improve some of the brighter and edgier recordings, moderating them to a more musical balance.

Lab Report

The adjustable variations in filter response only affected the upper treble, and the primary response fitted the Philips pattern with the usual minor ripples in the upper range. These are harmless and amount to 0.2dB giving a mild loss of output where they were present. A small loss in output was noted at low frequencies (some 1dB down at 20Hz) but this related to the 10kohm loading of the pen chart recorder used for the measurements. With most pre-amplifiers, the input impedance is rather greater than this, and the low frequency rolloff will move to a correspondingly lower frequency. For example, with a typical 50k input impedance, the −1dB low frequency point will appear at 4Hz. In theory CD players can respond down to DC, and several models in fact specify frequency responses down to 2Hz.

Fine channel separation was shown, together with very good channel balance. Even at 20kHz, the separation still averages 106dB. As a true dual-convertor deck the phase difference between channels was zero. At full level, distortion figures were good rather than excellent, but quickly improved at lower modulation levels. The low distortion at −80dB coupled with the excellent result for level offset at −90dB confirmed the manufacturer's claims of genuine 16 bit performance. On high frequency intermodulation it was fine while the de-emphasis operation was correct. A maximum of 4.25V was available from a low 108ohm output impedance. Mechanical noise was very low, while the track access time was a sluggish 9 seconds. No problems occurred with error correction and it easily met the top test disc standards here.

Electrical noise levels were exceedingly low, the recorded figures for this machine being at the threshold of measurement; in fact all met or beat −112dB, whether weighted or unweighted.

Sound Quality

For reference purposes the *CD1* was set to filter 'one', its nominally flat position. One complication concerned its relatively high output level of 4V for full modulation, which is double the usual figure, and intended to allow the *CD1* to be coupled directly to a power amplifier by making use of the high quality passive volume fitted to the lower deck.

Once correct levels had been established, accurate listening could begin. In fact, this machine showed its true mettle right from the opening bars of the first disc we played, James Newton Howard. It seemed to combine the best attributes of the superior machines tested so far.

In basic character it was essentially musical, showing this most clearly on orchestral strings by managing to avoid the tendency to brittle 'wiriness' so often heard. In the bass it gave an excellent performance, showing an impressive feeling of extension and power allied to excellent control on percussion. It could portray depth to a surprisingly high degree over the entire frequency range.

In the treble the *CD1* remained sweet and musical over a wide range of sources. Some discs which had appeared vague in treble imaging or unduly sibilant seemed to be tamed by the *CD1*, bringing them into clear focus. Stereo images were very stable and well formed, showing very good width and considerable depth.

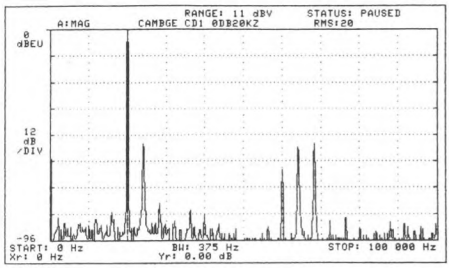
Still better results were obtained when we bypassed the pre-amplifier and connected the *CD1* direct. For an audiophile CD enthusiast, this mode provides the best sound of all, a rating that was fully confirmed with a current production sample auditioned in 1987.

Conclusions

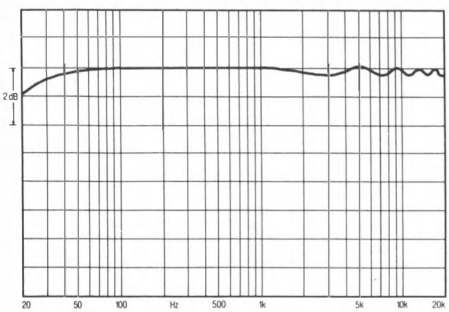
The advanced design and circuitry of this top class CD player have clearly paid off in its exceptional performance. With such a machine, compatibility with upper grade audiophile electronics is assured, and the intrinsic merits of CD as a medium, such as silent surfaces, and inaudible wow and flutter, can make themselves felt.

Update

A new production sample of the *CD1* was checked and auditioned for the 1987 series of tests, in the light of a number of changes to



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (below) frequency response.



power supplies, components used, and wiring layout. This development has succeeded in maintaining the *CD1's* position as the subjective prime reference, ahead of the competition and with an excellent sound quality rating. Recommended.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.18dB	0.07dB	0.12dB
Stereo separation	114.6dB	108.8dB	106dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−82.6dB	−83.2dB	−83.9dB
Total harmonic distortion, −10dB		−74.7dB	—
Total harmonic distortion, −60dB		−43.6dB	—
Total harmonic distortion, −80dB		−26.5dB	—
Intermodulation, 19kHz/20kHz, 0dB			−82.3dB
Intermodulation, 19kHz/20kHz, −10dB			−72.2dB
Frequency response, left channel			+0.31dB, −0.43dB
Frequency response, right channel			+0.30dB, −0.43dB
Signal-to-noise, 20Hz-20kHz unweighted			−113dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−113dB
Output level, 0dB, left/right			4.25V/4.25V
Output impedance			108 ohms
De-emphasis			5kHz, −4.63dB; 16kHz, −9.25dB
Error correction capability			>900μm gap, >800μm dot
Mechanical noise			very low
Spuriae up to 100kHz			−52.4dB
Resolution at −90dB			+0.38dB
Headphone socket			no
Dimensions (w×d×h)			45×37×19cm
Estimated typical purchase price			£1500

First reviewed: The Collection 1986. Rating: Recommended.

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DENON DCD 300

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TEL: (0753) 888447

Denon are one of the smaller Japanese operations, and one of the more recent to get proper distribution on the UK market. They specialise in hi-fi separates, and after attracting considerable attention with a range of good quality cassette decks are fast gaining a similar reputation in amplifiers and CD players too. For 1987 they are launching no fewer than six new models, covering every conceivable price point from this £210 '300 up to the exotic £1200 '3300.

This is the basic machine in the range. It is midi in size, light in weight, manual in operation, black in colour, and decently finished to Japanese build standards. A fairly elaborate though quite small display provides both track and timing information simultaneously, with various additional status indicators. The control layout is neat enough and was well liked, play, pause, and stop coming readily to hand, above the programming and repeat play buttons. The other operational controls, giving audible search, skip, display mode, open/close and the headphone socket are strung out willy nilly in a long line. The rear panel just has a pair of phono outputs.

LAB REPORT

Using standard 16-bit linear operation with a single time-shared DAC, the '300 gave a respectable rather than exceptional set of lab figures, appropriate enough to its budget price. The response showed a typical Denon characteristic, with a mild mid treble dip and following peak, but flat enough nonetheless. Channel balance was close, deteriorating slightly at high frequencies — like both the below average channel separation and good harmonic distortion. Intermodulation distortion was good, with ultrasonic components pretty well controlled.

Test track access time was a slowish 5 seconds, but the machine was mechanically very quiet and showed very good immunity from shock and vibration. Error correction and tracking tests gave no problems, but 0dB white noise was clipped top and bottom. Both signal-to-noise ratios were respectable enough, though somewhat asymmetric between channels, as were the

rather below average readings for ultrasonic spuriae. Low level linearity was a little disappointing too, rating around 14.6 bits.

Sound Quality

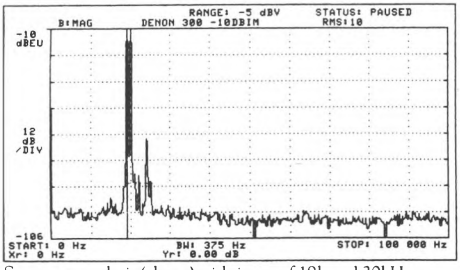
Just scraping into the above average ratings is a fine result for a budget price player with this standard of build quality. The sound was lively and open, with above average dynamics and clarity. Focus was good and the stage wide, with quite good depth besides. The treble was a trifle 'brittle' and forward, showing mild 'grain' and coarseness, but bass was above average. Overall this player gave a cheerful 'honest' sound.

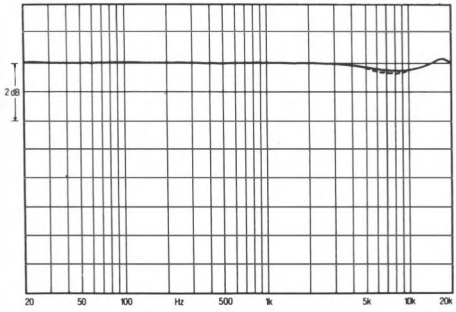
Conclusions

Unspectacular all round competence is becoming a hallmark of Denon's budget models, and is precisely the situation with the *DCD 300*. Different competing players may sound better, measure better or be built a fraction better, but few offer better balance for the price, so despite the compromises imposed by price this Denon budget model well merits a Best Buy rating.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.05dB	0.04dB	0.17dB
Stereo separation	80.7dB	81.9dB	67.3dB
Channel phase difference	0°	4°	85°
Total harmonic distortion, 0dB	−88.4dB	−89.1dB	−61.2dB
Total harmonic distortion, −10dB	—	−88.5dB	—
Total harmonic distortion, −60dB	—	−35.9dB	—
Total harmonic distortion, −80dB	—	−17.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−89.8dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−88.6dB	—
Frequency response, left channel	0.09dB, 0, −0.13dB		
Frequency response, right channel	0.09dB, 0, −0.01dB		
Signal-to-noise, 20Hz-20kHz unweighted	96/88dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	91/87dB		
Output level, 0dB, left/right	2V		
Output impedance	1.2kohms		
De-emphasis	1kHz, 0.21dB; 5kHz, 4.0dB; 16kHz, 8.9dB		
Track access time	5.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−83/96dB		
Resolution at −90dB	−81.6/−81.4dB		
Headphone socket	yes (fixed output) 100ohms		
Dimensions (w×d×h)	33.5×32×8.5cm		
Estimated typical purchase price	£210		



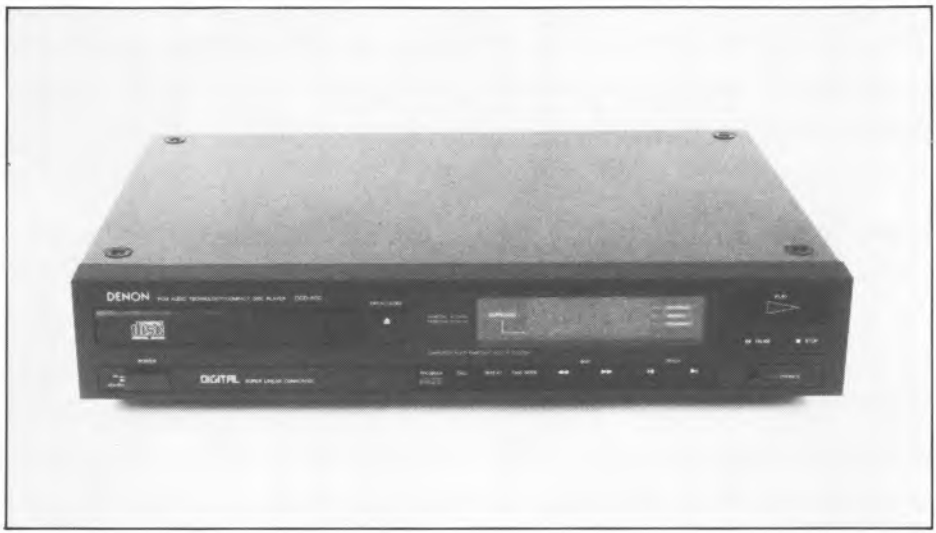


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

DENON DC-500

HAYDEN LABORATORIES, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST. PETER, BUCKS.
TEL: (0753) 888447



Denon are one of the smaller Japanese operations, and one of the more recent to get proper distribution on the UK market. They specialise in hi-fi separates, and after attracting considerable attention with a range of good quality cassette decks, are fast gaining a similar reputation in amplifiers and CD players, launching no fewer than six of the latter for '87.

The £250 *DCD 500* sits at the lower end of the range. It is a full size model similar to the '700 but without the remote control. It is a fairly basic machine, nicely built and finished with intelligent ergonomics and control layout, users commenting that it was particularly easy to drive.

The display is fairly elaborate though quite small, providing both track and timing information simultaneously, with various additional status indicators. The main drive controls fall conveniently to hand, while the other operational controls, giving audible search, skip, display mode, repeat, programming and a fixed output headphone socket are strung out in a long line. The rear panel has only a conventional stereo pair of phono sockets.

SOUND QUALITY

Rated comfortably above average, this is a good result for such a reasonably priced player. The sound was pleasant and lively, with good stereo focus and perspectives, and notable clarity. The midband sounded a little lightweight, while the treble was quite good, with only mild coarseness and slight grain and 'edge'. Bass was presentable, presentation clean, and the overall impression was of good balance and competence.

CONCLUSIONS

Though it lacks the luxury of a remote control found with many £250 models, the *DCD-500* performed sufficiently well in the listening tests to merit a strong recommendation, succeeding in providing a fine combination of sound and build quality at a very realistic price.

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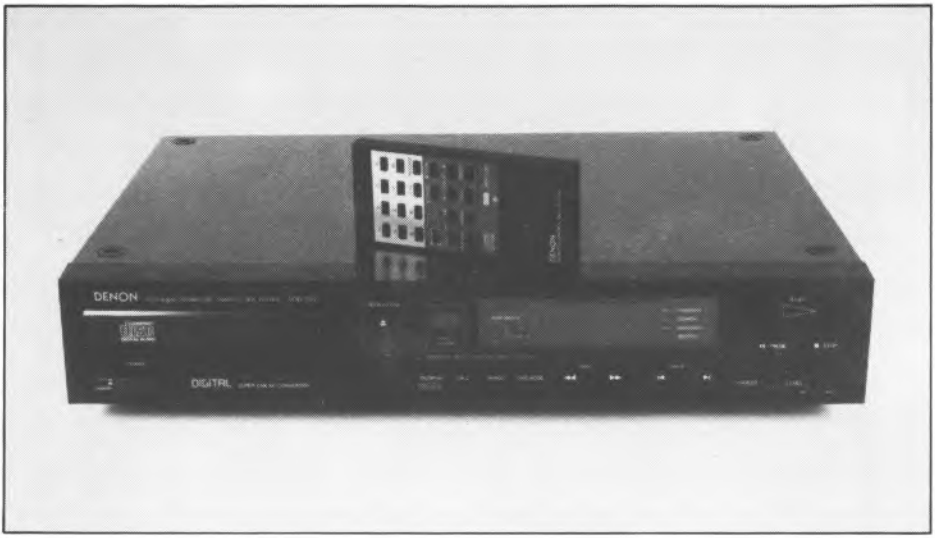


One of Japan's smaller consumer electronics operations, hi-fi specialist Denon are also one of the more recent to get proper distribution on the UK market. After attracting considerable attention with a range of good quality cassette deck separates, they are fast gaining a similar reputation in amplifiers and CD players too. Showing great confidence in the new medium, as well as a determination to compete with the marketing strategies of the giants, they are launching no fewer than six new 1987 models, covering every conceivable price point from £200 to £1200.

The £290 *DCD 700* sits at the lower end of the middle of the range. It is a full size model similar to the *'500*, but includes a full feature remote control. That aside it is a fairly basic machine, nicely built and finished with intelligent ergonomics and control layout, users commenting that it was particularly easy to drive.

The display is fairly elaborate though quite small, providing both track and timing information simultaneously, with various additional status indicators. The main drive controls fall conveniently to hand, while the other operational controls, giving audible search, skip, display mode, repeat, programming and the variable output headphone socket are strung out in a long line. The various switches plus a ten-digit keypad are all on the remote handset. The rear panel has only a conventional stereo pair of phono sockets.

LAB REPORT

Using standard 16-bit linear operation with a single time-shared DAC, the *'700* shows significant detail improvements over the cheaper *'300*, indicating tighter tolerances throughout, while a special delay sampling technique avoids the interchannel high frequency phase difference normally associated with single DAC designs. The response showed a typical Denon characteristic, with a mild treble unevenness but flat enough nonetheless. Channel balance was close, and separation very good. Harmonic distortion was only average, worsening at high frequencies, but intermodulation was pretty good, with ultrasonic components well under control.

Mechanically quiet and with excellent shock and vibration rejection, track access time was a slowish 5.5 seconds. Error correction and tracking tests gave no problems. A couple of

limitations shown in the *300* are carried on into the *700* model: 0dB white noise was again clipped top and bottom, and signal-to-noise ratios were still somewhat asymmetric between channels at high frequencies. The reading for ultrasonic spuriae was much improved, as was low level linearity at around 15.6 bits.

Sound Quality

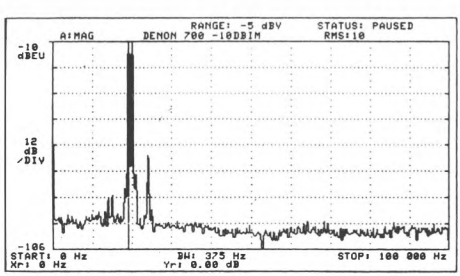
Rating firmly above average, the *DCD 700* shows small but worthwhile improvements in sound quality over both the cheaper Denon models, so justifying its price point. The overall sound was pleasant, with good perspectives and a treble described as quite sweet, with little grain or subjective distortion. Bass was focused, firm and well defined, and the midband clear and neutral, though the treble could have been more detailed and dynamic contrasts were a little muted. Overall this is a very competent middle-ranking deck.

Conclusions

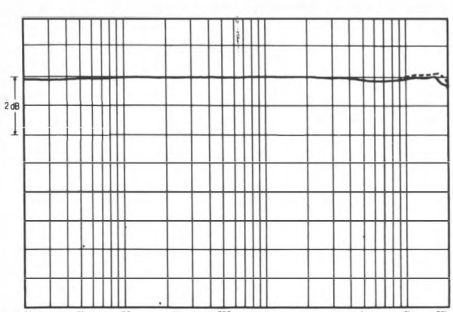
Given the £290 price, the *DCD 700* has clearly done enough to merit firm recommendation. The remote control assists already good ergonomics; the lab performance shows some attention to component tolerancing; the range of facilities is ample for most users; the build quality is sufficient to inspire some confidence; and the sound quality is comfortably up to the mark.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.03dB	0.02dB	0.01dB
Stereo separation	98dB	98dB	96dB
Channel phase difference	0°	0°	7°
Total harmonic distortion, 0dB	−91.5dB	−86.8dB	−57dB
Total harmonic distortion, −10dB	—	−87dB	—
Total harmonic distortion, −60dB	—	−29dB	—
Total harmonic distortion, −80dB	—	−19dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−82.6dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−90.2dB	—
Frequency response, left channel	−0.03dB, 0, −0.45dB		
Frequency response, right channel	−0.03dB, 0, −0.49dB		
Signal-to-noise, 20Hz-20kHz unweighted	98/95dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	92/88dB		
Output level, 0dB, left/right	2.1V		
Output impedance	1kohm		
De-emphasis	1kHz, 0.3dB; 5kHz, 4.6dB; 16kHz, 9.2dB		
Track access time	5.5secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−105.2dB		
Resolution at −90dB	−87.9/−85.4dB		
Headphone socket	yes (variable output) 100ohms		
Dimensions (w×d×h)	43.5×31.5×9cm		
Estimated typical purchase price	£290		

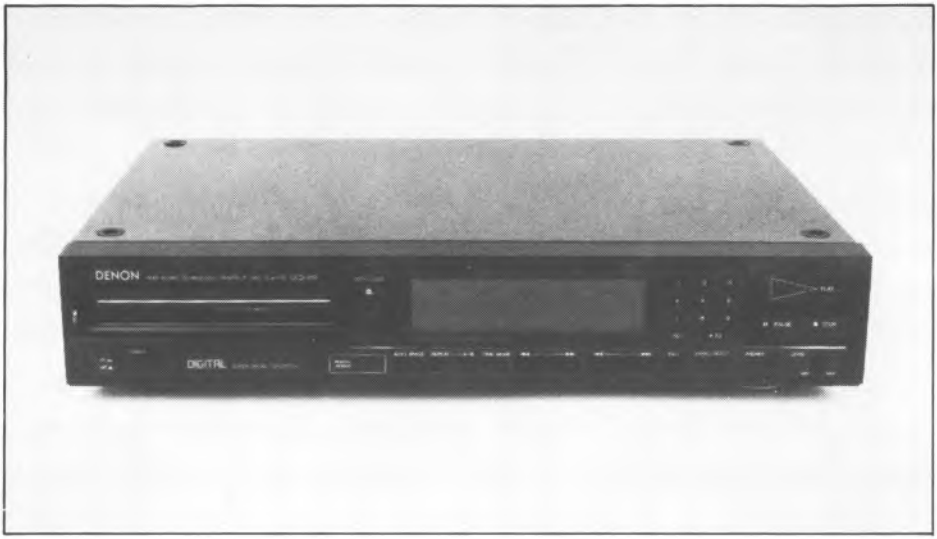


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



DENON DCD-900

HAYDEN LABORATORIES, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST. PETER, BUCKS.
TEL: (0753) 888447



Denon are one of the smaller Japanese operations, and one of the more recent to get proper distribution on the UK market. They specialise in hi-fi separates, and after attracting considerable attention with a range of good quality cassette decks, are fast gaining a similar reputation in amplifiers and CD players, launching no fewer than six of the latter for '87.

The £330 *DCD-900* is the top model in the 'affordable' price range, and is a full size full-remote model similar to the *'700* but somewhat more heavily built and with a number of extra facilities. It is a fairly complex machine, nicely built and finished with intelligent ergonomics, if perhaps a little on the complicated side for some users we suspect.

The display is very elaborate though quite small, providing track, index and timing information simultaneously on three digital indicators, with 20-digit music calendar and various additional status indicators. Next to the display, an 11-key pad provides the direct track access available on the remote control. The main drive controls fall conveniently to hand, while the other operational controls, giving audible search, skip, display mode, repeat, programming and a variable output headphone socket are strung out in a long line. The various switches plus a ten-digit keypad are all on the remote control handset. The rear panel has only a conventional stereo pair of phono sockets.

SOUND QUALITY

Scoring above average overall, the *'900* was rated fractionally above the cheaper Denon machines apart from the *'700*, yet this is still a good result for the price. Pleasantly lively, with good dynamics, it gives a fine stereo image with good frontal detail, focus, depth and width. Sounding slightly 'lean' in the midband, the treble is a touch forward with a hint of roughness. Bass is competent, but there was slight congestion on complex material. Overall this is a good but unexceptional performer.

CONCLUSIONS

Decent sound quality, fine build quality and plentiful facilities at a realistic price is quite sufficient to ensure this model's Recommendation, but it is not our favourite member of the Denon range.

BY THE SOUND ORGANISATION, 1 CATHEDRAL STREET, LONDON SE1. TEL: 01-403 2255 / 403 3088
also DCD 1500 1700 3300 etc.

DENON DCD 1500

HAYDEN LABORATORIES, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST. PETER, BUCKS SL9 9UG.
TEL: (0753) 888447

The *DCD 1500* is an upmarket design, very well equipped and selling for around £480. Claims are made for advanced technology, and the range of features suggests that it should offer good value. This full width drawer-loader includes a comprehensive display. A chart shows up to 20 programmed tracks and track numbers up to a total of 99 plus index numbers and timings are also indicated. Programming is simplified by a numerical keyboard. Facilities include fast track-skip, audible music cueing, index access and versatile repeat modes, including short passage A to B repeat. The machine may be set in timer mode for auto-start on power up.

A front panel headphone socket includes its own level control, and the bulk of the front panel buttons are actually duplicated on the full feature remote control. An additional, valuable remote facility is a volume control, and a given setting will be memorised for about a month if the power is turned off. Both variable and the fixed 2V outputs are available on this machine.

Technically advanced features include dual 16 bit D/A converters, two-times oversampling, 120th order digital filtering, and slow rate analogue filtering thereafter. Good transient response is a key feature of this system, which is essentially phase linear over the audible range. Denon's 'Super Linear' conversion system improves low level resolution and nulls the zero crossing point distortion.

LAB REPORT

The claims for the high resolution were upheld, with the player offering virtually full 16 bit performance: the level error at −90dB averaged 0.8dB, which is a very small amount. Harmonic distortion at full level was pretty good — better than 86dB down (0.005%) throughout the frequency range, though the right channel measured a few dB poorer than the left at 20kHz. This difference could also be seen in the results for crosstalk or channel separation: right-on-left measured −78.7dB, while left-on-right scored an impressive 102dB; such differences are often due to minor asymmetries in circuit layout.

Channel balances were very good, and due to the dual converters the two channels were phase-aligned. Very flat in the midband, the frequency response showed a mild 0.22dB rise at low frequencies coupled with a similar amount of droop at high frequencies. The close matching of this effect between the two channels sug-

gests that it is deliberate.

The results were good if not in the highest class for the two-tone intermodulation and differences between the channels were small. A standard 2.06V output was obtained from a low 10ohm source impedance. Mechanically the machine was very quiet, and gave fine results for the electrical signal-to-noise ratio. Note however, that the CCIR weighted figures without pre-emphasis showed the right channel 5dB noisier than the left.

Ultrasonic spuriae were well rejected, by typically 100dB, and track access times were typically good, averaging 3-4 seconds. Error correction tests revealed a slight shortfall, the deck failing to cope with the longest 900μm error gap; however, to its credit, shock and vibration resistance was fine. Sound quality *via* the headphone socket was well above average, and no premature clipping was detected on the peak white noise test signal.

Sound Quality

Rated well in the listening tests, the *DCD 1500* offered a neutral dynamic sound, lively, yet pleasantly balanced, and with a musical midrange. Ambience was well reproduced in the mid, and stereo depth was clearly one of its stronger points. However, it could sound a little 'forward' and 'up-front' at times. Stereo sound stages were well-focused, with an impression of coherent stable images. Detail was generally very good, though on very complex sections some midrange congestion was noted. The bass was a touch 'lightweight', and would have benefitted from a little more impact, while the treble could also have done with a touch more 'sparkle'.

Conclusions

This versatile, well equipped player offers an impressive array of features including remote volume control. The lab performance met high standards, and the sound was essentially musical with good stereo depth and focus. Fine finish and foolproof operation means that this Denon player still provides fair value for money, and remains worth considering.

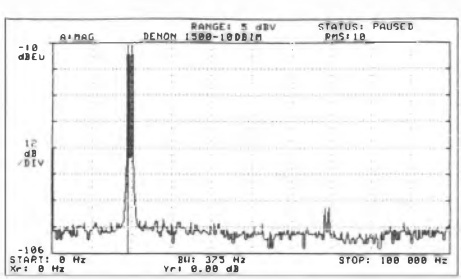
Test Results

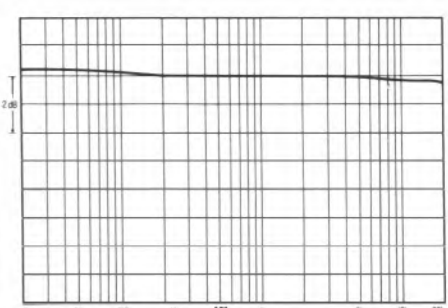
	20Hz	1kHz	20kHz
Channel balance	0.24dB	0.26dB	0.24dB
Stereo separation	−131.9dB	−119.1dB	−102.3dB*
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−91.2dB	−87.3dB	−86.1dB
Total harmonic distortion, −10dB	—	−86.4dB	—
Total harmonic distortion, −60dB	—	−48.9dB	—
Total harmonic distortion, −80dB	—	−24.9dB	—

Intermodulation, 19kHz/20kHz, 0dB	−87.5dB
Intermodulation, 19kHz/20kHz, −10dB	−89.0dB
Frequency response, left channel	+0.23dB, −0.31dB
Frequency response, right channel	+0.25dB, −0.30dB
Signal-to-noise, 20Hz-20kHz unweighted	−102dB
Signal-to-noise, CCIR/ARM, 1kHz ref	−99dB
Output level, 0dB, left/right	2.06V
Output impedance	10ohms
De-emphasis	correct
Track access time	4.0secs
Error correction capability	>800μm gap, >800μm dot
Mechanical noise	very low
Spuriae up to 100kHz	left −99.0dB, right −102.1dB
Resolution at −90dB	left +1.18dB, +0.69dB
Headphone socket	yes (variable output)
Dimensions (w×d×h)	43.5×35×8.5cm
Estimated typical purchase price	£480

**Left channel −131.9dB, −105.5dB, −78.7dB*

First reviewed 1986





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

DENON DCD 1700

HAYDEN LABORATORIES LTD, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST PETER, BUCKS.
TEL: (0753) 888447

Japanese hi-fi specialist Denon are showing great confidence in the CD medium, launching no fewer than six new 1987 models, covering every conceivable price point from £200 to £1200. The deluxe *1700* comes in at a cool £600, roughly twice the price of the *700* or *900* (and 30 per cent more than last year's still extant *1500*). Denon grade their machines carefully, ringing the changes from a comparatively small but high quality range of options. The *1700* therefore inherits the more elaborate display with three numeric displays and disc calendar instituted with the *900*, and adds extra build quality, component tolerancing and under the skin engineering features — special dual DACs and construction to immunise against vibration etc.

The standard of finish and presentation matches the high price. But despite the complexity ergonomics remain good and the machine is still easy to drive, assisted by full remote control operation. The main drive controls are nicely grouped, with skip and scan beneath play and beside stop, while the subsidiary functions run along beneath a direct entry keypad that assists quick pre-programming. The usual display and memory functions are supplemented by 'time search' and 'auto space' (neither of vital significance, frankly). The headphone socket and a set of line output sockets have a shared front panel volume control, and an additional switch provides direct digital output through an additional single coaxial phono socket.

LAB REPORT

The *1700* uses advanced dual 16-bit high precision DACs, with compensation circuit for 'zero cross' distortion, plus oversampling and both digital and analogue filtering. The frequency response shows a family similarity to the *1500* model introduced in 1986 — essentially flat but with a very mild downtilt from bass to treble — while the dual DACs ensure close phase correspondence between channels. Channel separation is very good, albeit deteriorating somewhat at high frequencies.

Harmonic distortion measured particularly well at low levels, and intermodulation was likewise very good — the spectrogram showing virtually no unwanted components in or out of band up to 100kHz.

Mechanically quiet and with good shock and vibration rejection, Denon's top models now

have linear motor optics drive, giving a fast track access time of 2 seconds. Error correction and tracking tests gave no problems. Unlike cheaper Denon models the 0dB white noise test was unclipped, and signal-to-noise ratios were impeccable. Ultrasonic spuriae were well suppressed, and a good figure of around 15.6 bits was recorded for low level linearity.

Sound Quality

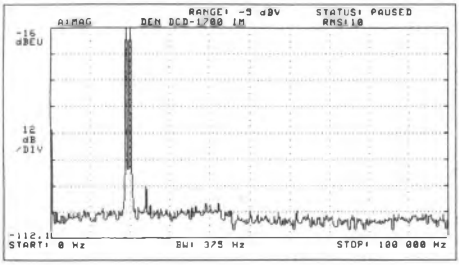
Getting into the very good class does much to justify the highish price of this player, not to mention the elaborate technology and engineering. Dynamics were particularly striking, while the treble was exceptionally clear if a touch 'clinical'. The midband was a touch 'lean' tonally, but with fine resolution, while the bass was very good, giving a sense of scale and power. The stereo image showed fine width and focus, and the sound overall was strong and coherent, approaching reference standards, with just very slight muddling on loud complex sections.

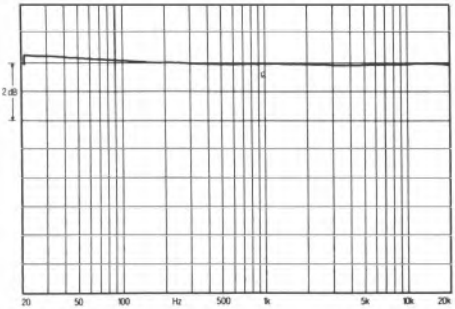
Conclusions

The *DCD 1700* is a very impressive CD player in every respect. The presentation and engineering are both to the highest standards, with evidence of careful quality control, and the sound quality is fully competitive — substantially better than last year's *1500*, for instance. Clearly recommendation is entirely appropriate.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.02dB	0.01dB	0.03dB
Stereo separation	109dB	115dB	76dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−99dB	−94dB	−84dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−40.4dB	—
Total harmonic distortion, −80dB	—	−32dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−85dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−98dB	—
Frequency response, left channel	0.32dB, 0, −0.03dB		
Frequency response, right channel	0.32dB, 0, −0.03dB		
Signal-to-noise, 20Hz-20kHz unweighted	104/108dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	99/103dB		
Output level, 0dB, left/right	2.10V		
Output impedance	150ohms		
De-emphasis 1kHz, −0.15dB; 5kHz, −4.09dB; 16kHz, −8.89dB			
Track access time	2.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−104dB		
Resolution at −90dB	−87/−87.7dB		
Headphone socket	yes (variable output) 1ohm		
Dimensions (w×d×h)	43.3×35×10.5cm		
Estimated typical purchase price	£599		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

DENON DCD-3300

HAYDEN LABORATORIES, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST. PETER, BUCKS.
·———TEL: (0753) 888447———·

Japanese hi-fi specialist Denon are showing great confidence in the CD medium, launching no fewer than six new 1987 models, covering every conceivable price point from £200 to £1200. The flagship *3300* comes in at an extravagant £1200, roughly twice the price of the *'1700* next rung down the ladder. It is very much the luxury model in terms of presentation and build quality, but more particularly in the elaborate high-tech internal engineering. Features here include optical internal coupling, separate analogue and digital power supplies, a substantial and rigid copper/aluminium chassis, plus a heavy bottom panel on vibration insulating feet.

Assisted by full remote control operation, the main drive controls are nicely grouped, with skip and scan beneath play and beside stop. Logically, if unexpectedly, the subsidiary function switches are hidden behind the flap, leaving the programming button and 1-10 direct entry keypad more easily accessible. The unusual display and memory play functions are supplemented by 'time search' and 'auto space' (neither of vital significance, frankly). The headphone socket and a set of line output sockets have a shared front panel volume control and an additional switch provides direct digital output through an additional single co-axial phono socket.

SOUND QUALITY

Rating very good on sound quality, the *'3300* did not fully justify its extravagant pricetag nevertheless. With fine dynamics and real drive in abundance, it had a strong, powerful bass, fine precise treble, and good neutral midband with just a touch of leanness. Resolution was very good, providing fine detail at all levels. Stereo images showed very good depth with slight narrowing, but tight focus and clear perspectives. The overall sound was tight and coherent.

CONCLUSIONS

Though this beautiful player makes a worthwhile flag-carrier for Denon's CD aspirations, it is undoubtedly a costly model to produce, and in our view does not quite come up to expectations sonically — very good in itself, it did not sound significantly superior to the half-price *DCD-1700* under our conditions.

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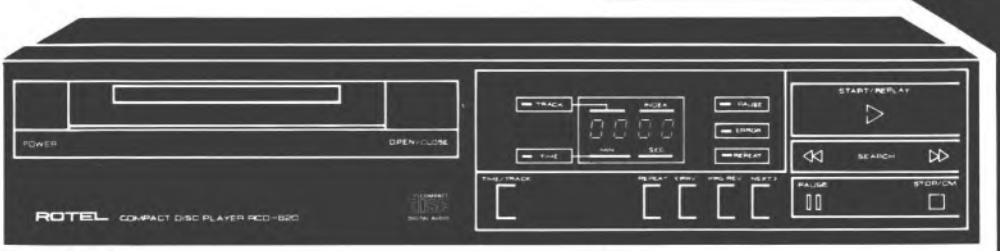

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BEST BUY

FERGUSON CD-04

THORN EMI FERGUSON, CAMBRIDGE HOUSE, CAMBRIDGE ROAD, ENFIELD, MIDDLESEX EN1 1UL.
TEL: 01-363 5353

Though Ferguson do not make their own CD equipment, their reputation and market share on TV and video products ensure that the Thorn EMI brand is widely distributed, primarily through the less specialist dealers, so the marketing of bought-in audio products is a logical strategy to follow.

This 1987 £200 midi-sized player differs from the 1986 *CD-02* model in being based on Yamaha rather than Sony technology. It must be one of the simplest players around — but that in itself is something of a strength. It also shows considerably more evidence of intelligent contemporary design than most — sparsely functional from a distance, easy to comprehend and use close up.

Part and parcel of the simplicity is a rather limited range of facilities on offer, though some users might regard a little self-discipline in this area as no bad thing. A small display gives basic machine condition information and details on one of three disc parameters, while facilities are limited to track skipping (not high speed search) and a nine track memory. And the excellent operating manual makes a welcome change from multi-lingual Far Easternspeak.

LAB REPORT

The *CD-04* uses standard Japanese technology, with a single, 16-bit DAC, 2× oversampling and digital filtering. The frequency response is smooth enough, but marred slightly by a 0.5dB peak centred on 15kHz, the phase response reflecting the channel-shared DAC. Channel balance was close, stereo separation respectable, and harmonic distortion good. Spot measurements for intermodulation distortion were also low, but the spectrogram shows a few more ultrasonic components than might be desirable.

Output impedance is a shade high for direct power amplifier connection, though such a scenario does seem a trifle unlikely. Track access speed and shock and vibration rejection were both about average and there was a mild degree of mechanical noise, but error correction tests were passed without fuss, and on our sample low level linearity was exceptionally good. Signal-to-noise ratios were good too, but the level of ultrasonic spuriae was rather poor. Overall, these are well balanced and competent results nevertheless.

SOUND QUALITY

The *CD-04* turned out to be one of the better

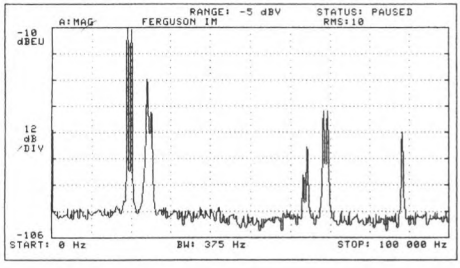
sounding 'budget' machines, rating a very respectable 'average plus' overall which betters a number of more pretentious machines. Described as strong and forceful, tending to a little hardness in the midband at high levels, the bass sounded extended, 'punchy' and quite dynamic, while the treble was a trifle 'lazy' and somewhat projected. Midband focus was good, and the stereo image showed fairly good depth.

Conclusions

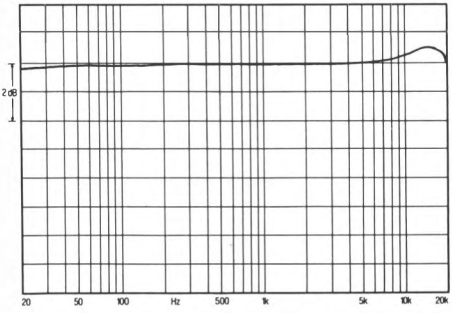
This new Ferguson could well provide an answer for those appalled by the complexities of many CD players and seeking a low cost, good quality, simple performer. Japanese build quality with a decent sound and respectable lab performance at a competitive price all indicate a Best Buy rating.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.08dB	0.08dB	0.06dB
Stereo separation	93dB	91dB	81dB
Channel phase difference	0°	2°	42°
Total harmonic distortion, 0dB	−84dB	−80dB	−78dB
Total harmonic distortion, −10dB	—	−83dB	—
Total harmonic distortion, −60dB	—	−44dB	—
Total harmonic distortion, −80dB	—	−23.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−83dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−89dB	—
Frequency response, left channel	0.01dB, 0, −1.42dB		
Frequency response, right channel	0.01dB, 0, −1.28dB		
Signal-to-noise, 20Hz-20kHz unweighted	98/101dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	93/97dB		
Output level, 0dB, left/right	1.95V		
Output impedance	1kohms		
De-emphasis	1kHz, 0.31dB; 5kHz, 4.13dB; 16kHz, 9.23dB		
Track access time	4.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−45dB		
Resolution at −90dB	−91.1/−90.8dB		
Headphone socket	no		
Dimensions (w×d×h)	33.3×29×8.5cm		
Estimated typical purchase price	£199		



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



GOODMANS GCD-500S

GOODMANS LTD, 2 MARPLES WAY, KINGSCROFT CENTRE, HAVANT, HANTS.
TEL: (0705) 486344

This £160 manually operated budget player has an S suffix to distinguish it from last year's *500*, though apart from the worthwhile 20 per cent price cut it appears to be very little changed as a consumer package, with the same basic front panel and range of features. Last year's model was a little disappointing in sound quality and showed some inconsistency between samples under lab measurements besides; pressed for space, we have restricted this year's coverage to a short, subjective review.

Construction is sound enough considering the price, but there are obvious price economies in such areas as the integral flying heads. The basic range of facilities includes most of the usuals: 16-track programmable memory and repeat functions, audible scan and track skip etc., all of which are nicely laid out and easy to comprehend and use. The simple 4-digit switch-mode digital display has extensive machine status indicator backup.

SOUND QUALITY

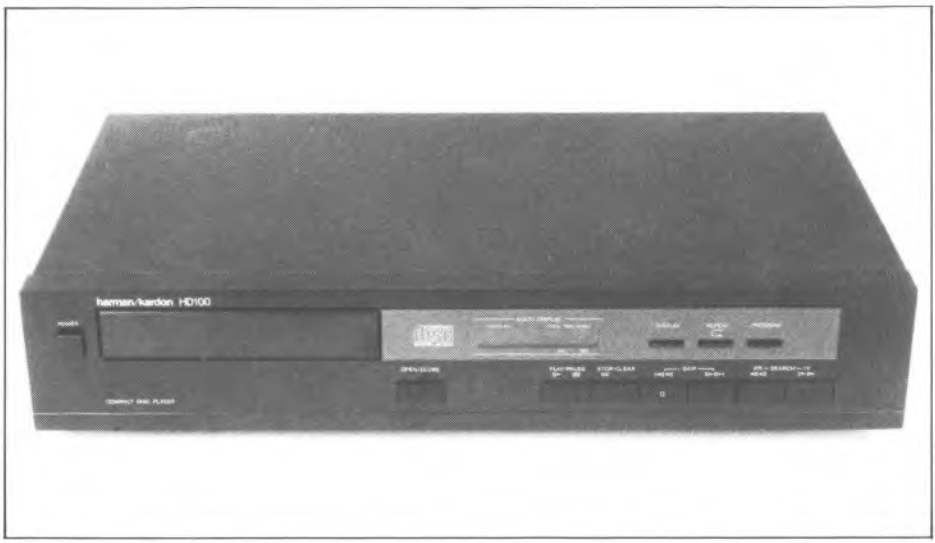
Rated well below average, albeit better than the lightweight portable 'personals', the current Goodmans model found little favour with the listening panel. Criticisms of various degrees were directed at most aspects of the sound quality, the bass sounding thumpy with poor differentiation, the midband a little hard and harsh, while the treble was 'zingy'. Dynamics were compressed and low level detail was suppressed. The stereo image was narrowed with reduced depth and focusing that seemed to vary with modulation level. In all, this was clearly a second class sound.

CONCLUSIONS

This may be the cheapest model in the book, but that doesn't guarantee good value for money. Irrespective of reasonable finish and build quality and a fair range of facilities, frankly the sound quality does not measure up against competition at only fractionally higher prices.

HARMAN KARDON HD100

HARMAN (AUDIO) UK LTD, MILL ST, SLOUGH, BERKS SL2 5DD.
TEL: (0753) 76911



Best known for their amplifiers, though active across the board in electronic and electromagnetic components, Harman Kardon are essentially a US company of many years' standing, whose products are manufactured in Japan. The *HD100* is the cheapest of three CD players in their range, so its quite high £400 price tag buys only a very limited range of facilities, not including remote control.

Attractively stark and functional, our sample was finished in a very matt black, with a substantial and solid front panel. Build quality is very good, though with no apparent efforts made to combat vibration. Ergonomics are clear and sensible, uncluttered by the excess of facilities that often afflict mid-price players. The seven large transport buttons are clearly labelled in gold lettering, giving the usual skip and scan functions, while the smaller subsidiary controls for repeat, programming and display mode are mounted alongside the display on a plastic subfascia. The display itself is very small, though the absence of remote control renders the size needed for reading at a distance largely unnecessary. It has two separate digital readouts plus a couple of status indicators.

LAB REPORT

This 16-bit 2× oversampling machine has a single, timeshared DAC, so there is some phase discrepancy between channels at high frequencies. The frequency response was generally flat, with just mild high frequency ripple. Channel balance was very close, deteriorating marginally at high frequencies, and separation was reasonably good. Harmonic distortion figures were normal at low levels but weak at high levels, particularly at high frequencies. Intermodulation figures were also unimpressive at high levels in particular, and the spectrogram shows quite a lot of ultrasonic activity.

Output level is just a shade higher than the CD spec, which could prove misleading in A/B comparisons. Track access speeds were quite rapid and mechanical noise was moderate, while shock and vibration rejection was only average. Signal-to-noise ratios were very good, but ultrasonic spuriae were at a slightly higher than average level. Low level linearity was good, reduced slightly to 15.3-bits overall by some peak level compression.

SOUND QUALITY

The *HD100* rated a straight average overall

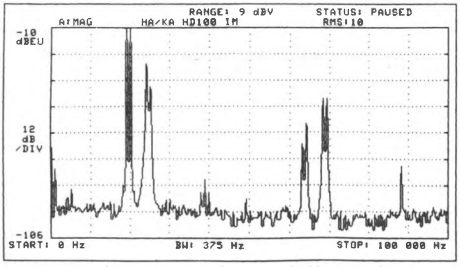
during our listening tests, a decent enough result to be sure but a little disappointing considering the price. Bass was deep and generous, giving good 'slam' and a fine sense of scale, but the midband sounded a little lean and hard with some loss of dynamics and high level congestion; treble was slightly bright and lispy. Stereo focus and depth were reasonable, with some loss of ambience but good low level resolution. In all, the *'100* gave a rather mixed subjective performance.

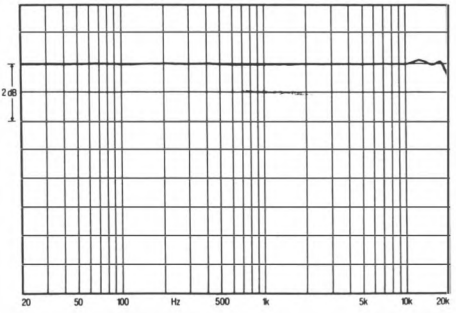
Conclusions

Though one cannot quibble with the fine build quality, and the styling and presentation are more attractive than most, the limited facilities (notably the absence of remote control), unexceptional lab performance plus an overall average rating on listening tests are not sufficient to justify recommendation for this fairly expensive player.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.01dB	0.23dB
Stereo separation	−98dB	−92dB	−81dB
Channel phase difference	0°	2°	40°
Total harmonic distortion, 0dB	−67dB	−67dB	−39.4dB
Total harmonic distortion, −10dB	—	−69dB	—
Total harmonic distortion, −60dB	—	−43dB	—
Total harmonic distortion, −80dB	—	−19dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−49dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−64dB	—
Frequency response, left channel	0.01dB, 0, −0.79dB		
Frequency response, right channel	0.01dB, 0, −1.02dB		
Signal-to-noise, 20Hz-20kHz unweighted	106/108dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	101/102dB		
Output level, 0dB, left/right	2.25V		
Output impedance	250ohms		
De-emphasis	1kHz, 0.22dB; 5kHz, 3.31dB; 16kHz, 8.5dB		
Track access time	4.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−78dB		
Resolution at −90dB	−91.7/−91.5dB		
Headphone socket	no		
Dimensions (w×d×h)	44×25.5×9.2cm		
Estimated typical purchase price	£399		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

HITACHI DA007

HITACHI SALES (UK) LTD, HITACHI HOUSE, STATION ROAD, HAYES, MIDDX UB3 4DR.
TEL: 01-848 8787

Hitachi are one of the giant Japanese conglomerates, with interests ranging from power stations to consumer electronics, taking in elevators, computers and microprocessors on the way. Since the video boom, the development of a UK TV set manufacturing base, and the emergence of the hi-fi systems market over the past ten years, their interest in specialist hi-fi components seems to have waned somewhat, though the *FT-5500* tuner has continued to enjoy healthy sales and the *LC-OFC* wire developments have also enhanced their reputation.

They were amongst the first onto the CD player scene, but were unrepresented in last year's edition, so the appearance of a new *DA-007* is doubly welcome. Priced at £330, this is a luxury model with comprehensive facilities and full remote control. Neither midi nor full-width in the normally understood 330mm/430mm sense, the visual appearance is enhanced by wooden end-cheeks making an all too rare appearance.

Construction is lightweight but of good quality, with fine external finish and good 'feel'. Hitachi claim exclusive components selected specifically for audio quality, but whether or not there is a serious attempt to minimise vibration effects depends on what is meant by the phrase 'vibration cut mechanism VC', emblazoned across the loading drawer but unexplained in the rather inscrutable manual. The control layout is logical, promoting easy use, while both handset and machine have 10-digit keypads for direct track entry. The usual range of facilities are provided, with audible search, skip, repeat, and programming, plus a volume slider for a headphone jack. The smallish display has two separate digital readouts, plus status indicators.

LAB REPORT

Using a single shared DAC with 2× oversampling, the basic technology is conventional enough. The response shows a gentle slope downwards from bass to treble, plus some rather sharp unevenness in the extreme treble, while the channel phase difference created by the single DAC was held to a minimal 32°. Channel balance was held to normal commercial tolerances, showing a minor channel discrepancy at high frequencies, while separation was pretty good, again falling off a little at high fre-

quencies. Harmonic distortion was OK, deteriorating somewhat at low levels, but intermodulation figures were very good, reinforced by the fine spectrogram result.

The output level was a little below the official CD spec, so care will be needed to adjust levels if making A/B comparison with other machines. Track access time of 4 seconds was around average, shock and vibration rejection likewise, while mechanical noise was quite low. Electrical noise levels were pretty good, and ultrasonic spuriae held to a low level, but the low level linearity of a *de facto* 14.3-bits was a trifle disappointing.

Sound Quality

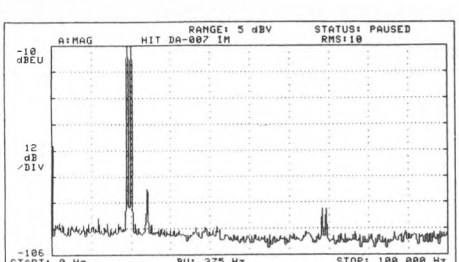
Hitachi do not have much of a track record for CD sound quality in *Hi-Fi Choice*, but the *'007* proved to be much the best yet from this manufacturer, the very respectable scores falling right on the borderline between average and above average categories. This competent all-rounder sounded quite tidy and well integrated, suffered from slight losses in dynamics, transparency and depth, and added slight hardness to the mid and grain to the treble, but the bass was fine, and the overall result pretty decent.

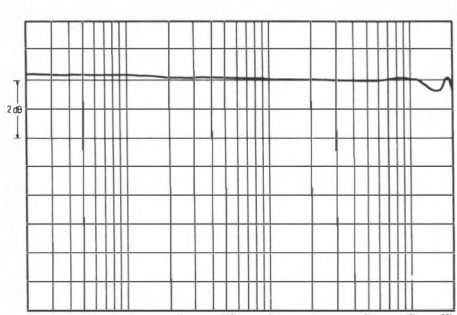
Conclusions

Built well and attractively domesticated with its wooden trim, the *'007* proved to be a pretty good all-rounder, though it failed to excell in any particular respect. Considering the competition at its mid-way price point, formal recommendation is not appropriate, but it remains worth considering nevertheless.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.32dB	0.32dB	0.23dB
Stereo separation	106dB	103dB	79dB
Channel phase difference	0°	2°	32°
Total harmonic distortion, 0dB	−84dB	−82.5dB	−80dB
Total harmonic distortion, −10dB	—	−78dB	—
Total harmonic distortion, −60dB	—	−33.5dB	—
Total harmonic distortion, −80dB	—	−13.7dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−92dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−84.5dB	—
Frequency response, left channel	0.25dB, 0, −0.22dB		
Frequency response, right channel	0.25dB, 0, −0.76dB		
Signal-to-noise, 20Hz-20kHz unweighted	94/98dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	89/94dB		
Output level, 0dB, left/right	1.72V		
Output impedance	450ohms		
De-emphasis	1kHz, 0.14dB; 5kHz, 4.35dB; 16kHz, 8.6dB		
Track access time	4.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	quite low		
Spuriae up to 100kHz	−102dB		
Resolution at −90dB	−81.6/−84dB		
Headphone socket	yes (variable output) 57ohms		
Dimensions (w×d×h)	37×27×8.3cm		
Estimated typical purchase price	£330		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

JVC XL V400B

JVC (UK) LTD, 12 PRIESTLEY WAY, ELDONWALL TRADING ESTATE, STAPLES CORNER, LONDON NW2. TEL: 01-450 3282

This remote control full width CD player sells for around £370 and includes a good range of facilities, including a front panel headphone socket with level control, and some multi-function buttons to aid operation. The fluorescent display has been extended and can show overall timings, track timings or remaining time; track and index numbers are displayed separately, while a bar graph lists all the available tracks up to 20 and indicates which have been programmed. Programming can be random or in order.

The player has the usual controls for audible music cueing and fast track skip. Repeat functions may be selected for A to B sections, for programmed tracks and for the whole disc. A synchro socket on the rear panel provides autostart with an appropriately interfacing cassette recorder.

Track entry on the machine is by means of successive key presses when using the machine, but the remote control has a ten digit numeric keyboard which quickly speeds up the programming. All the necessary functions except headphone level are present on the useful *RM-V400* handset.

Technically, several large scale integrated circuits simplify the construction, and the laser transport is a mass produced assembly of precision lightweight moulded plastics. A single 16 bit linear converter is time-shared between the channels, and a double oversampling method is used, combining multipole linear phase digital filtering before the decoder, and some lower order analogue filtering after conversion.

LAB REPORT

Channel balance was very good, and the frequency response does show a family resemblance; in this case the extreme treble was completely contained, while the preceeding dip reached 0.4dB. At 20kHz output was 0.8dB down, but this is not significant.

Channel separation reached a very fine 100dB in the midband, decaying to 74dB at 20kHz. The usual maximum of 42° was noted for interchannel phase difference. Total harmonic distortion averaged −90dB (0.003%) in the midrange, and was held to a very good −87dB at 20kHz. Likewise, the high frequency intermodulation figures were very good at −85dB full level and

−82dB at the −10dB test level. However, harmonic distortion results were impaired at the lower signal levels, and only −22dB was produced at −80dB modulation, 1kHz. Level error at −90dB averaged 4.3dB, indicating an estimated 15.4 bit resolution.

Output level was on the high side, at 2.2V from a 650ohm source, and the de-emphasis correction was in order. Track access time was average, and mechanical noise was held to fairly low levels. Absolutely no problems were encountered with the error correction, and the white noise test signal was handled without complaint. The non-inverting output was almost linear phase, but the rejection of the spurious response was −68dB at 88kHz, weaker than average.

Sound Quality

The '400 offered a fairly lively almost 'typical CD digital sound'. Firm and crisp, it failed to beat the average ranking. The mid was somewhat lightweight, a touch 'thin' and 'forward', with a loss of fine depth resolution. Depth effects were not fully brought out, and ambience was also subdued. The treble showed a hint of 'grain' and 'edge'; while the bass was quite sharp, the impression of extension and weight was missing. Focus was about average.

Conclusions

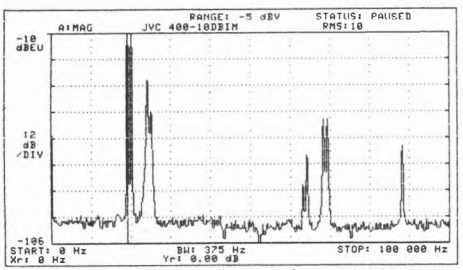
Although basically very satisfactory — JVC have equipped this player well for the money, and much of the technical performance is to a good standard — the sound quality is however unexceptional, and does not justify a recommendation at this price level.

Test Results

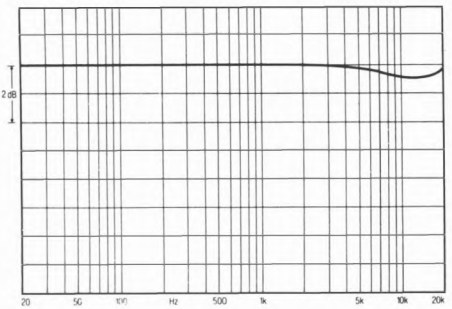
	20Hz	1kHz	20kHz
Channel balance	0.04dB	0.04dB	0.04dB
Stereo separation	−95.1dB*	−100.2dB	−74.0dB
Channel phase difference	0°	3°	42°
Total harmonic distortion, 0dB	−93.0dB	−90.8dB	−86.7dB
Total harmonic distortion, −10dB	—	−81.7dB	—
Total harmonic distortion, −60dB	—	−45.5dB	—
Total harmonic distortion, −80dB	—	−21.8dB	—
Intermodulation, 19kHz/20kHz, 0dB			−94.5dB
Intermodulation, 19kHz/20kHz, −10dB			−83.2dB
Frequency response, left channel			+0.02dB, −0.79dB
Frequency response, right channel			+0.02dB, −0.79dB
Signal-to-noise, 20Hz-20kHz unweighted			−97dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−92dB
Output level, 0dB, left/right			2.2V
Output impedance			650ohms
De-emphasis			correct
Track access time			6.0secs
Error correction capability			>900μm gap, >800μm dot
Mechanical noise			fairly low
Spuriae up to 100kHz			−47.6
Resolution at −90dB			left −4.30dB, right −4.39dB
Headphone socket			yes (variable output)
Dimensions (w×d×h)			43.5×30×8cm
Estimated typical purchase price			£369

**Left channel, −88.1dB*

First reviewed 1986.

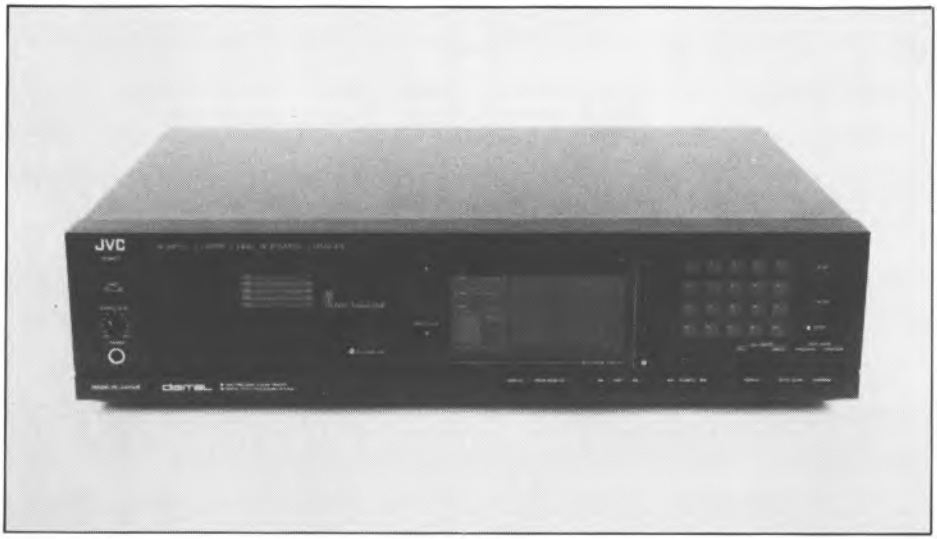


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



JVC XL-M700

JVC (UK) LTD, 12 PRIESTLEY WAY, ELDONWALL TRADING ESTATE, STAPLES CORNER,
LONDON NW2 7AF. TEL: 01-450 3282



Known formally as a Compact Disc Automatic Changer, this substantial, heavy, full-width and full-remote-control player looks a little daunting when first removed from the box. However, closer acquaintance shows that careful thought has gone into the ergonomics. The really clever trick has been to provide two separate loading drawers — one for a single disc, the other accepting the six-disc magazine. This cake-and-eat-it-too approach neatly avoids suffering the operational complexities of the original autochangers of a year or so ago when merely wishing to play single discs. Nice though this approach is, it does not come cheap — £570 puts the price up there with the weight and bulk.

When simply pressing 'play', the machine cycles steadily through all the loaded discs, beginning with the single drawer unit if loaded. But extensive pre-programming functions are available to those who choose to interact with the 20+1 track selection keypad, the seven button disc selector plus various programming switches. In addition to such modes as repeat and intro-scan, a true 'random play' function lets the machine make up the playlist, continuing presumably to provide background music *ad infinitum* (or *nauseum*).

Though the total mass is quite high, no special techniques seem to be used to suppress vibrations. The rear panel has a pair of audio phono sockets which links up with other JVC 'Compu-Link' products to provide a measure of automatic interaction in an appropriate system context.

Lab Report

Based on 16-bit 2× oversampling technology with a single DAC, the frequency response was generally flat, showing just the mildest ripple beginning at high frequencies, and the effect of the shared DAC may be seen in the phase change at high frequencies too. Channel balance was close and figures obtained for stereo separation and harmonic distortion are all fine, while intermodulation distortion is very low indeed.

The output level is a touch on the high side, error correction tests were all passed without problem, and track access times are commendably rapid. Mechanical noise is low, but the immunity from shock and vibration was rated only average. The measured resolution of

around 15.3 bits is reasonable, as is the suppression of ultrasonic spuriae, while the intermodulation spectrogram shows a number of components, particularly in the 60-70kHz range.

Sound Quality

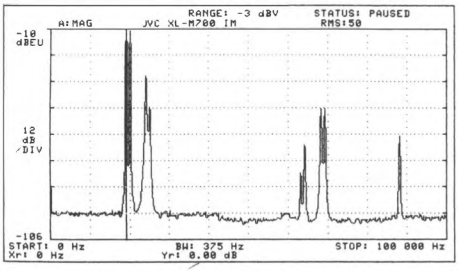
With an overall rating just above average, the JVC falls a little short of the audiophile mark but nonetheless turns in a respectable and solid performance. The sound was considered agreeably dynamic and lively, with decent verve and pace, and firm control and resolution at the frequency extremes. The soundstage was open and well-focused with quite good depth, but there was some masking of low level detail and ambience information. A mild degree of treble forwardness was noted, along with some 'thinning' and 'hardness' in the midrange.

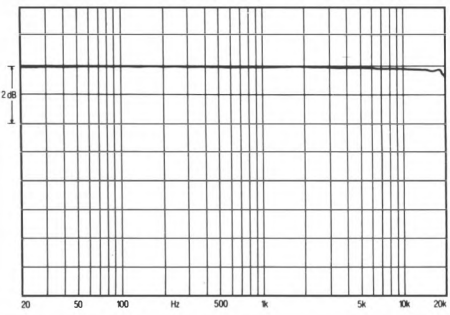
Conclusions

The value for money rating for this unusual player will depend entirely on the value attached by the user to the unique single/autochanger combination. The all round competence on sound quality and lab performance is not alone sufficient to justify the £570 asking price, but the ergonomics have been extremely well thought out, greatly facilitating the operation of a multi-role player. Accepting that the autochanger features account for a fair chunk of the price, the '700 is worth considering.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.14dB	0.13dB	0dB
Stereo separation	101dB	88dB	83dB
Channel phase difference	0°	0°	40°
Total harmonic distortion, 0dB	−80dB	−82.6dB	−85dB
Total harmonic distortion, −10dB	—	−79dB	—
Total harmonic distortion, −60dB	—	−43dB	—
Total harmonic distortion, −80dB	—	−21dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−103dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−100dB	—
Frequency response, left channel	0.00dB, 0, −0.8dB		
Frequency response, right channel	0.00dB, 0, −0.8dB		
Signal-to-noise, 20Hz-20kHz unweighted	99/103dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	95/98dB		
Output level, 0dB, left/right	2.32V		
Output impedance	650ohms		
De-emphasis	1kHz, 0.39dB; 5kHz, 4.68dB; 16kHz, 9.34dB		
Track access time	2.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−67dB		
Resolution at −90dB	−86.3/−86.2dB		
Headphone socket	yes (variable output) 110ohms		
Dimensions (w×d×h)	43.5×31×11.3cm		
Estimated typical purchase price	£570		

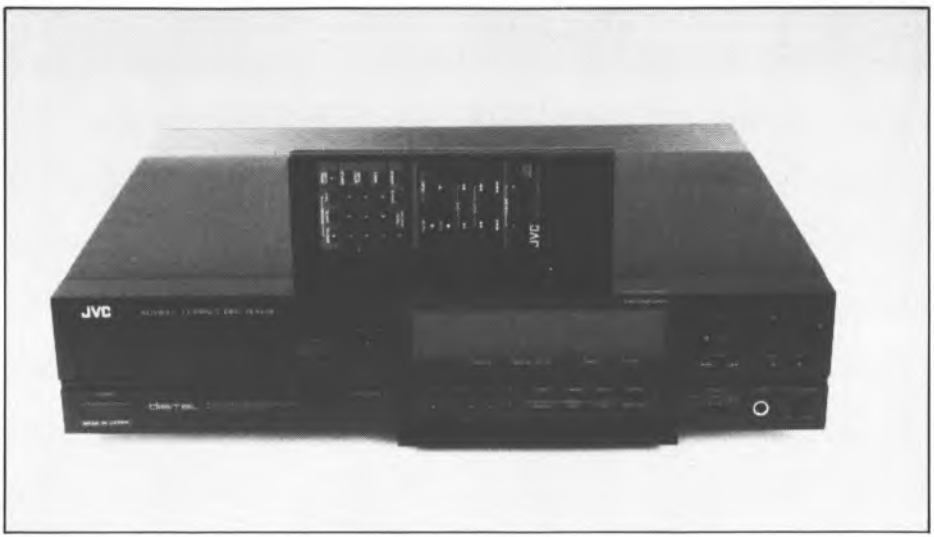




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

JVC XL-V1100

JVC (UK) LTD, PRIESTLEY WAY, ELDONWALL TRADING ESTATE, STAPLES CORNER,
LONDON NW2 7AF. TEL: 01-450 3280



This substantial, heavily engineered machine represents one of two alternative 'flagship' approaches being pursued by JVC: lacking the multiple autochanger transports of the *M700*, the *'1100* nevertheless costs some £90 more at £659. It is the 'high tech' model of the two, with 16-bit 4X oversampling dual converters, multiple power supplies, high audio quality components etc. The metal mechanism shows some suspension decoupling, and construction quality is generally good.

The main controls are sensibly placed and easy to use, while the subsidiaries, and the 10-digit direct access keypad are both rather tucked away beneath a hinged cover. Fortunately their functions are duplicated on the full infrared remote control. The very elaborate display includes three separate if small digital readouts for track, index and timings, plus a 1-16 music calendar and numerous status indicators. Perhaps the most interesting feature is the motorised volume control, driveable from the remote and also controlling the heaphone level. All the usual functions like scan and skip are present, plus a few more to baffle the unwary — intro-scan gives edited highlights, for example.

Sound Quality

This prestige luxury model costs a little more than the elaborate multi-play *M700*, yet did only slightly better on the listening tests, rating a disappointing 'above average' overall. The treble quality that caused the main panel unease was recessed yet a touch lispy on sibilants, and lacking in fine detail. Otherwise fairly pleasant and reasonably dynamic, the bass register was good and stereo staging was very presentable, with decent width, depth and focus.

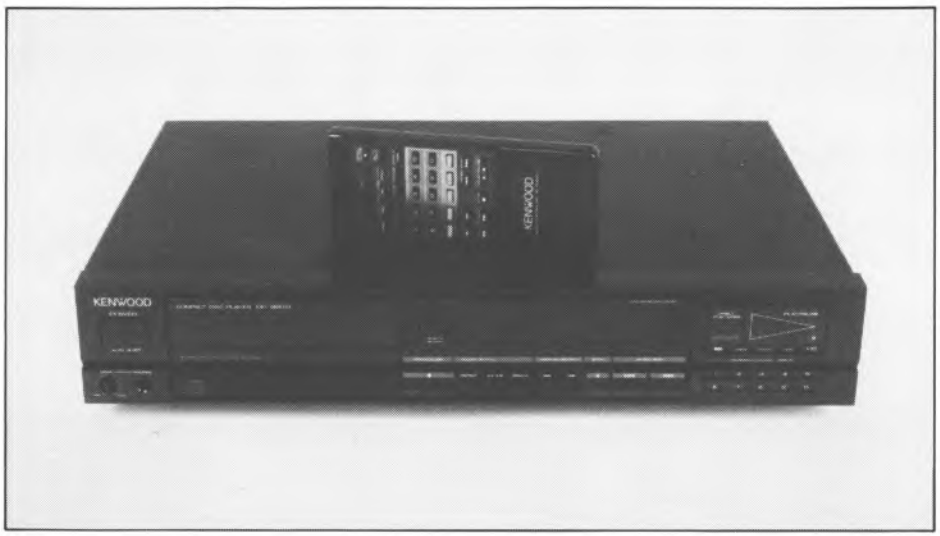
Conclusions

One can praise the build quality of this flagship model, but the heavy investment in technology and engineering does not seem to be reflected in a correspondingly high standard of sound quality, which is where the *'V1100* ultimately disappoints.

RECOMMENDED

KENWOOD DP990D

TRIO KENWOOD UK LTD, 17 BRISTOL ROAD, METROPOLITAN CENTRE, GREENFORD, MIDDX UB6 8UP.
TEL: 01-575 6030



Once known as Trio in the UK, the brand name change to Kenwood brings the UK product into line with the rest of the world. The smartly finished full-width *DP-990D* looks like a prestige model with its solidly cast front panel, offering full remote control with an extensive display, so it is a welcome surprise to find the price is a fairly modest £299. Both display details and legends are rather on the small side for easy reading, but the control grouping is logical enough and two large buttons provide useful 'manual override' out of the automatics and programming functions.

The operating manual is particularly arch, sprinkled with such headings as: "To play from the desired time of the desired tune", or "To play the previous or next tune". Writ very tiny upon the player itself are references to an (unspecified) 'over sampling system', plus a 'linear skate' disc loading mechanism whose advantages (or disadvantages) receive no reference whatsoever in the manual.

The unit as a whole is solidly built, but shows no apparent techniques specifically aimed at avoiding unwanted vibration effects. The front panel features a headphone jack with volume control, the rear a pair of phono audio outputs only.

LAB REPORT

Technology based on 16-bit chips with 2× oversampling and a shared DAC have resulted in an overall lab performance that was entirely competent, if unspectacular, rather reflecting the price level of the player. The response showed mild high frequency ripple, and a slight 'bump' in the filter characteristic centering on 15kHz — small enough in degree but just at the edge of the audible band nonetheless. Channel balance could have been closer at low and mid frequencies, but stereo separation, harmonic and intermodulation distortions were all good, the IM spectrogram showing just two obvious components at 68-70kHz.

While mechanical noise was very low and resistance to shock and vibration good, the track accessing time was a rather slow 6 seconds. Error correction and white noise tests were cleared

without problems, noise was low, ultrasonic spuriae were well suppressed, and low level linearity was quite good, indicating a resolution of 15.5 bits.

Sound Quality

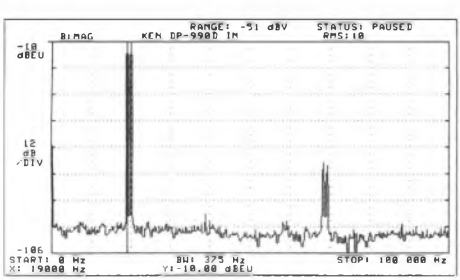
The '990*D* rated a firm average, leaning towards the plus side, which is quite a good result for its price. Depth and stereo focus were both quite good, though there was some loss of resolution on low level ambient information. Dynamics were considered only average, with some limitation, and the subjective tonal balance included a subtle treble exaggeration. Some 'coarseness' was noted in the upper midrange, and the bass was a touch 'heavy' and 'slowed'.

Conclusions

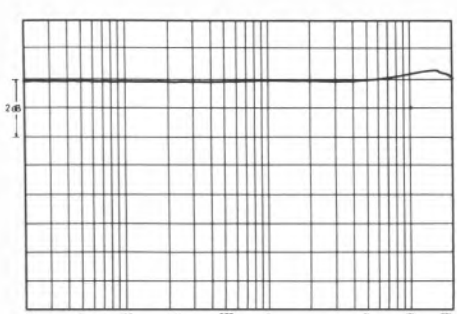
Kenwood's *DP990D* clearly sits right on the borderline of recommendation. Both the listening tests and lab performance are par for the price, and the package is further enhanced by exceptional standards of finish and presentation, plus full feature and remote control provisions. On balance and bearing in mind the good all-round package it deserves recommendation, with the caution that comparable sound quality can be obtained more cheaply elsewhere.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.2dB	0.28dB	0.02dB
Stereo separation	105dB	105dB	80.5dB
Channel phase difference	0°	0°	40°
Total harmonic distortion, 0dB	−90dB	−91dB	−86dB
Total harmonic distortion, −10dB	—	−82.5dB	—
Total harmonic distortion, −60dB	—	−43dB	—
Total harmonic distortion, −80dB	—	−19dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−91dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−80.8dB	—
Frequency response, left channel	0.02dB, 0, −0.61dB		
Frequency response, right channel	0.03dB, 0, −0.34dB		
Signal-to-noise, 20Hz-20kHz unweighted	98/103dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	93/98dB		
Output level, 0dB, left/right	2.05V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.42dB; 5kHz, 4.58dB; 16kHz, 9.2dB		
Track access time	6.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−101dB		
Resolution at −90dB	−86.6/−88.2dB		
Headphone socket	yes (variable output) 82ohms		
Dimensions (w×d×h)	44×30×9.5cm		
Estimated typical purchase price	£700		



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



LUXMAN D-100

HW INTERNATIONAL LTD, 3-5 EDEN GROVE, LONDON N7 8EQ.
TEL: 01-607 2717

Luxman are a smallish Japanese company that has always specialised in the luxury end of the hi-fi separates market, and has carved quite a niche for itself as a modern valve amplifier manufacturer on the Japanese market. Though they recently introduced an elaborate *D-109* multi-box/digital amplifier CD apparatus, this arrived too late for inclusion, so we have had to settle for the rather less extraordinary but considerably cheaper *D-100* to represent the *marque*.

However, £450 is hardly bargain basement stuff, and the *D-100* is quite sparsely equipped, so Luxman are clearly going for a market that appreciates the very high standards of finish and build quality that are evident, most notably in the front panel and the 'feel' of the controls. Though quite heavy, there is no evidence of any particular attempt to combat outside vibration.

Machine facilities are quite sparse, promoting simple operation, and are backed up by the infra-red remote control. (Neither the handset nor the manual accompanied the review machine, so you'll have to find out for yourself what facilities it has!) The usual main transport functions including skip and scan are sensibly grouped at the right hand end of the top section of the fascia, while three smaller buttons covering subsidiary functions like display mode, repeat and programming, plus the headphone socket and its volume control are distributed along the lower section.

LAB REPORT

Based on Yamaha CX-series technology, this Luxman uses 2× oversampling with a single, shared 16-bit DAC, showing the expected high frequency interchannel phase shift. The frequency response showed the expected mild last-octave 0.4dB peak, but was flat enough elsewhere. Channel balance was reasonable, separation unexceptional, and harmonic distortion below average, deteriorating at low levels and towards the bandwidth extremes. Intermodulation distortion was quite good, and the spectrogram was clean apart from some 25kHz components.

The output impedance was a trifle high, which could give rise to difficulties in direct/passive connection to some power amplifiers. Track access was quite fast, mechanical noise low, and resistance to shock and vibration very good. Error correction and tracking tests posed

no problems and ultrasonic spuriae were well suppressed, but signal-to-noise ratios were a little below average, and low level resolution was an unimpressive 14.5-bits.

Sound Quality

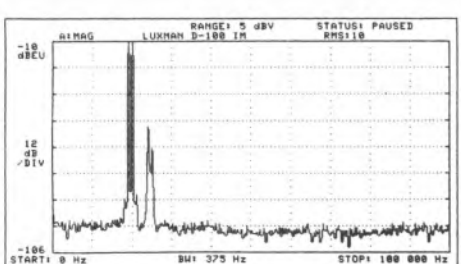
The slightly below average rating for this player is something of a disappointment considering its price, and results from a sound that was considered a trifle old-fashioned, partly reflecting the fact that the *D100* has been on the market for rather longer than most of the machines tested. The treble was slightly defocused, forward and brash, though elsewhere stereo focus was fairly good and depth reasonable. The bass sounded a little 'softened', and the midrange slightly congested, especially on complex material.

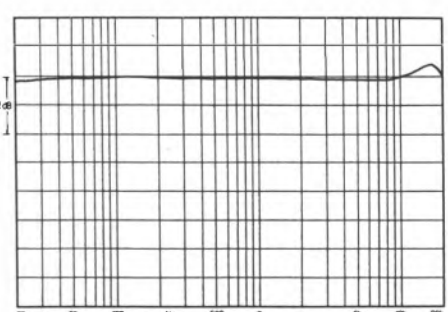
Conclusions

Beautiful presentation and build quality plus simplicity of operation are clear points in favour of the *D-100*. But the lab performance was nothing special, and the listening tests were even less positive, indicating that this particular machine is starting to slip behind the times in view of its quite high price.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.21dB	0.21dB	0.19dB
Stereo separation	90dB	86dB	64dB
Channel phase difference	0°	5°	70°
Total harmonic distortion, 0dB	−68dB	−84dB	−68dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−38dB	—
Total harmonic distortion, −80dB	—	−15.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−89dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−92dB	—
Frequency response, left channel	−0.01dB, 0, −0.83dB		
Frequency response, right channel	0dB, 0, −0.82dB		
Signal-to-noise, 20Hz-20kHz unweighted	93/96dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	88/91dB		
Output level, 0dB, left/right	2.02V		
Output impedance	1.2kohms		
De-emphasis	1kHz, 0.5dB; 5kHz, 4.76dB; 16kHz, 8.82dB		
Track access time	3.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−98dB		
Resolution at −90dB	−84.2/−83.5dB		
Headphone socket	yes (variable output) 50ohms		
Dimensions (w×d×h)	43.6×30×8.5cm		
Estimated typical purchase price	£450		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

BEST BUY

MARANTZ CD273

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE, HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633

Marantz are a subsidiary of Philips, but operate largely autonomously nonetheless as a specialist hi-fi brand, with entirely separate marketing and significant differences between product ranges. The CD players have most in common, and it is possible to establish equivalent models (this *273* being closely related to the Philips *160*), but Marantz have stayed true to their hi-fi roots, specifying components selected for good sound quality and adding modifications of their own in some instances.

Received only just in time for the 1987 edition, this brand new manual control midi-sized Marantz is available in two versions. This review concentrates upon the 'standard' *'273*, priced at a competitive £199, but a *CD273SE* 'special edition' model is also available for an extra £40, identical in overall appearance and facilities but with added UK-sourced 'Eurotweaks' to enhance the sound quality.

The control layout is relatively clean and sensibly laid out, the large and clearly labelled main operating controls (including skip and audible scan) set apart from the less important programming (20 tracks), repeat and display functions. The display itself is quite small, but gives two separate numerical readouts for track number and elapsed or remaining time, and remains uncluttered by machine status LEDs. The presentation is smart with a good standard of finish, though the machine is very light in weight, a little flimsily constructed and plasticky in feel. However, much emphasis is placed on the under the skin engineering, features such as the separate analogue and digital power supplies and twin DACs being rare enough at twice the price.

LAB REPORT

Despite its budget price, this machine has advanced technical features, using twin 16-bit DACs with 4× oversampling, and therefore shows no interchannel phase difference at high frequencies. Indeed the measurement set overall was no less impressive. Response is extremely flat, albeit with a trace of ripple at high frequencies. Channel balance measured very close, channel separation was outstanding, and harmonic distortion pretty good, albeit marred at low levels. Intermodulation distortion was exceptionally low, though the spectrogram does show a few clusters of ultrasonic spuriae.

Track access time was a reasonable 3.5 seconds, mechanical noise was reasonably low, shock and vibration resistance were very good, and error and tracking tests posed no problems. Signal-to-noise figures were exceptionally good, ultrasonic spuriae were quite well under control, and low level linearity was a reasonable 15 bits.

Sound Quality

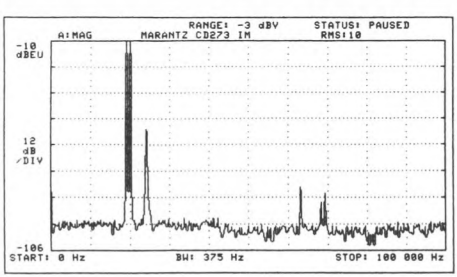
Not only did the '273 provide fine lab measurements for its price, it did very well in the listening tests too. The 'standard' model was rated firmly above average, close to the good category, and praised for its cheerful, lively, open and dynamic sound. There was a touch of treble brightness, but in this respect it was considered slightly cleaner than its sister machine, the Philips 160. Stereo staging was impressive, with good focus, clarity and definition, and decent bass resolution.

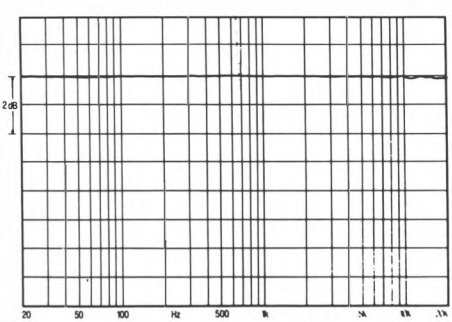
Conclusions

The fine lab performance and listening test results, together with good presentation and ergonomics make a Best Buy rating mandatory for this budget price player. The only minor quibble might be that the build is a little less rugged and operation a little less smooth than some of the competition.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.03dB	0.02dB	0.02dB
Stereo separation	121dB	108dB	98dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−88dB	−84dB	−80dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−42dB	—
Total harmonic distortion, −80dB	—	−14dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−105dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−99dB	—
Frequency response, left channel	0.03dB, 0, −0.03dB		
Frequency response, right channel	0.03dB, 0, −0.03dB		
Signal-to-noise, 20Hz-20kHz unweighted	110/111dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	105/106dB		
Output level, 0dB, left/right	2.1V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.38dB; 5kHz, 4.6dB; 16kHz, 9.1dB		
Track access time	3.5secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	fairly low		
Spuriae up to 100kHz	−86dB		
Resolution at −90dB	−101/−104dB		
Headphone socket	no		
Dimensions (w×d×h)	32×31×8.6cm		
Estimated typical purchase price	£199		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

BEST BUY

MARANTZ CD-273SE

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE, HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633

Received only just in time for the 1987 edition, this brand new manual control midi-sized Marantz is available in two versions. The 'standard' '273 is priced at a competitive £199, but this review concentrates upon the *CD273SE* 'special edition' model which costs an extra £40 and is identical in overall appearance and facilities (barring a pretentiously scripted Special Edition front panel logo), but with added UK-sourced 'Eurotweaks' to enhance the sound quality.

The control layout is relatively clean and sensibly laid out, the large and clearly labelled main operating controls (including skip and audible scan) set apart from the less important programming (20 tracks), repeat and display functions. The display itself is quite small, but gives two separate numerical readouts for track number and elapsed or remaining time, and remains uncluttered by machine status LEDs.

Presentation is smart with a good standard of finish, though the machine is very light in weight, a little flimsy in construction and plasticky in feel. However, much emphasis is placed on the under the skin engineering, features such as the separate analogue and digital power supplies and twin DACs being rare enough at twice the price.

SOUND QUALITY

Eclipsing the high standards set by the standard model, the '*273SE* scored a strong 'good' overall rating — edging towards audiophile territory at a near-budget price! Fine dynamics accompany a clean, coherent and stable stereo image, with good width and depth. The sound was easy and non-fatiguing, tidy and well ordered, with low distortion and pretty good low level resolution. Neutral in balance, the midrange showed less 'muddle' than the standard model.

CONCLUSIONS

One may assume a good lab performance comparable to the standard model. Build quality is quite adequate, finish and presentation good, but the '*SE* is in any case an obvious Best Buy, simply on the basis of fine sound quality versus price.

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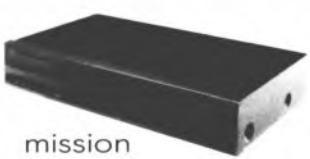

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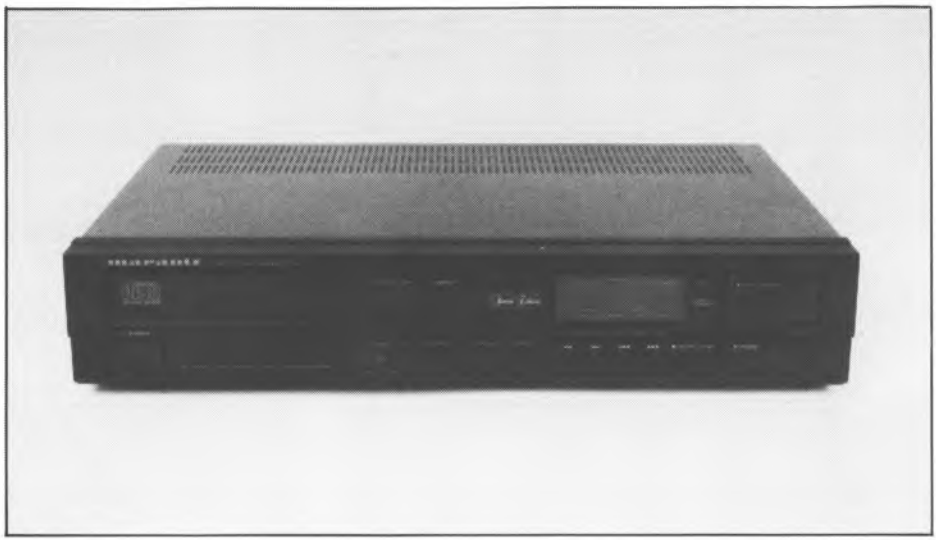
RECOMMENDED

MARANTZ CD65

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE, HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633



In many ways this is a typical mid-priced CD player — black, standard size, standard search and programming facilities, manual control, selling for £380, but in point of fact it is claimed to be the leading seller *via* independent dealers during the pre-Christmas period 1987. There is much in common with the remote-control Marantz *CD75*, and its nearest Philips equivalent is the *CD460*.

Manufactured in the Philips factory in Belgium, it shares much tried and tested common technology with most other Marantz and Philips models, not to mention a number of the players which are modified, branded and marketed by small specialist manufacturers. But Marantz see themselves as hi-fi specialists too — though owned by Philips they operate autonomously to a great extent. They brand and sell only hi-fi equipment and are not in the business of flogging lightbulbs and toasters, so they like to distinguish their models from those of the parent company.

The *CD65*s now sold in the UK have been mildly 'tweaked' to enhance sound quality — a little like the specialist-branded machines though not perhaps to quite the same degree. The technology includes the latest 16-bit 4× oversampling technique, with dual D/A converters giving essentially linear phase, and digital filtering.

SOUND QUALITY

Originally rating above average and falling a little beneath the sonic shadow of the *CD75*, the '65 has now been upgraded to *SE*-type specifications. Still falling a little short of the current '75, the '65 has a similar overall rating as the midi-sized *'273SE*. The high quality Philips 16-bit sound has superior focus, dynamics and treble precision, giving a fine combination of liveliness and neutrality, with good stereo presentation.

CONCLUSIONS

The *CD65* has been improved sufficiently so that this already best selling model still represents fair value for money, well deserving firm recommendation. It is, however, perhaps marginally the weakest in this respect compared with the *'273* and *'75* models.

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BEST BUY

MARANTZ CD75

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE, HARMONDSWORTH, MIDDEX UB7 0LW. TEL: 01-897 6633

This is a typical mid-priced CD player — black, standard size, standard search and programming facilities, with remote control included at £450.

Manufactured in the Philips factory in Belgium, it shares much tried and tested common technology with most other Marantz and Philips models, not to mention a number of the players which are modified, branded and marketed by small specialist manufacturers. But Marantz see themselves as hi-fi specialists too — though owned by Philips they operate autonomously to a great extent. They brand and sell only audio equipment and are not in the business of flogging lightbulbs and toasters, so they like to distinguish their models from those of the parent company.

The CD75s that are sold in the UK market have therefore been mildly 'tweaked' at Marantz UK by changing certain output and power supply capacitor grades, in an attempt to enhance sound quality and give them an edge — a little like the specialist-branded machines though not to the same degree.

The technology includes the latest 16-bit 4X oversampling technique, with dual D/A converters giving essentially linear phase, and digital filtering. This latest chip set has more on board memory and therefore more powerful error correction than earlier models, and indeed those of many competitors.

LAB REPORT

Though there is still a trace of high frequency ripple under great magnification, the frequency response is essentially flat. Channel balance is indicative of normal commercial tolerances, with the twin converters providing zero phase error at high frequencies. Results for harmonic and intemodulation distortion were very good, albeit with some vibration between channels. White noise at 0dB showed slight clipping asymmetry, and resolution at −90dB does show room for improvement.

Error correction is to the highest standards, and the player acquitted itself well on the 'fingerprint' test. The unit is mechanically quiet in operation and behaved itself well under vibration or shock excitation. Track access times

were quite rapid and output met the 2V spec. from a comfortably low source impedance.

Sound Quality

Despite its comparatively modest price, the *CD75* turned in a very fine performance on the listening tests, comfortably beating its '65 sibling and coming close to several highly rated machines costing considerably more. Though falling a little short of the very best in terms of detail and dynamic resolution, the overall balance is particularly finely judged and the limitations very evenly spread. Lacking a little in bass 'speed' and 'weight', depth and space were also slightly curtailed, but the mid/treble balance is sweet, even and open.

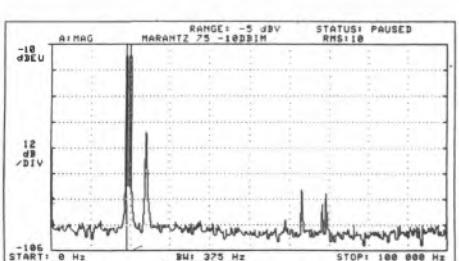
Conclusions

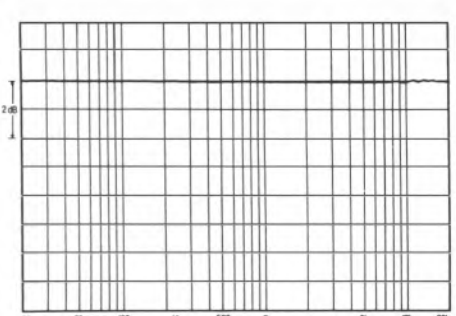
The *CD75* must surely be the best bargain around in CD players at the moment, and it is on this machine that Marantz UK's own special touches appear to have had the most telling effect. Delivering a sound quality that can rival machines twice the price even though it may lack some of their luxury touches, the *CD75* is an obvious Best Buy.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.14dB	0.15dB	0.13dB
Stereo separation	117dB	106dB	103dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−92.7dB	−89dB	−86dB
Total harmonic distortion, −10dB		−83dB	—
Total harmonic distortion, −60dB		−45dB	—
Total harmonic distortion, −80dB		−18dB	—
Intermodulation, 19kHz/20kHz, 0dB			−90dB
Intermodulation, 19kHz/20kHz, −10dB			−92dB
Frequency response, left channel	0	0	−0.09dB
Frequency response, right channel	0	0	−0.08dB
Signal-to-noise, 20Hz-20kHz unweighted			−110dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−104dB
Output level, 0dB, left/right			2.03V
Output impedance			200 ohms
De-emphasis	−0.38dB(1kHz), −4.63dB(5kHz), (−9.1dB(16kHz)		
Track access time			3.5secs
Error correction capability			gap>900μm, dot>800μm
Mechanical noise			very low
Spuriae up to 100kHz			−87.3dB
Resolution at −90dB		L −97.9db, R −108dB	
Headphone socket			variable, 150 ohms
Dimensions (w×d×h)			42×32×8.5cms
Estimated typical purchase price			£450

First reviewed The Collection 1987





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

MARANTZ CD94

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE,
HARMONDSWORTH, MIDDLESEX UB7 0LW. TEL: 01-897 6633

The prestige £800 '94 is completely different in appearance, construction and price from previous Marantz CD players, though the technology at its heart is still fundamentally familiar. It is manufactured in Japan (in what was a Marantz factory before the Philips takeover) and offers deluxe build quality and certain features designed to enhance sound quality. Much of the reason behind the pricetag can be identified by lifting the carton: it is much heavier than other current models because it incorporates a number of expensive metal diecastings in place of the plastics mouldings used extensively in the Hasselt range.

The styling has been carefully arranged to promote ease of use, separating the controls into two groups. The main operational controls (play, stop/pause, skip, open/close, plus FTS select) are to the right and below the quite elaborate display. Subsidiary facilities including a 10-digit keypad and headphone socket are tucked behind a hinged cover, permitting audible scan, repeat, display mode, programming, etc. 'Favourite track selection' (FTS) is a useful feature which enables the machine to store and automatically play preprogrammed track selections from up to 150 or so discs in a collection. The rear panel has sockets for optical and electronic digital data outputs besides normal stereo audio, and the full remote control can be interlinked with other compatible system components.

The extra build quality undoubtedly promotes confidence in use. The main frame and the disc playing chassis are both substantial metal diecastings, with the latter spring-decoupled for vibration suppression. The top cover has been damped and the heatsink at the rear likewise designed to be inherently non-resonant.

LAB REPORT

The internal technology is the familiar Philips 16-bit 4× oversampling, with separate DACs, powerful error correction and digital filtering. Additional attention here is paid to power supplies and audio circuitry, with extra internal screening. The frequency response was ruler flat, with the merest suggestion of HF ripples under our large scale magnification. Channel phase difference was zero due to the twin DACs, while channel balance was held to normal commercial tolerances. Separation and distortion figures were truly outstanding, though the IM spectrogram does show some ultrasonic spuriae.

Error correction was very good on all tests, and resistance to shock or vibration likewise. Mechanical noise was very low, and track access times about average. The output level met the format specification, from a usefully low source impedance. Electrical noise levels were state-of-the-art, but the 0dB white noise test showed slight rounding at the top of the waveform, ultrasonic spuriae could have been lower, and the practical low level resolution was only 15 bits, a rather average result for an expensive machine.

Sound Quality

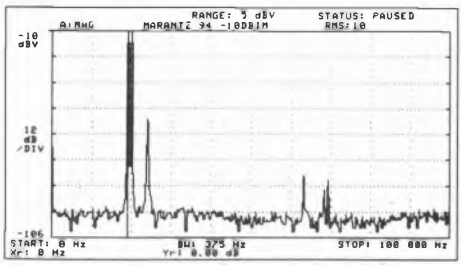
The efforts that have gone into creating this machine have not been wasted, the expense being subtantially vindicated by a very good sound quality rating — rather better than that achieved by Philips with the 960 in point of fact. Retaining the fundamentally fine character of this 16-bit 4× oversampling chip set and losing nothing in dynamics, drama and bass drive, the 94 is also clearly more restrained, refined and good mannered. Giving a dependable sound that is easy to listen to, stereo perspectives were very good and the midband notably neutral, though there was a hint of laziness in the bass and treble.

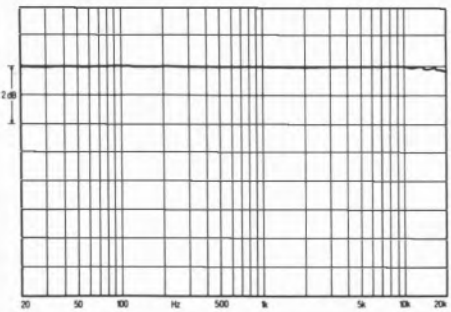
Conclusions

Clearly the best Marantz CD player, the CD 94's high build quality and good objective and subjective performance obviously deserve confident recommendation. The value for money is perhaps not quite in the *CD 75* league, but it is fair to suggest that the far higher build quality of the mechanism in particular should result in a more consistent performance over time and from sample to sample.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.16dB	0.16dB	0.14dB
Stereo separation	101.3dB	110.6dB	112.6dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−92.7dB	−88.7dB	−90dB
Total harmonic distortion, −10dB	—	−84dB	—
Total harmonic distortion, −60dB	—	−50.4dB	—
Total harmonic distortion, −80dB	—	−20.4dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−91.6dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−91dB	—
Frequency response, left channel	+0.01dB, 0, −0.2dB		
Frequency response, right channel	0dB, 0, −0.18dB		
Signal-to-noise, 20Hz-20kHz unweighted	109/108dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	108/106dB		
Output level, 0dB, left/right	2V		
Output impedance	56ohms		
De-emphasis	1kHz, 0.4dB; 5kHz, 4.6dB; 16kHz, 9.3dB		
Track access time	3.5secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−87.1dB		
Resolution at −90dB	−102/−104dB		
Headphone socket	yes (variable output) 207ohms		
Dimensions (w×d×h)	46×36×10.5cm		
Estimated typical purchase price	£800		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

MEMOREX CD 1400

TANDY UK, TANDY CENTRE, LEAMORE LANE, BLOXWICH, WALSALL, WEST MIDLANDS WS2 7PS.
TEL: (09224) 77778

Memorex have a noted track record in tape technology, not to mention magnetic storage in general, but this is the first time we have encountered hardware under their name. In fact the Memorex brand here has little or nothing to do with those tape people, but is now being used by the Tandy Corporation for various hardware items sold through their extensive UK chain of franchised shops, presumably because it has better public awareness than their earlier Realistic brand.

The £230 *CD-1400* is a conventional enough machine of Japanese manufacture, with a simple infra-red remote control covering a fairly basic roster of facilities. Neither midi nor 'maxi' in size, but tending towards the former, the construction is lightweight, with little apparent attention paid to reducing vibration effects, but the manual's description of a 'cushioned' disc tray does make a genuflection in this direction.

Finish is good, the simple ergonomics making it easy and straightforward to use with just the minimum number of buttons to worry about, though the legends do give pause for thought — the aggrandised Automatic Search Music System (ASMS) is simply 'track skip' by another name. Audible scan, index search, 15-track memory play and repeat functions are also provided, and the display has two separate digital readouts plus machine status indicators.

LAB REPORT

The *CD-1400* uses traditional 16-bit linear conversion, with a 'brickwall' filter and single, time-shared DAC, bringing in consequence a significant high frequency interchannel phase shift. The frequency response was a trifle uneven at high frequencies, and mildly recessed around 4-8kHz. Channel balance was very close, and separation was respectable enough, though deteriorating at high frequencies, as was the case with otherwise good harmonic distortion figures. IM distortion was low, and the spectrogram was fairly clean apart from prominent spuriae around 25kHz.

Absolute phase was inverted, and the output level was a little below spec — sufficient to disadvantage this player in A/B comparison if adjustment is not made. Track access time was a reasonable 4 seconds, mechanical noise was moderate, and error correction/tracking tests were handled without problems. Shock and vibration rejection was only average, and the

0dB white noise test showed slight clipping. Electrical noise levels were good, ultrasonic spuriae were well suppressed and low level linearity was a very respectable 15.6-bits.

Sound Quality

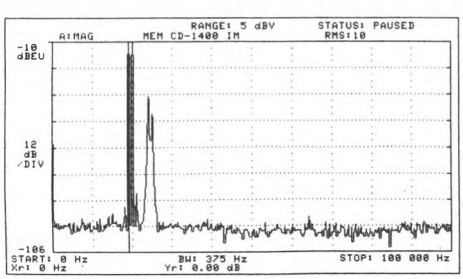
Though rating below average overall, the Memorex by no means disgraced itself. It sounded a little old fashioned in the manner of older 16-bit linear players, against the context of the latest generation of players elsewhere. Mild criticism was made of treble 'swish' and 'brittleness', and a slight loss of detail, clarity and dynamics. The bass was a touch emphasised and slowed, the soundstage showed some flattening of perspective and reductions in stereo depth and width, and the sound seemed better with less taxing, lower level program material.

Conclusions

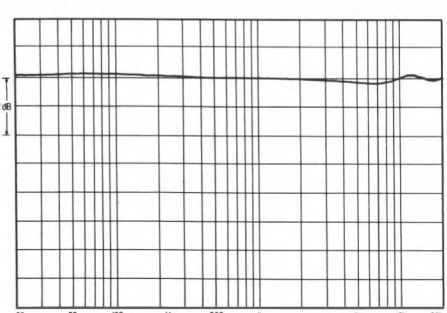
This respectable enough machine showed no particular weakspots and offered a fair complement of facilities for the price, along with the undoubted benefit of Japanese build quality. The lab and subjective performances were both a little below average, so no formal recommendation is appropriate, but that is not to say this model does not offer a fair performance at a fair price.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.04dB	0.04dB	0.07dB
Stereo separation	94dB	93dB	72dB
Channel phase difference	0°	5°	76°
Total harmonic distortion, 0dB	−88dB	−84dB	−62dB
Total harmonic distortion, −10dB	—	−85dB	—
Total harmonic distortion, −60dB	—	−46dB	—
Total harmonic distortion, −80dB	—	−24dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−86dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−91dB	—
Frequency response, left channel	0.17dB, 0, −0.59dB		
Frequency response, right channel	0.17dB, 0, −0.56dB		
Signal-to-noise, 20Hz-20kHz unweighted	96/99dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	91/96dB		
Output level, 0dB, left/right	1.79V		
Output impedance	450ohms		
De-emphasis	1kHz, 0.15dB; 5kHz, −4.3dB; 16kHz, −9.16dB		
Track access time	4.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−104dB		
Resolution at −90dB	−87.1/−88.9dB		
Headphone socket	none		
Dimensions (w×d×h)	37×27×7.1cm		
Estimated typical purchase price	£230		



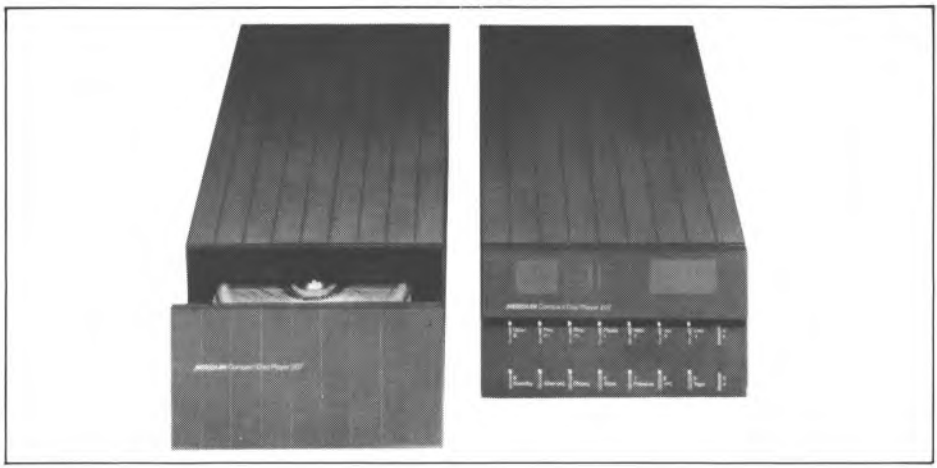
Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



RECOMMENDED

MERIDIAN 207

BOOTHROYD STUART LTD, 13 CLIFTON ROAD, HUNTINGDON, CAMBRIDGESHIRE PE18 7EJ.
TEL: (0480) 57339



After the success of their Philips-derived *MCD* and *Pro-MCD* players, Meridian have gone a substantial step further than most specialists in designing this new *207*. Not only is it indisputably the most elegant looking CD player around, it also has capabilities only matched by B&O in providing full 'round the house' remote operation. And where the earlier MCDs (based on the early Philips 100 chassis) were sparse, the *207* is much better endowed with automatic/programming facilities.

This is a two-box player, consisting of separate transport and electronics sections which can be sited side by side or stacked to taste. A pinstripe motif provides attractive visual distinction which is reflected in the layout of the chassis controls and remote unit. The control keys are straightforward in the main, but contain a shift-key system for less commonly used functions which takes a little learning — this is really just a matter of getting used to a new approach.

This electronics section also contains a simple inbuilt pre-amplifier which provides electronic volume control and switching for two other line level inputs. In this sense the *207* can therefore be connected directly to a power amplifier or a pair of Meridian's active loudspeakers, while also accepting and switching additional signals from tuner and tape sources. Both these functions will be controllable from the optional *209* remote control unit, itself a substantial casting allowing, ultimately, armchair control throughout the house from different independent sources. A more elaborate *201* pre-amplifier is due on the market imminently, providing more sophisticated system control than those available with just the CD player, plus a *204* FM tuner/timeswitch.

The transport section is a Philips' die-cast chassis adapted as a substantially built slide-out drawer system, giving the stacking advantages of a front loader. The metal sleeve and glass front plate provide a measure of acoustic isolation during play, reducing vibration at the disc. Meridian continue to rely upon the 14-bit 4X oversampling technology that they used in the *Pro-MCD*, an approach which they share with several other notable upmarket designs. Considerable care has been taken over the various power supplies needed, separating analogue from digital and running the transport separately as well.

LAB REPORT

Originally measured in pre-production form but giving essentially the same results when a pro-

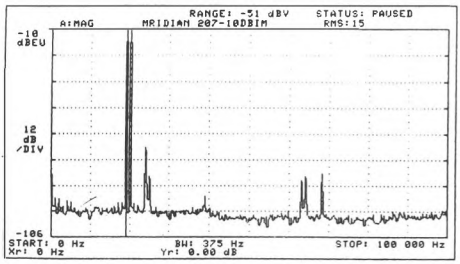
duction model was checked, the frequency response showed a mild, gentle rolloff above 1kHz, amounting to −1.5dB at 20kHz, overlaying the high frequency ripple characteristic of this chip set. Channel balance was very close, with zero HF phase error and fine stereo separation. Distortion results were generally good, while 0dB white noise and −90dB resolution both gave excellent results — 14-bit notwithstanding. Error correction and shock/ vibration sensitivity were very good, while mechanical noise was low. Track access was a reasonable 4secs.

The fixed output met the standard, while the output via the electronic volume control gave up the 9V, both from low source impedances. This volume control showed good channel tracking down to low levels and had a decent law to retain normal 'feel'.

The pre-amp section was also checked out. The line input response showed a sensible HF rolloff to −3dB at 45kHz. Sensitivity was sensible for most sources, though overload margins could have been a little better, and the impedance was a little on the low side, particularly for interfacing some valve eqiupment. Distortion, noise and other measured parameters were all fine.

Sound Quality

Re-auditioned in production form to confirm the fine prototype results, Meridian seem well able to maintain standards. Highly rated on the listening tests, the sound was lively yet without hardness. Depth was considered very good rather than exceptional, and stereo width was marginally less than the best too. The perceived mid-range balance was particularly liked, and the bass was crisp and articulate. The upper treble showed a touch of exaggeration, and transparency and 'air' were a trifle constrained.



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

There was a mild loss of quality when used via the pre-amp section rather than from the fixed output, but this is in the context of a conventional system, where the Meridian may be used to drive active speaker systems directly, providing an effective compensation.

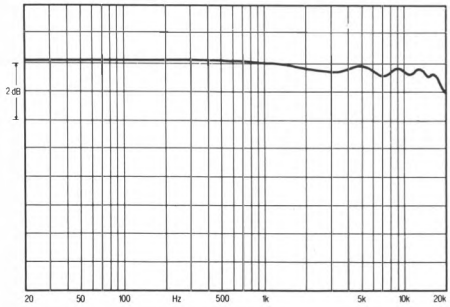
Conclusions

The *207* delivered a sound quality in the very top class, comfortably ahead of more mass produced products and bettered only slightly by significantly more expensive models. Not only arguably the prettiest model around, it is also one of the most capable with its on-board pre-amp, while Meridian's plans indicate that it is future-ready to an unusual degree. Clearly deserving strong recommendation, it is now up to Meridian to make this hitherto scarce model widely available.

Test Results

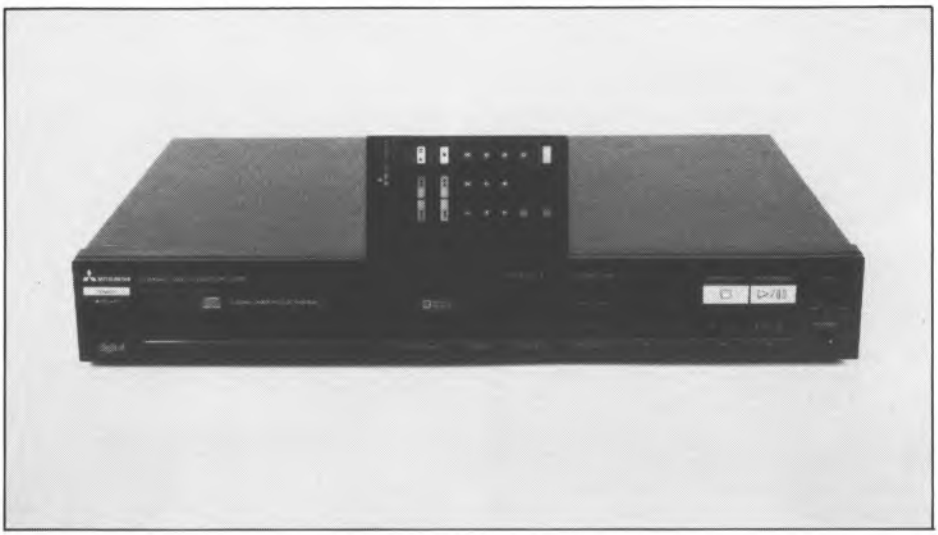
	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.01dB	0.01dB
Stereo separation	120dB	102dB	78dB
Channel phase difference	0	0	0
Total harmonic distortion, 0dB	−91.2dB	−84.3dB	−85dB
Total harmonic distortion, −10dB		82.4dB	—
Total harmonic distortion, −60dB		43.8dB	—
Total harmonic distortion, −80dB		19.7dB	—
Intermodulation, 19kHz/20kHz, 0dB			−86.2dB
Intermodulation, 19kHz/20kHz, −10dB			−86.3dB
Frequency response, left channel	+0.07dB	0	−1.53dB
Frequency response, right channel	+0.07dB	0	−1.48dB
Signal-to-noise, 20Hz-20kHz unweighted			95.5dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−96dB
Output level, 0dB, left/right		2.09V fixed, 9.06V variable	
Output impedance		58ohms fixed, 19ohms variable	
De-emphasis	−0.52dB(1kHz), −5.52dB(5kHz), −9.7dB(16kHz)		
Track access time			4secs
Error corection capability		gap>900, μm dot, >800μ	
Mechanical noise			very low
Spuriae up to 100kHz			−87.6dB
Resolution at −90dB		L −2.02dB, R −4.62dB	
Headphone socket			3.5mm miniature
Dimensions (w×d×h)		(16×38×10)×2 cms	
Estimated typical purchase price			£850

First reviewed The Collection 1987



MITSUBISHI DP209R

MITSUBISHI ELECTRONIC (UK) LTD, HERTFORD PLACE, MAPLE CROSS, RICKMANSWORTH, HERTS WD3 2BJ. TEL: (0923) 770000



There are in fact two *DP209* machines from the Mitsubishi stable, sufficiently similar to share the same instruction manual but distinguished by a couple of luxury trimmings on the £250 '*R* model featured here. Logically adding full infra-red remote control, the '*R* is also equipped with a headphone jack with its own volume control, but in other respects is identical with the standard '209.

This is an unusually slim full-width machine, light in weight and lacking any apparent provision against external mechanical shock. The control surfaces are matt black against a 'lacquer-finish' front panel, with intelligent separation and silver highlighting of the major power, stop and play buttons.

The usual comprehensive display provides a variety of pertinent details regarding the content of the disc and programming of the player. Control functions likewise permit great flexibility of searching, repeating and programming for those prepared to master the manual. The rear panel phono sockets are accompanied by a 7-pin DIN socket offering subcode output against possible future applications.

LAB REPORT

Technically conventional enough, the *209* is a 16-bit 2× oversampling machine with single DAC shared between channels, as shown by the high frequency phase difference. The frequency response looks a trifle odd compared with most CD players. Even allowing that the expanded vertical scale tends to exaggerate anomalies, the steepness of the treble peak is a little alarming. Note also the slightly suppressed lower treble range. Channel balance was close enough, but stereo separation and harmonic distortions both measured a little on the weak side. The intermodulation spectrogram showed components at 25/26kHz, but was commendably clean further up the band.

Both output level and impedance were a trifle on the high side, while high level white noise showed some clipping. Error correction was fine, but vibration and shock resistance were relatively poor. Noise levels and ultrasonic spuriae were both held to low levels, but low level resolution was below average, giving an effective resolution of around 14.5 bits. Taken overall, these results are competent enough, but not particularly inspiring.

Sound Quality

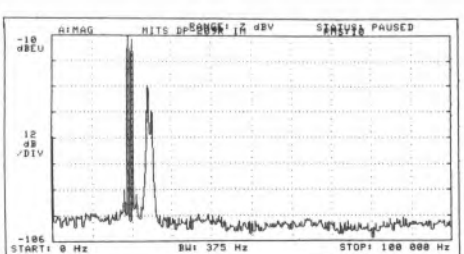
Rating below average overall on the listening tests, the '209 was criticised for possessing a rather 'thin' midrange, and having a 'waspy', 'lispy' effect in the treble. The bass was free from boom, if a touch 'softened' nonetheless. The sound was quite 'busy', with reasonably lively dynamics and quite good focus. The sound stage was somewhat narrowed with mildly curtailed depth, while discrimination of subtle tonality and fine low level detail was considered a little suspect.

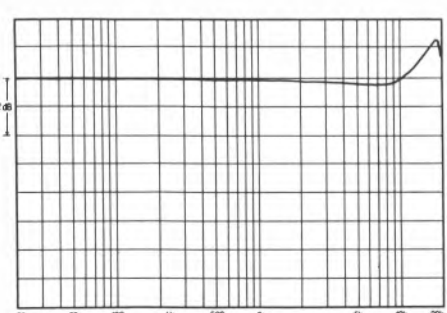
Conclusions

This is a neat package visually and ergonomically, selling at a reasonably competitive price considering the fair range of facilities on offer. Both lab and listening tests gave respectable enough results overall, but neither showed sufficient distinction to single this model out for formal recommendation. Decent enough to merit consideration, the '209 neither impressed nor depressed but is unavoidably rather run-of-the-mill.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.15dB	0.16dB	0.03dB
Stereo separation	77dB	74dB	54dB
Channel phase difference	0°	0°	44°
Total harmonic distortion, 0dB	−81dB	−82dB	−37dB
Total harmonic distortion, −10dB	—	−78dB	—
Total harmonic distortion, −60dB	—	−35dB	—
Total harmonic distortion, −80dB	—	−18dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−82dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−75dB	—
Frequency response, left channel	0.15dB, 0, −1.86dB		
Frequency response, right channel	0.14dB, 0, −2.04dB		
Signal-to-noise, 20Hz-20kHz unweighted	98/102dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	94/97dB		
Output level, 0dB, left/right	2.23V		
Output impedance	1kohm		
De-emphasis	1kHz, −0.17dB; 5kHz, −4.29dB; 16kHz, −7.13dB		
Track access time	5.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−102.4dB		
Resolution at −90dB	−81.5/−81.4dB		
Headphone socket	yes (variable output) 69ohms		
Dimensions (w×d×h)	42.5×28×6.3cm		
Estimated typical purchase price	£250		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

MISSION PCM7000

MISSION ELECTRONICS LTD, STONEHILL, HUNTINGDON, CAMBRIDGE PE18 6ED.
TEL: (0408) 57477

Like other manufacturers relying upon the Philips 16-bit chip set, Mission's *PCM* series were subject to some delay, but eventually reached the shops in Autumn 1986. The two models are both based on the Philips *450/650* chassis, the *4000* logically costing around £400, but the *7000* £600. They are distinguished from the Philips models by an unusually large proprietary display, and from each other by D/A converter selection and complex additional circuitry that includes remote volume control on the more expensive *7000* assessed here.

The extra electronics includes additional power supplies and analogue filtering, plus a special electronic volume attenuator operating in 1dB steps down to −6dB and claimed to sound superior to others of the breed.

The large display may be a little obtrusive for some, but it does at least facilitate remote operation by being easily legible from a distance. And it disappears entirely from view when the machine is switched off, whereupon the machine looks neat and spare, with minimal operating legends. When powered up the display gives comprehensive information in response to the remote control.

The Philips 16-bit *450/650* chassis shows improvements in tracking error processing over earlier models, and continues to use four times oversampling, with digital filtering and dual converters. Mission select the D/As used in the *7000*. The chassis is constructed from plastics mouldings while the optics use a single beam laser.

LAB REPORT

The frequency response showed the expected very mild high frequency rippling and a slight rolloff at very high frequencies, amounting to around 1dB at 20kHz — probably inaudible to many listeners, and possibly marginally beneficial besides. Channel balance was close enough, while high frequency phase difference is eliminated by the dual D/A converters. The variable output degraded stereo separation marginally, but inconsequentially, and showed fine channel balance tracking. Distortion results were good throughout, though 0dB white noise showed a trace of compression and −90dB resolution showed room for improvement.

Error correction is to the highest standards, coping with all the tests with ease and also

proving very good in resisting the effects of shock and vibration. Track access times were adequate enough at 5secs, and mechanical noise was low. Output met the format specification for level and source impedance.

Sound Quality

The *PCM7000* sounded clearly better than its *DAD* predecessor by a substantial margin, but perhaps shows less model-to-model improvements than that achieved elsewhere. The sound was attractively 'bouncy' and dynamic, with good bass 'speed' and a well balanced spacious midrange, but also a touch of treble 'brightness' and 'grain'. Space, 'air' and transparency were all good, though somewhat less than the best, and some slight muddling was also noted.

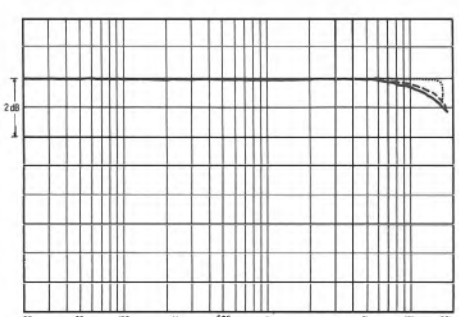
Conclusions

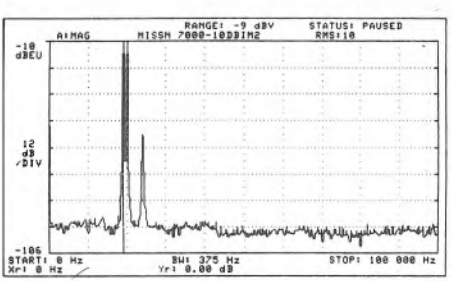
The *PCM7000* is a fine sounding CD player, with some nice ergonomic touches, particularly in the large informative display. Deserving recommendation on the basis of its sound quality alone, it is also true to say that the delays in getting this product to market have dulled its competitiveness a trifle, such is the steepness of the learning curve and rate of progress in CD player design.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.2dB	0.26dB	0.19dB
Stereo separation	103dB	102dB	100dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−92dB	−88.7dB	−85.3dB
Total harmonic distortion, −10dB		84dB	—
Total harmonic distortion, −60dB		−47.1dB	—
Total harmonic distortion, −80dB		−21.6dB	—
Intermodulation, 19kHz/20kHz, 0dB			−90.5dB
Intermodulation, 19kHz/20kHz, −10dB			−82.8dB
Frequency response, left channel	+0.03dB		0 −1.15dB
Frequency response, right channel	+0.02dB		0 −1.01dB
Signal-to-noise, 20Hz-20kHz unweighted			−105dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−100dB
Output level, 0dB, left/right			2.1V
Output impedance			200 ohms
De-emphasis			correct
Track access time			5 secs
Error correction capability			gap>900µm, dot, >800µm
Mechanical noise			low
Spuriae up to 100kHz			−100.6dB
Resolution at −90dB			L −6.8dB, R −10.6dB
Headphone socket			none
Dimensions (w×d×h)			43×32×9cm
Estimated typical purchase price			£600

First reviewed The Collection 1987





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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NAKAMICHI OMS-3E

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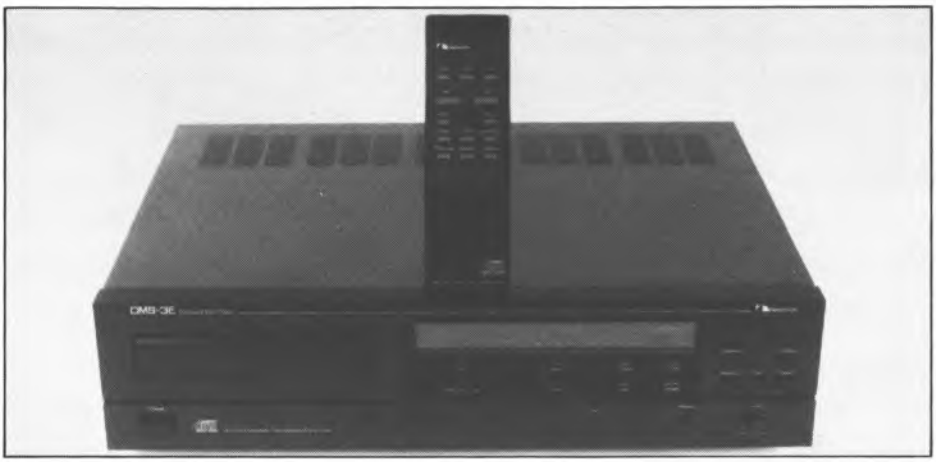

Nakamichi are best known for their legendary cassette decks, which provide an industry reference standard for sound, engineering and build quality — not to mention price. Now they are applying similar standards to CD players: four have recently become available in the UK, priced from £1,000-£2,000, comprising two distinct ranges of two models each. The subject of this review is the cheapest (!) model of all, the £1,000 OMS-*3E*, which is superficially nearly identical to the *4E*, with both featuring 16-bit 2× oversampling. However, certain under-the-skin specification changes have taken place between the models, the '*3E* being slightly lighter, with slightly lower power consumption and slightly inferior detail measurements, indicating some savings being made on the power supply side.

Black and brutal front panel over-engineering is Nakamichi house style, not to mention a highly effective marketing tool, and it is here in full measure, creative strong positive impressions regarding the constructional quality of the unit. The substantial casework is mechanically damped, and the disc transport further isolated from the environment. The '*3E* is a relatively simple machine operationally, and is accompanied by an equally simple remote control unit.

The main driving controls for play, skip and scan are characteristically large and chunky, clearly labelled, and prominently sited beneath a comprehensive display. This has two rather small digital readouts for timings and track numbers, plus a number of machine status LEDs. The remaining program, repeat, and display mode features are switched from a cluster of smaller buttons above the headphone socket and its attendant volume control.

SOUND QUALITY

Only just managing the 'good' category on listening tests, the '*3E* created a good initial impression with a firm dynamic sound, but the treble was regarded as unexceptional and mildly dulled. The stereo showed moderately good focus and depth but a lack of true transparency. Bass showed reasonable drive and power, but the overall sound was significantly behind the '*4E*.

CONCLUSIONS

Despite Nakamichi's legendary build quality and presentation, when sound quality is taken into the equation this expensive machine doesn't quite make the grade. Nakamichi fans need to spend just a little more, and should look at the sister '*4E* model with its improved power supplies more closely.

NAKAMICHI OMS-4E

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Nakamichi are best known for their legendary cassette decks, which provide an industry reference standard for sound, engineering and build quality — not to mention price. Now they are applying similar standards to CD players: four have recently become available in the UK, priced from £1,000-£2,000, comprising two distinct ranges of two models each. The subject of this review is the top model of the cheaper (!) range, the £1,200 *OMS-4E*.

Black and brutal front panel over-engineering is Nakamichi house style, not to mention a highly effective marketing tool, and it is here in full measure, creating strong positive impressions regarding the constructional quality of the unit. The substantial casework is mechanically damped, and the disc transport further isolated from the environment. The *'4E* is a relatively simple machine operationally, and is accompanied by an equally simple remote control unit: there is no calculator-style keypad for direct entry programming on either, but its omission does help to keep the control surfaces uncluttered.

The main driving controls for play, skip and scan are characteristically large and chunky, clearly labelled, and prominently sited beneath a comprehensive display. This has two rather small digital readouts for timings and track numbers, plus a number of machine status LEDs. The remaining program, repeat, and display mode features are switched from a cluster of smaller buttons above the headphone socket and its attendant volume control.

LAB REPORT

Nakamichi's own digital circuitry has similarities to the Philips system, using two separate 16-bit converters with 4× oversampling, with digital and analogue filtering and selected quality components in strategic locations. The frequency response shows a mild and clearly deliberate treble rolloff, but (less excusably for such an expensive unit) some uncorrectable channel imbalances at high frequencies. The overall channel balance also showed some QC limitations, and reflections of this mild asymmetry were seen in the otherwise good distortion and channel separation figures as well. The IM spectrogram showed a reasonable control of ultrasonics.

The output level was somewhat above spec. — to the point where care needs to be taken

to avoid misleading results from listening tests. Track access times were a bit slow, but mechanical noise was very low and shock and vibration rejection very good. Error correction and tracking tests were handled without problems, electrical noise levels were very low, and ultrasonic spuriae were well suppressed. The practical low level linearity was 15.2 -bits — reasonable, but nothing special.

Sound Quality

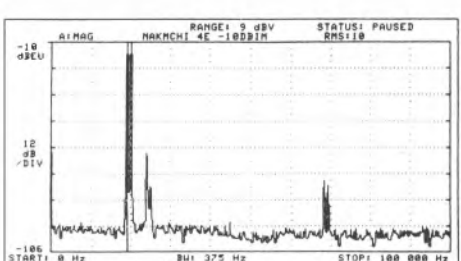
Very good sound quality ratings are rare enough, but the *OMS-4E* qualifies with plenty of room to spare, and clearly represents one of the major benchmarks for sound quality. The treble sounds open and clear, conveying much subtle detail, while the bass is tight and powerful. Dynamics are well conveyed, and the stereo image has fine focus with good width and depth. The midrange sounded just a touch thin, a trifle 'solid state' in character, but this is a great player nonetheless.

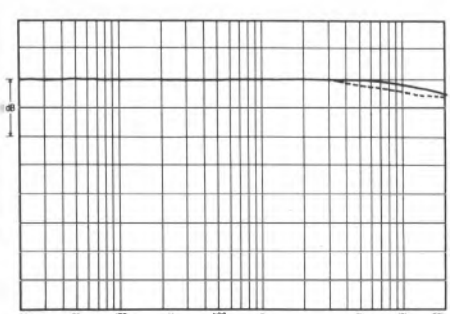
Conclusions

Clearly meriting recommendation on the basis of its exceptional sound quality, this Nakamichi will also be liked for its solid construction and comparative simplicity. Lab performance was very good too, albeit with evidence of room for tighter quality control, but on the evidence of this player in particular Nakamichi are a force to be reckoned with for those seeking the ultimate CD player.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.44dB	0.45dB	0.25dB
Stereo separation	113.2dB	102.9dB	72.4dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−88.9dB	−90dB	−86.4dB
Total harmonic distortion, −10dB	—	−88.5dB	—
Total harmonic distortion, −60dB	—	−43.8dB	—
Total harmonic distortion, −80dB	—	−23.9dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−89.6dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−92.9dB	—
Frequency response, left channel	0.01dB, 0, −0.6dB		
Frequency response, right channel	0.01dB, 0, −0.4dB		
Signal-to-noise, 20Hz-20kHz unweighted	103/97dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	97/92dB		
Output level, 0dB, left/right	2.65V		
Output impedance	228ohms		
De-emphasis	1kHz, 0.32dB; 5kHz, 4.4dB; 16kHz, 8.9dB		
Track access time	6.5secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−108.2dB		
Resolution at −90dB	−87.1/−83.9dB		
Headphone socket	yes (variable output) 150ohms		
Dimensions (w×d×h)	43×35×11.5cm		
Estimated typical purchase price	£1200		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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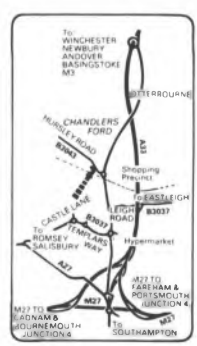

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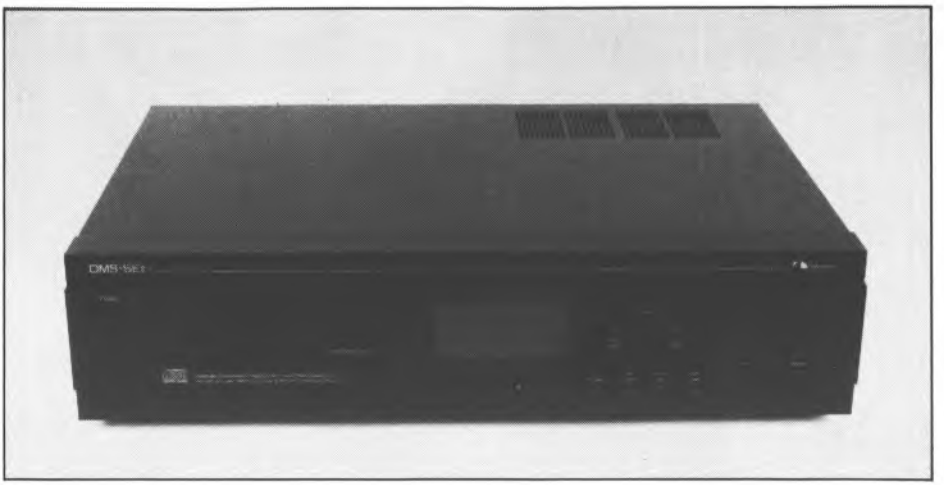

Nakamichi are best known for their legendary cassette decks, which provide an industry reference standard for sound, engineering and build quality — not to mention price. Now they are applying similar standards to CD players: four new models have recently become available in the UK, priced from £1,000-£2,000, comprising two distinct ranges of two models each. The subject of this review is the cheaper (!) model of the more expensive range. The £1,500 *OMS-5EII* is fitted with the 'flagship' internals of the 4× oversampling *'7EII* but in a much simplified and less well equipped package. It lacks the luxury of even the simple remote control afforded the cheaper *'3E* and *'4E* models, not to mention the track-programming facilities of the humblest midi CD player, Nakamichi here making a positive virtue out of simplicity.

Black and brutal front panel over-engineering is Nakamichi house style, not to mention a highly effective marketing tool, and it is here in full measure, creative strong positive impressions regarding the constructional quality of the unit. The substantial casework is mechanically damped, and the disc transport further isolated from the environment. The main driving controls for play, skip and scan are prominently sited beside a comprehensive display. This has two rather small digital readouts for timings and track numbers, plus a number of machine status LEDs. The sole remaining facilities provide display mode switching and simple repeat.

SOUND QUALITY

Just reaching a 'very good' rating, the *OMS-5EII* is another good-sounding Nakamichi deck, closely resembling and not far behind the flagship *'7EII*, but also lagging a little behind the cheaper *'4E* under our listening conditions. Highly competent, stereo images were well constructed, with clear, unambiguous focus, good stage width and fine depth. The bass had extension, power and 'scale'; the midband was detailed if a trifle forward; the treble was well above average, if not in the highest class, with slight sibilant and grainy effects.

CONCLUSIONS

This is another good Nakamichi deck, delivering near state-of-the-art performance and build quality in a deliberately starkly functional package, but at a very high price which reduces its competitiveness somewhat. A good performer without any doubt, the *'5EII* is still overshadowed by the cheaper *'4E*.

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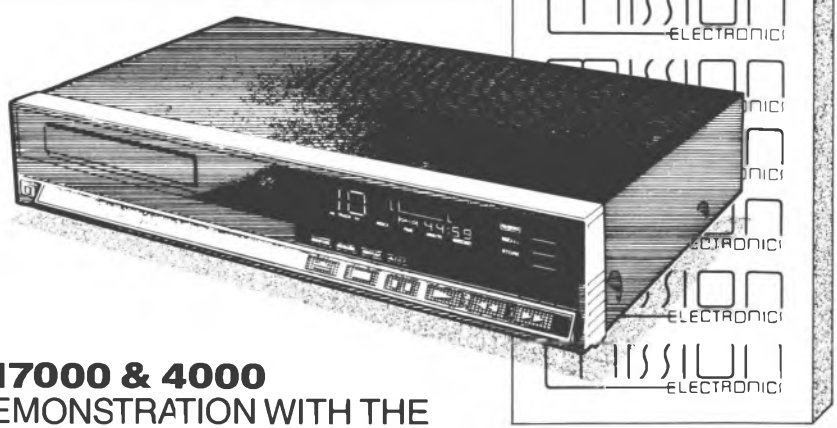

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Nakamichi are best known for their legendary cassette decks, which provide an industry reference standard for sound, engineering and build quality — not to mention price. Now they are applying similar standards to CD players: four new models have recently become available in the UK, priced from £1,000-£2,000, comprising two distinct ranges of two models each. The £2,000 *OMS-7EII* of this review is the top model of the more expensive range, with 'flagship' dual 16-bit 4× oversampling technology in a rather elaborate package of features and facilities, including full keypad remote control.

Black and brutal front panel over-engineering is Nakamichi house style, not to mention a highly effective marketing tool, and it is here in full measure, creating strong positive impressions regarding the constructional quality of the unit. The substantial casework is mechanically damped, and the disc transport further isolated from the environment. The main driving controls for play, skip and scan are prominently sited beside a comprehensive display. This has two rather small digital readouts for timings and track numbers, plus a number of machine status LEDs. The right hand end of the unit bristles with buttons, comprising a 10-digit track entry keypad, plus programming, time display and repeat functions. A headphone jack with its own volume control is also fitted.

SOUND QUALITY

This very expensive CD player at least made a serious attempt to justify its price with appropriate sound quality, comfortably rating 'very good' overall, though it did not quite achieve the same overall standard as its cheaper *OMS-4E* stablemate, one of our leading references. The sound is open, firm and clear, with fine detail resolution, good depth, width and focus. The bass is solid with good extension, the treble detailed but just a touch untidy — vocals showed a mild tendency to 'spitch'. Dynamics were generally good, but there was a touch of graininess in the upper mid and treble.

CONCLUSIONS

The only really serious criticism of this excellent CD player is its exceptionally high price. Build quality, features and sound quality are all in the top class, but the sound may be bettered for less money elsewhere in Nakamichi's range in our opinion.

RECOMMENDED

PHILIPS CD150BH

PHILIPS ELECTRICAL LTD, CITY HOUSE, 420-430 LONDON ROAD, CROYDON, SURREY CR9 3QR.
TEL: 01-689 2166

This budget Philips machine comes with a remarkable £180 price tag, and employs a powerful set of integrated circuits offering 16 bit resolution via the Philips 14 bit four times oversampled scheme, noted for its good sound quality.

With the *CD150*, Philips have decided to join the Japanese in offering a slim, midi-sized machine with a fast front loading mechanism and the now familiar array of push buttons. Audible music cueing is also provided at two speeds, with track skip and comprehensive track programming. The basic deck is described as 'remote ready' and the infra-red hand control can be added at any time, at an extra cost of £40 or so. Another rear panel facility connects to the matching Philips midi system providing a centralised system remote facility.

Like the Far Eastern competition, the *'150* also has a fluorescent display, rather larger than the pea sized version fitted to the earlier Philips machines. Track numbers and timings may be displayed, with tracks entered for programming via successive key entries, and the data is acquired quickly. The audio output is at standard level from the usual nickel plated phono sockets. At best, the Philips owner can make his own choice of interconnect.

As regards its construction, the *'150* feels rather lightweight, with extensive use of plastic mouldings. Conversely, its construction is quite accurate. The number of printed circuits has also been reduced, and a new laser head has been fitted. This and the new central circuitry are jointly responsible for the decent track access speed shown, an improvement on previous Philips models.

LAB REPORT

Despite lower prices and a new chip set, the full Philips CD player performance has been broadly maintained in this budget model. The fine frequency response shown here will be familiar to regular readers, its characteristic mild high frequency ripples generally felt to be subjectively harmless. Limits of ±0.2dB sufficed for the whole range while excellent results were also obtained for channel separation; for example, 108dB was quite typical. With the use of dual D/A converters, interchannel phase shift was essentially zero.

On harmonic distortion at full level it measured very well, this including the in-band

products of 20kHz, at an excellent −88dB. Good linearity was shown at lower signal levels, though by −60dB there was evidence of wide-band hum modulation — probably mild supply ripple on the D/A converter lines. In consequence the distortion at −80dB was a little higher than average with a −90dB level error of around +5dB. The practical resolution was estimated to be 15¼ bit. Fine results were obtained for intermodulation distortion at both test levels. With a standard 2V output, its source impedance was low at 200 ohms. Track access times were fairly rapid, mechanical noise was quite low and no problems were encountered with respect to error correction. The usual exemplary signal to noise ratios were obtained.

Sound Quality

Scoring above average, and thus doing very well at the price, the *CD150* rewarded us with a fine standard of bass precision and power. Mid definition was very good though tonally speaking the mid was a touch lean and thin, presented a little forward in the stereo image. The latter was well focused and stable with respectable depth and above average transparency. The treble also attained a good standard.

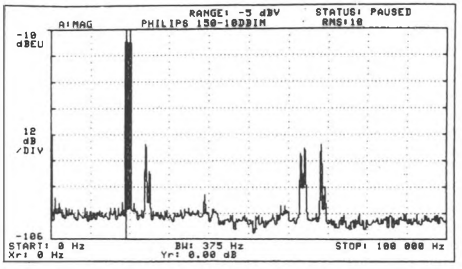
Conclusions

Philips have brought their classic CD sound down to a bargain price level, and despite its 'plastic' feel, the *CD150* was one of our favourite budget players in 1986, and still maintains confident Recommendation by 1987 standards.

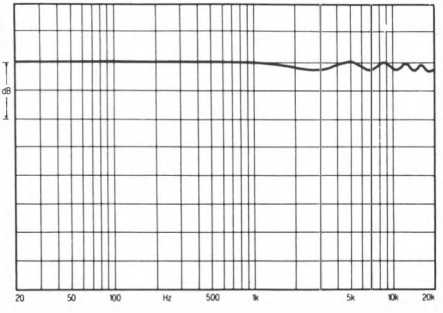
Test Results

	20Hz	1kHz	20kHz
Channel balance	0.02dB	0.02dB	0.05dB
Stereo separation	−108.6dB	−111.8dB	−108.2dB
Channel phase difference	0°	0°	1°
Total harmonic distortion, 0dB	−89.5dB	−90.4dB	−87.5dB
Total harmonic distortion, −10dB	—	−83.6dB	—
Total harmonic distortion, −60dB	—	−42.0dB	—
Total harmonic distortion, −80dB	—	−21.9dB	—
Intermodulation, 19kHz/20kHz, 0dB			−85.8dB
Intermodulation, 19kHz/20kHz, −10dB			−88.0dB
Frequency response, left channel			+0.04dB, −0.50dB
Frequency response, right channel			+0.04dB, −0.42dB
Signal-to-noise, 20Hz-20kHz unweighted			−98dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−115dB
Output level, 0dB, left/right			2.0V
Output impedance			200ohms
De-emphasis			correct
Track access time			4.5secs
Error correction capability			>800µm gap, >800µm dot
Mechanical noise			very low
Spuriae up to 100kHz			−72.5dB
Resolution at −90dB			left +4.0dB, right +4.89dB
Headphone socket			no
Dimensions (w × d × h)			32 × 30 × 8.5 cm
Estimated typical purchase price			£180

First reviewed 1986



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



BEST BUY

PHILIPS CD 160

PHILIPS ELECTRICAL LTD, CITY HOUSE, 420-430 LONDON ROAD, CROYDON, SURREY, CR9 3QR.
TEL: 01-689 2166

Philips have capitalised on their position as co-inventors of the CD medium to re-establish themselves in the hi-fi marketplace, by means of a succession of standalone players whose main distinguishing feature has been a high quality sound at a competitive price. Whereas most other consumer electronic brands update complete ranges on a more-or-less annual cycle basis, Philips introduce items piecemeal, often adjusting relative prices at the same time, so that the range gradually evolves from month to month. It therefore becomes a little confusing to keep track.

The *CD 160* (and the identical remote control *'260*) are the middle models of the midi-size players, and belong to the same technology generation as the full size *'460*, with 16-bit dual DACs and 4X oversampling. There is no longer any price saving in going midi, but the *'160* nevertheless sells at a 'budget' £200, and offers most of the usual basic features with an optional add-on remote if desired.

The control layout is relatively clean and sensibly laid out, the large and clearly labelled main operating controls (including skip) set apart from the rather scattered scanning, programming (20 tracks), repeat and display function controls. The display itself is quite small, and is rather cluttered by machine status LEDs. The presentation is smart with good finish, but the machine is a little flimsy in construction and plasticky in feel.

SOUND QUALITY

Rating firmly above average despite its budget price, the *CD160* represents a worthwhile sonic improvement on the earlier but nonetheless respected *CD150B*. The *'160* sounds clearer, with better focus, higher definition and more convincing bass. The treble has a touch of brightness — a slight defocusing with a wispiness and zing in the high treble — but it is dynamic, cheerful and lively, with an attractive, open sound that was generally well received.

CONCLUSIONS

Though mildly overshadowed by the now similarly priced *'460*, and the slightly more expensive *'360*, the *CD-160* is still a Best Buy model, particularly for those who place sound quality ahead of a slightly plasticky build quality in their order of priorities.

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PHILIPS CD460

PHILIPS ELECTRICAL LTD, CITY HOUSE, 420-430 LONDON ROAD, CROYDON, SURREY CR9 3QR.
TEL: 01-689 2166

Philips have capitalised on their position as co-inventors of the CD medium to re-establish themselves in the hi-fi marketplace, by means of a succession of standalone players whose main distinguishing feature has been a high quality sound at a competitive price. Whereas most other consumer electronic brands update complete ranges on a more-or-less annual cycle basis, Philips introduce items piecemeal, often adjusting relative prices at the same time, so that the range gradually evolves from month to month. It therefore becomes a little confusing to keep track.

The '460 is Philips' mainstream full size machine. From the same generation as the midi '160, it was the model in which they first introduced the 16-bit 4× oversampling circuitry. But the subsequent arrival of the FTS-equipped remote-control '360 brought a recent substantial price cut to £200 for the '460 (remote here is an optional extra).

Like the midi machines, build quality is adequate rather than luxurious, but unlike the midis the control layout is rather bitty. The facilities are the normal standard collection of skip, scan, repeat, and 20-track programming, with a limited single 4-digit multi-function display.

SOUND QUALITY

In the wake of its recent significant price cut, the '460 gives even more exceptional sound quality for the money, undermining many more expensive models with a 'good' overall rating. The sound is lively and dynamic, with an open, well-focused image and respectable depth and perspectives. Clear and uncomplicated with a pretty firm and rhythmic bass, the midrange was a touch 'lean' but not hard, while the treble was mildly defocused with some coarseness and brittleness.

CONCLUSIONS

This is a clear Best Buy model. It is amongst the best sounding and least expensive of current budget players, and full width to boot, with the only minor criticisms relating to a rather 'plasticky' build quality compared to the best oriental standards, plus some room for improvement in the ergonomics.

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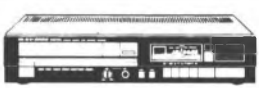

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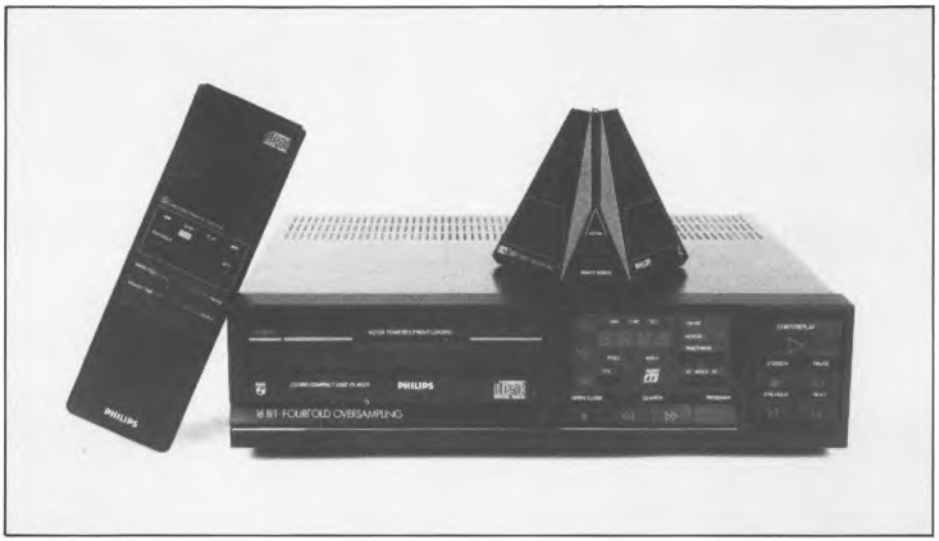
BEST BUY

PHILIPS CD360

PHILIPS ELECTRICAL LTD, CITY HOUSE, 420-430 LONDON ROAD, CROYDON, SURREY CR9 3QR.
TEL: 01-689 2166



Philips have capitalised on their position as co-inventors of the CD medium to re-establish themselves in the hi-fi marketplace, by means of a succession of stand-alone players whose main distinguishing feature has been a high quality sound at a competitive price. Whereas most other consumer electronic brands update complete ranges on a more-or-less annual cycle basis, Philips introduce items piecemeal, often adjusting relative prices at the same time, so that the range gradually evolves from month to month. It therefore becomes a little confusing to keep track. Writing in Spring 1987 the *CD360* is the top model of three midi-size players; is one of the most recent introductions to the range, using the latest simplified board construction techniques; and is modestly priced at £250 for a full-feature remote-control player.

Sharing the same basic chassis as the *CD160*, the *360* adds two thoroughly desirable extra features: a limited function remote control (an outboard item available as an optional extra on other midi players), and the rather clever FTS (favourite track selection) facility. FTS allows the user to store permanently an order of play programme for any or all of the discs in his collection (up to a couple of hundred), the machine automatically identifying the disc and executing the stored programme when FTS is selected.

The control layout is relatively clean and sensibly laid out, the large and clearly labelled main operating controls (including skip) set apart from the rather scattered scanning, programming (20 tracks), repeat and display function controls. The display itself is quite small, and is rather cluttered by machine status LEDs. The presentation is smart with good finish, but contruction is a little flimsy and plasticky in feel. The rear panel had a digital output as well as conventional stereo audio.

LAB REPORT

Despite the budget price and construction, this machine has advanced technical features. It uses the latest twin 16-bit DACs with 4× oversampling, and so has no interchannel phase difference at high frequencies. Indeed, overall the measurements were very impressive. Response is extremely flat, albeit with a trace of ripple at high frequencies. Channel balance measured very close, channel separation was outstanding, and harmonic distortion very good,

albeit marred by a channel imbalance at low levels. Intermodulation distortion was exceptionally low, though the spectrogram does show a few clusters of ultrasonic spuriae.

Track access time was a reasonable 4 seconds, mechanical noise was very low, shock and vibration rejection were excellent, and error and tracking tests posed no problems. The 0dB white noise test did reveal some rounding at the top, and very slight rounding at the bottom of the waveform. Signal-to-noise figures were exceptionally good, and ultrasonic spuriae were quite well under control. However, low level resolution on our sample was a disappointing 14 bits.

Sound Quality

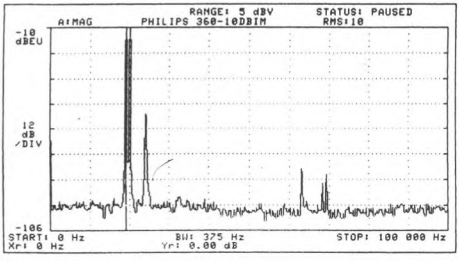
Despite their apparent physical similarities, the *360* sounded significantly better than the still highly rated *160*, turning in a 'good' rating overall which is quite remarkable for the price. This is probably due to the simplified construction of this more recent model. To a basically attractive, lively and open sound, a the *360* adds better dynamics, a firmer clearer bass, a more sharply defined and located treble with less untidiness besides, plus general improvements in stereo imagery and ambience resolution, and less muddle.

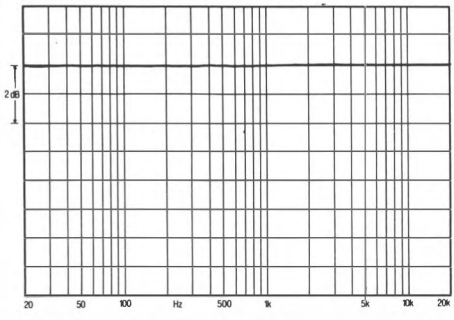
Conclusions

The fine lab performance and exceptional listening test results, together with good presentation and the attractive FTS feature make a Best Buy rating mandatory for this modestly priced midi machine. This is a lot of plastic player for the money.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.05dB	0.05dB	0.05dB
Stereo separation	119dB	106dB	99dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−93.2dB	−86.4dB	−86.8dB
Total harmonic distortion, −10dB	—	−83.4dB	—
Total harmonic distortion, −60dB	—	−47.6dB	—
Total harmonic distortion, −80dB	—	−21.2dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−94.3dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−94.9dB	—
Frequency response, left channel	0dB, 0, −0.03dB		
Frequency response, right channel	0dB, 0, −0.03dB		
Signal-to-noise, 20Hz-20kHz unweighted	111/110dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	108/105dB		
Output level, 0dB, left/right	2.15V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.38dB; 5kHz, 4.6dB; 16kHz, −9.1dB		
Track access time	4.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−87.1dB		
Resolution at −90dB	−94.9/−107.2dB		
Headphone socket	no		
Dimensions (w×d×h)	32×30.5×9cm		
Estimated typical purchase price	£249		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

ECOMMENDED

PHILIPS CD960

PHILIPS ELECTRICAL LTD, CITY HOUSE, 420-430 LONDON ROAD, CROYDON, SURREY CR9 3QR.
TEL: 01-689 2166

Brand new for 1987, the remote-control *CD960* is completely different in appearance, construction and price from Philips' previous CD players, though the technology at the heart of this prestige player is still fundamentally familiar. It is manufactured in Japan at a factory which Philips acquired when purchasing Marantz some years ago, and is conceived as a new 'flagship' for their audio range, offering deluxe build quality and certain features designed to enhance sound quality. A *CD94* Marantz equivalent shares many components, but differs significantly in cosmetics and has other component changes.

Much of the reason behind the £700 pricetag can be identified by lifting the carton. It is much heavier than other current Philips' and incorporates a number of expensive metal diecastings in place of the plastics mouldings used extensively in the Hasselt range.

Out of the box, the styling has been carefully arranged to promote ease of use, separating the controls into three groups. The main operational controls are on the vertical front panel, secondary facilities are placed on an angled ledge which is distinctly reminiscent of Aiwa's cassette decks, and compulsive button pushers can access a sliding drawer which provides still further program/timing complexities. The only disadvantage of this layout is the tendency of ledges to accumulate dust.

Special features include full remote control which can be interlinked in the future with other compatible system components, optical and electronic digital data outputs, and Philips' 'favourite track selection' (*FTS*), which enables the machine to play any of the discs in a collection in any permanently stored pre-programmed track order of so desired.

The extra build quality undoubtedly promotes confidence in use. The main frame and the disc playing chassis are both substantial metal diecastings, with the latter spring-decoupled for vibration suppression. The top cover has been damped and the heatsink at the rear likewise designed to be inherently non-resonant. The internal technology is the familiar Philips 16-bit 4X oversampling, with separate D/A converters, powerful error correction and digital filtering. Additional attention here is paid to power supplies and audio circuitry, with extra internal screening.

Lab Report

The frequency response was ruler flat, with the merest suggestion of HF ripples under large scale magnification. Channel phase difference was zero due to the twin D/A converters, while channel balance was held to normal commercial tolerances. Separation and distortion figures were truly excellent, and −90dB resolution was also good, but there was slight asymmetric compression with 0dB white noise.

Error correction was very good on all tests, and resistance to shock or vibration was excellent. Mechanical noise was very low, and track access times about average. The output level met the format specification, from usefully low source impedance.

Sound Quality

The listening tests confirmed the success of Philips' efforts in improving the sound over their standard — already good — players. The rating was only bettered by a handful of 'audiophile' models, reflecting significant improvements in dynamics and control. Bass was powerful and dynamic, albeit a trifle softened at the extreme low end, while the midrange was pure and relaxing, showing good depth, convincing perspectives and no gain. The treble sounded unforced, the generally fine string tone accompanied by slight 'sheen'

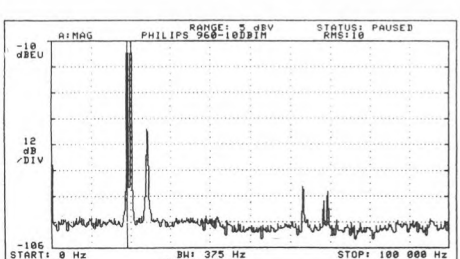
Conclusions

This new Philips machine has fine build quality and presentation, with excellent 'graded' ergonomics that were simple to use. The lab results were exemplary, with no sign of weakness, while the sound quality improvements over Philips' 'mainstream' models more or less justifies its premium price. The machine as a whole is very satisfying and well balanced, deserving recommendation.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.13dB	0.12dB	0.05dB
Stereo separation	107dB	110dB	120dB
Channel phase difference	0	0	0
Total harmonic distortion, 0dB	−92.4dB	−89.6dB	−85.9dB
Total harmonic distortion, −10dB		−81.4dB	—
Total harmonic distortion, −60dB		−49.8dB	—
Total harmonic distortion, −80dB		−24.1dB	—
Intermodulation, 19kHz/20kHz, 0dB			−93.9dB
Intermodulation, 19kHz/20kHz, −10dB			−92.3dB
Frequency response, left channel	0	0	0
Frequency response, right channel	0	0	−0.1dB
Signal-to-noise, 20Hz-20kHz unweighted			110dB
Signal-to-noise, CCIR/ARM, 1kHz ref			108dB
Output level, 0dB, left/right			2.1V
Output impedance			56 ohms
De-emphasis	−0.4dB(1kHz), −4.7dB(5kHz), −9.3dB(16kHz)		
Track access time			3.5secs
Error correction capability			>900µm dot, >800µm
Mechanical noise			very low
Spuriae up to 100kHz			−87.4dB
Resolution at −90dB			L−93.5dB, R−94.7dB
Headphone socket			variable (207ohms)
Dimensions (w×d×h)			42×38×10cm
Estimated typical purchase price			£700

First reviewed The Collection 1987



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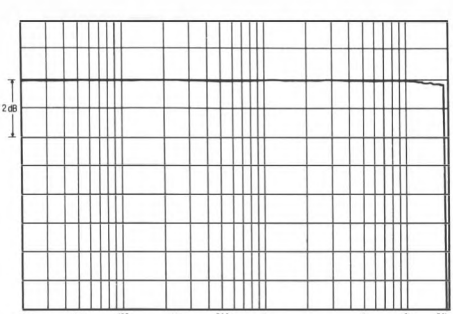
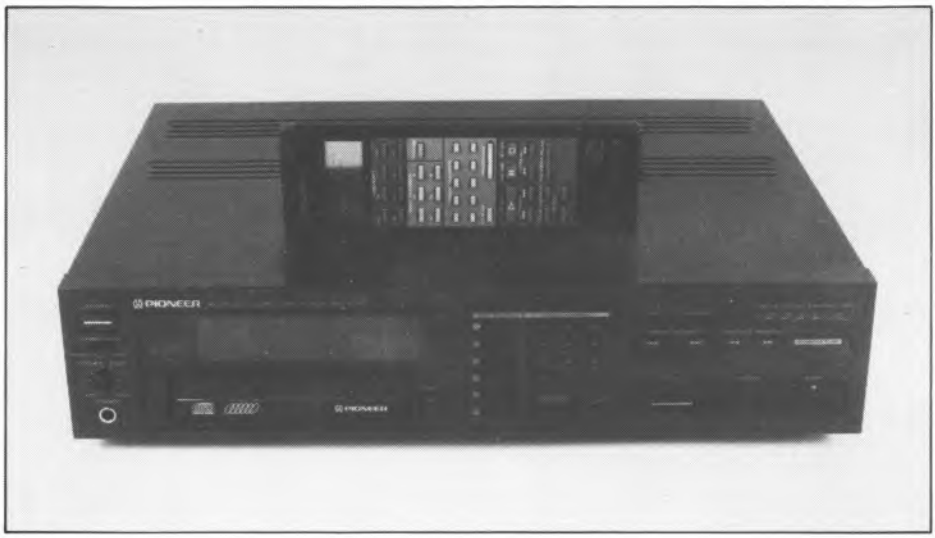


PIONEER PD-M70

PIONEER HIGH FIDELITY GB LTD, FIELD WAY, GREENFORD, MIDDX UB6 8UZ.
TEL: 01-575 5757



Living up to their name, Pioneer were one of the originators of the magazine-loading CD autochanger, an approach that takes particular advantage of the capabilities of the new medium, allowing up to six hours of continuous pre-programmed music (for insomniacs?).

The *PD-M70* reviewed here is in many senses a development of the *PD-M6* tested last year, still using a time-shared single DAC with 2× oversampling and a price now up to £399. It is supplied with two loading magazines, one of which takes up to six CDs at a time, the other a single disc for convenient single-play. Features include a complex remote control handset that has its own LCD display, plus the ability to store up to eight programmes in memory and operate a coarse digital volume control with 24dB overall range.

The wide range of programming functions result in some inevitable complexity, but separate keypads cover disc and track selection on both machine and remote, which helps. Additional functions include an 'accumulated time' which tots up the total playing time being programmed, on board timer start, plus genuine 'random play' or 'random program play'.

The player is substantially built, avoiding unwanted vibration effects with a honeycomb structured chassis. The front panel has a headphone jack with volume control while the rear has good quality phono sockets plus a subcode output.

LAB REPORT

Despite the intervening year's technical evolution, the *M70*'s lab performance closely paralleled its predecessor. The frequency response shows a similar flatness with slight high frequency ripple, while channel balance, separation and the various measured distortions were all very good. The IM spectrogram showed an almost identical pattern to the earlier machine, albeit some 20dB poorer on the 25kHz spuriae.

Mechanical noise levels were low, but the autochanger mechanism inevitably resulted in rather longer track access times than most. The response to mechanical shock and vibration was only average, but error correction tests were passed without problems. Noise was low, ultrasonic spuriae were well suppressed, but low level linearity, at around 15.1 bits, could have been improved.

Sound Quality

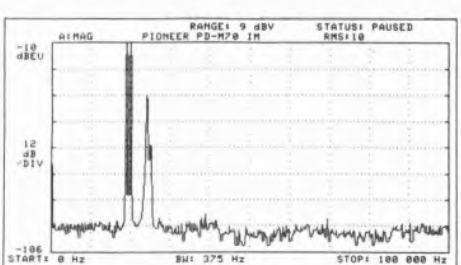
Keeping up with the steadily improving standards of commercial CD players, the *M70* rated average overall, tending towards the plus side. Delivering a solid and competent performance, the sound was a little heavy in the bass but generally tidy overall. Image depth was considered pretty good, though there was some narrowing of the soundstage and masking of low level detail. A mild degree of congestion was noted at high levels, and some listeners considered the sound a trifle uninvolving overall.

Conclusions

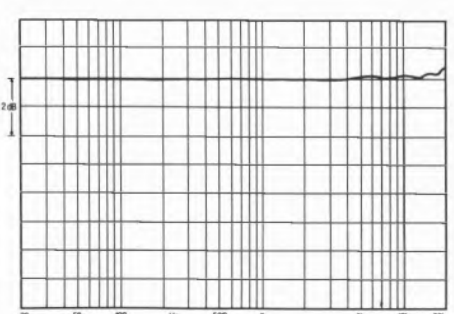
Though the *M70* doesn't entirely justify its price on sound quality grounds alone, it does deliver a decent standard of lab and subjective performance while at the same time incorporating a remarkable catalogue of features to justify its price premium, notably the autochanger and sophisticated remote control. Falling a shade short of formal recommendation, it is clearly worth considering for those who will make extensive use of the multi-play option.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.12dB	0.11dB	0.06dB
Stereo separation	106dB	101dB	83.5dB
Channel phase difference	0°	0°	40°
Total harmonic distortion, 0dB	−82.5dB	−82dB	−83dB
Total harmonic distortion, −10dB	—	−84dB	—
Total harmonic distortion, −60dB	—	−48dB	—
Total harmonic distortion, −80dB	—	−22.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−94dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−97dB	—
Frequency response, left channel	−0.79dB, 0, −0.21dB		
Frequency response, right channel	−0.81dB, 0, −0.16dB		
Signal-to-noise, 20Hz-20kHz unweighted	99/101dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	92.5/94.5dB		
Output level, 0dB, left/right	2.28V		
Output impedance	925ohms		
De-emphasis	1kHz, 0.28dB; 5kHz, −4.51dB; 16kHz, −9.14dB		
Track access time	8.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−104dB		
Resolution at −90dB	−95.8/−98dB		
Headphone socket	yes (variable output) 120ohms		
Dimensions (w×d×h)	42×32×10.5cm		
Estimated typical purchase price	£399		

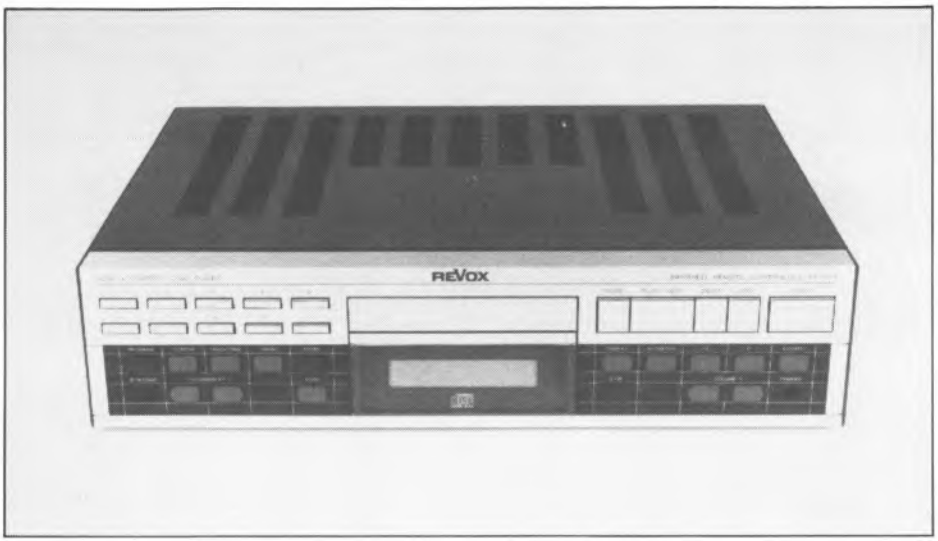


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



REVOX B226

F.W.O. BAUCH LTD, 49 THEOBALD STREET, BOREHAMWOOD, HERTS WD6 4RZ.
·———TEL: 01-953 0091———·



The new Revox *B226* CD player fully lives up to the high standards of design and finish that are the hallmarks of this luxury European brand. Superficially it is almost identical to its '225 predecessor, and is again based on Philips technology, but in this case it uses the latest 16-bit chip set. The unit as a whole and the control surfaces in particular feel reassuringly heavy and solid, as does the substantial slide-out drawer-loading mechanism.

Presentation is attractively different from the norm, the grey and matt silver with contrasting grey and red highlights creating something of a 'hi-tech/semi-pro' impression, enhanced perhaps by the small but informative LCD display. The control layout is complex, with a number of extra buttons covering functions which are not immediately self evident, but grouped in four distinct areas to provide an element of logic, with major functions in any case duplicated by full infra-red remote control.

The rear panel has fixed and variable phono outputs, plus two digital data outputs and a serial link system interface connector. Internal construction is to the highest standards, with minimal wiring.

LAB REPORT

This new model uses 16-bit ICs with 4× oversampling, with dual DACs preserving high frequency phase linearity. It is particularly interesting to note both the close similarity, as well as the steady small improvements in the measured performance of this model over its predecessor.

The virtually flat frequency response shows the much reduced ripple effect which accompanies this particular chip set. Channel balance might have been closer, but was at least consistent, while stereo separation was exceptional. Harmonic distortion levels were low at high levels, worsening significantly at lower levels, due to the rather poor low level linearity of our sample which could only register 15-bit resolution. IM distortion figures and spectrogram both gave very good results, almost identical to the earlier model.

While mechanical noise was very low and shock and vibration rejection good, track access times were a little on the slow side. Signal-to-noise ratios were exceptionally good, while ultrasonic spuriae and error correction results were both satisfactory. The overall lab performance is very sound, but considering the high

price there is still room for some quality control improvements in certain areas.

Sound Quality

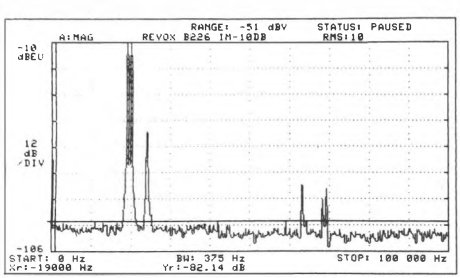
Rated on the borderline between 'above average' and 'good' overall, the '226 was considered to offer a marked subjective improvement over its predecessor. The balance was pleasantly neutral, with little observable coloration, but dynamics were somewhat 'softened', and both depth and focus were slightly compromised. The sound will satisfy many and is difficult both to dislike or criticise, but it lacked the 'speed', 'sparkle' and 'air' of more overtly audiophile-oriented components nonetheless when auditioned in our quite exotic system, and ultimately failed to generate sufficient listener interest to make the front rank.

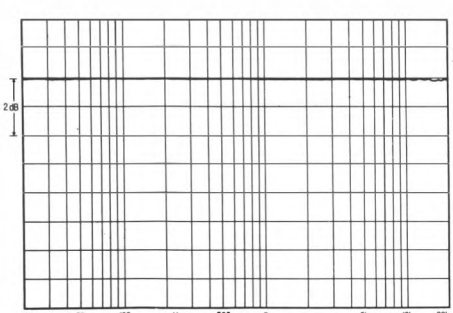
Conclusions

On sound quality value for money grounds the Revox *B226* still looks a rather expensive proposition. But the unique ergonomics, exceptional integrity and build quality do go a fair way towards sweetening the pill of the price, and the machine clearly makes a lot of sense in the context of a complete Revox system, for the discriminating user who values solid engineering with a uniquely European flavour.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.13dB	0.14dB	0.14dB
Stereo separation	126dB	108dB	97.4dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−95dB	−86dB	−83.8dB
Total harmonic distortion, −10dB	—	−78.5dB	—
Total harmonic distortion, −60dB	—	−38.5dB	—
Total harmonic distortion, −80dB	—	−12dB	—
Intermodulation, 19kHz/20kHz, 0dB			−98dB
Intermodulation, 19kHz/20kHz, −10dB			−96dB
Frequency response, left channel			0.03dB, 0, −0.03dB
Frequency response, right channel			0.03dB, 0, −0.04dB
Signal-to-noise, 20Hz-20kHz unweighted			105/108dB
Signal-to-noise, CCIR/ARM, 1kHz ref			100/102dB
Output level, 0dB, left/right			2.19V
Output impedance			220ohms
De-emphasis			1kHz, 0.36dB; 5kHz, 4.56dB; 16kHz, 9.05dB
Track access time			5.0secs
Error correction capability			>900μm gap, >800μm dot
Mechanical noise			v. low
Spuriae up to 100kHz			−86dB
Resolution at −90dB			−108/−101dB
Headphone socket			yes (variable output) 22ohms
Dimensions (w×d×h)			45×33×11cm
Estimated typical purchase price			£754





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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ROTEL RCD-820

ROTEL HIFI, 25 HEATHFIELD, STACEY BUSHES, MILTON KEYNES MK12 6HR.
TEL: (0908) 317707

Rotel have pioneered the technique of combining low cost Far Eastern manufacture with UK design expertise to create components specifically and successfully tailored to UK tastes. The amplifiers have taken the lead here, but other electronics components are also produced along similar lines, including two CD players, though in fact these are based on the popular Philips chassis, manufactured in Hasselt, Belgium. The basic '820 sells for around £249, £100 less than the 'tweaked' *BX*.

It is a full width unit finished in black, and is currently a simple manual machine with add-on remote control option, and has a fairly standard package of operating features. However, fully integrated remote control is promised from June 1987, with no price increase.

External finish is good, and build quality sound enough, if a little plasticky compared with some rivals. The display is a simple, switchable 4-digit section for timing or track presentation, backed by five status LEDs. Ergonomically the main operating panel is logically ordered, but the subsidiary functions of display switching, repeat, step, and 20-track programming seem randomly placed. The rear panel has a digital co-ax output and provision for an add-on remote control in addition to the phono stereo audio pair.

SOUND QUALITY

Showing the expected family resemblance to other Philips-based machines, of the *'460/'160 genre*, the '820 scored near the top of the 'above average' grouping, a decent result at the price but a full subjective grade behind the *'BX*'s achievement. The sound is direct and lively, well focused with a good scale of image, and seemed marginally sweeter, more precise and transparent in the treble than the standard brew, though such aspects were further improved in the *'BX*.

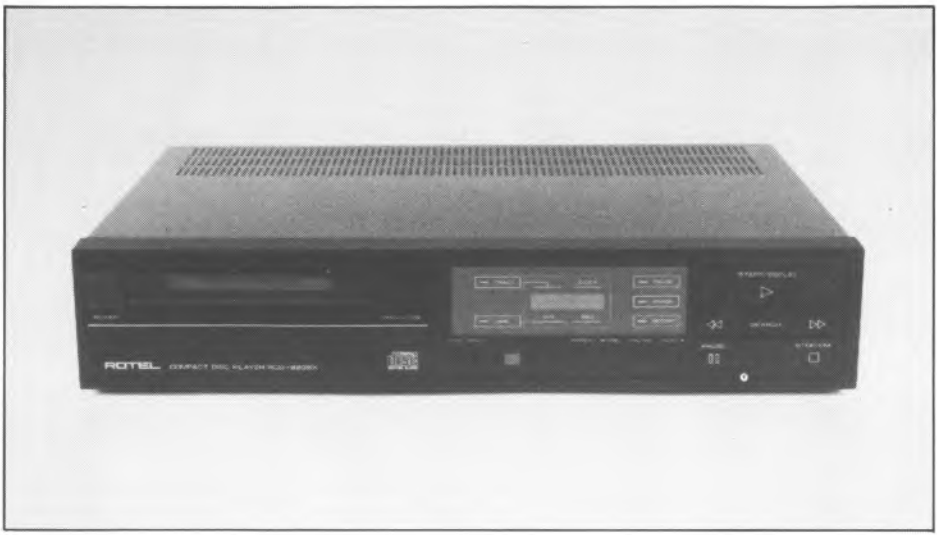
CONCLUSIONS

Though essentially a Philips clone at a somewhat higher price, the Rotel 820 does offer a very respectable sound quality for the price, and a reasonable build quality besides. It clearly deserves recommendation, particularly with the promised imminent incorporation of remote control without an increase in price.

RECOMMENDED

ROTEL RCD 820BX

ROTEL HI-FI, 25 HEATHFIELD, STACEY BUSHES, MILTON KEYNES MK12 6HR.
TEL: (0908) 317707



Rotel have pioneered the technique of combining low cost Far Eastern manufacture with UK design expertise to create components specifically and successfully tailored to UK tastes. The amplifiers have taken the lead here, but other electronics components are also produced along similar lines, including two CD players. Paralleling nomenclature used in the amplifiers, the model fully reviewed here is the *820BX* variant which is modified in the UK for improved sound quality. It sells for around £350, a £100 premium on the standard *'820*.

The *820BX* is a full-width unit finished in black and based on a Philips chassis (some derivation on the 460, one presumes). As tested this was a simple manual machine with optional add-on remote control, but this feature will be built in at no extra cost from summer '87, we understand. External finish is good, and build quality sound enough, if a little plasticky compared with some rivals. The display is a simple, switchable 4-digit section for timing or track presentation, backed by five status LEDs. Ergonomically the main operating panel is logically ordered, but the subsidiary functions of display switching, repeat, step, and 20-track programming seem randomly placed. The rear panel has a digital co-ax output and provision for the add-on remote control in addition to the phono stereo audio pair.

LAB REPORT

The range of test measurements indicate a fine overall lab performance, compromised slightly by some mild channel imbalances, presumably reflecting limited component tolerancing. The response is smooth and flat through most of the frequency band, showing gentle and probably sensible filtering towards the bandwidth extremes (11kohm loading). Close channel phase coherence confirms the twin 16-bit DACs, used with 4× oversampling. Channel separation was very good, though with significant difference between L on R and R on L. Both harmonic and intermodulation distortions were very good, the spectrogram showing a basically clean ultrasonic region with a single 25kHz component.

Output level was accurate, and source impedance low enough for direct power amplifier working. Mechanical noise was low, track accessing a fairly rapid 3.5 seconds, and error/tracking tests were handled without

problems. Feedback rejection was very good, though shock rejection rated only average. Electrical noise was very low indeed, and ultrasonic spuriae well suppressed, but low level linearity was a rather average 15-bits, and the white noise test (0dB) showed very slight rounding at the top.

Sound Quality

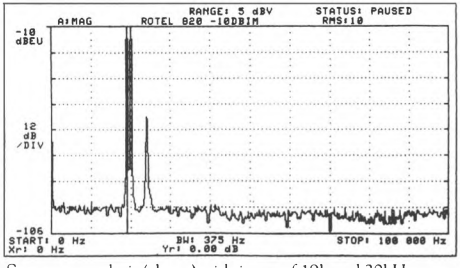
Rating a solid good overall, the *802BX* certainly provided a significant improvement over the standard *820*, though at the same time it did not particularly stand out amongst similar modified-Philips machines. Dynamics and depth were both good, but there was also a slight 'clouding' effect which reduced transparency through the well focused but slightly narrowed soundstage. The bass was firm, strong and well above average, while the treble was a mite recessed, lacking a little 'sparkle'. Overall, the sound was aptly described as both entertaining and involving.

Conclusions

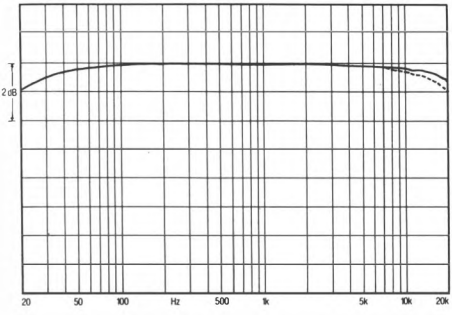
While the *820BX* CD player does not quite attain the competitive position of the *820BXII* amplifier, it is a respectable performer nonetheless. The lab performance was generally good, though not without a few L/R channel anomalies; the build quality and features were adequate, if ungenerous. But it has still done more than enough to merit recommendation on the basis of a fundamentally good standard of sound quality for the price, maintaining Rotel's reputation and philosophy in this new product area.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.02dB	0.43dB
Stereo separation	113dB	93dB	81.5dB
Channel phase difference	0°	0°	2°
Total harmonic distortion, 0dB	−93.4dB	−88.8dB	−84.8dB
Total harmonic distortion, −10dB	—	−83dB	—
Total harmonic distortion, −60dB	—	−46dB	—
Total harmonic distortion, −80dB	—	−21dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−94dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−90dB	—
Frequency response, left channel	−0.54dB, 0, −0.86dB		
Frequency response, right channel	−0.53dB, 0, −1.27dB		
Signal-to-noise, 20Hz-20kHz unweighted	107/107dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	103/103dB		
Output level, 0dB, left/right	2.1V		
Output impedance	200ohms		
De-emphasis	1kHz, −0.4dB; 5kHz, −4.7dB; 16kHz, −9.37dB		
Track access time	3.5secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−100dB		
Resolution at −90dB	−104.7/−100.1dB		
Headphone socket	no		
Dimensions (w×d×h)	42×31×8.5cm		
Estimated typical purchase price	£350		



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



SHARP DX 610

SHARP ELECTRONICS, THORP ROAD, MANCHESTER M10 9BE.
TEL: (061) 205 2333

Sharp stayed out of the CD business until expanding sales made it worthwhile setting up the production of their own high value machines. The *DX-610* and its brother the *DX-110* sell at the competitive £200 price level, and have been extensively advertised.

A fashionable front loader, the deck conforms to a basic specification, for example lacking remote control or access to those rarely-used index points — indeed few discs are indexed anyway, although the facility can be useful for music students. A headphone socket is provided, with a fixed volume level, and some experimentation might be required to find the optimum choice of headphone to produce a suitable loudness level.

The back-lit liquid crystal display gives track and timing information while additional features include fast track skip, plus two speed audible music cue and review. Programming facilities are not provided, though. Output is nominally to the 2V standard via RCA phono sockets.

Inside, the player made use of many large scale integrated circuits to reduce the component count and simplify the construction. Technically, it is a 16 bit linear machine, twice oversampled, with a time shared D/A converter. Some measured digital filtering is present, followed by shallow-slope analogue filtering to complete the suppression of spurious signals in the ultrasonic frequency range. This combination should result in an improved pulse response, as compared with the standard high slope brickwall filters. A smoother high end response is also likely, though the ultimate sound quality could not be predicted from this information alone.

LAB REPORT

The impulse response was of a superior kind, with moderate overshoot and well controlled ringing. Conversely, the machine was found to be phase inverting; generally, this will be of little consequence. Although some listeners are conscious of absolute phase, a knowledge of the phase of the accompanying system and of the particular recording would be essential to exploit this.

Very good channel matching was seen and the two response traces could be virtually laid one on the other. The response is mildly downtilted with increasing frequency though the effect is

slight. Specifically, above 6kHz the output fell to −0.6dB at 20kHz, but for most listeners this would pass unnoticed. The peak often noted at extremely high frequencies was entirely absent here. No problems could be associated with the separation results although these were poorer than average, measuring around 85dB midband. As is typical of the type, the interchannel phase difference was held to a maximum of 40° at 20kHz.

While the price may be budget, its resolution is not, and this machine was virtually to the 16 bit standard of the CD specification. The level error at −90dB was less than 1dB, while the midband distortion at full level approached 0.003%, or −90dB. The more searching 20kHz distortion measurement still scored a fine −83dB for the in-band component, though the theoretically inaudible 24kHz beat component was only 24dB down.

A very good response to the high frequency intermodulation test was seen, with −90dB of distortion at the −10dB reference level. Generally good spurious rejection was observed. The output was marginally higher than standard, at 2.15V, with a higher than average source impedance. Track access speeds were fine while the machine shows a slight preference on error correction for surface dots as opposed to information layer gaps. The last two gap levels produced 'ticking' but taken overall the error correction was OK. Signal to noise ratios were satisfactory.

Sound Quality

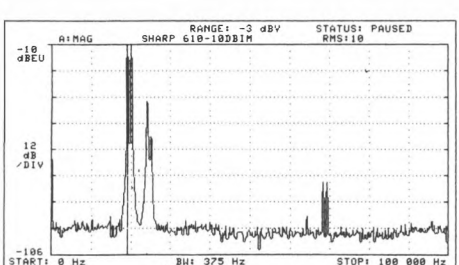
Scoring below average for this issue, the '610 still delivered quite a pleasant sound with softened dynamics and a loss of attack. Image focus was unimpressive with vague positioning of high frequencies. Some lack of air and sparkle was apparent while the bass could have been more tuneful. Subjectively, the treble was quite smooth but depth and ambience were constricted.

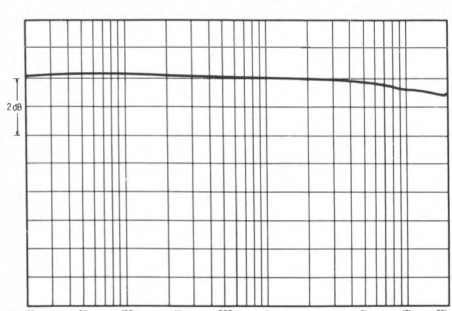
Conclusions

Generally satisfactory, this player avoided some of the 'edge' and 'hardness' associated with the sound of some of the other budget players. Although a bit below average on sonic grounds, it offers fair value.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.20dB	0.16dB	0.29dB
Stereo separation	−81.4dB	−84.7dB	−63.7dB
Channel phase difference	1°	3°	41°
Total harmonic distortion, 0dB	−86.3dB	−88.7dB	−82.6dB
Total harmonic distortion, −10dB	—	−85.9dB	—
Total harmonic distortion, −60dB	—	−42.0dB	—
Total harmonic distortion, −80dB	—	−22.9dB	—
Intermodulation, 19kHz/20kHz, 0dB			−85.1dB
Intermodulation, 19kHz/20kHz, −10dB			−90.9dB
Frequency response, left channel		+0.19dB,	−1.56dB
Frequency response, right channel		+0dB,	−1.42dB
Signal-to-noise, 20Hz-20kHz unweighted			−88dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−86dB
Output level, 0dB, left/right			2.15V
Output impedance			1.6kohms
De-emphasis			correct
Track access time			4.5secs
Error correction capability			>700μm gap, >800μm dot
Mechanical noise			very low
Spuriae up to 100kHz		−left −95.4dB, right	−100.3dB
Resolution at −90dB		left +0.66dB, right	+0.72dB
Headphone socket			yes
Dimensions (w×d×h)			43×31×8cm
Estimated typical purchase price			£199

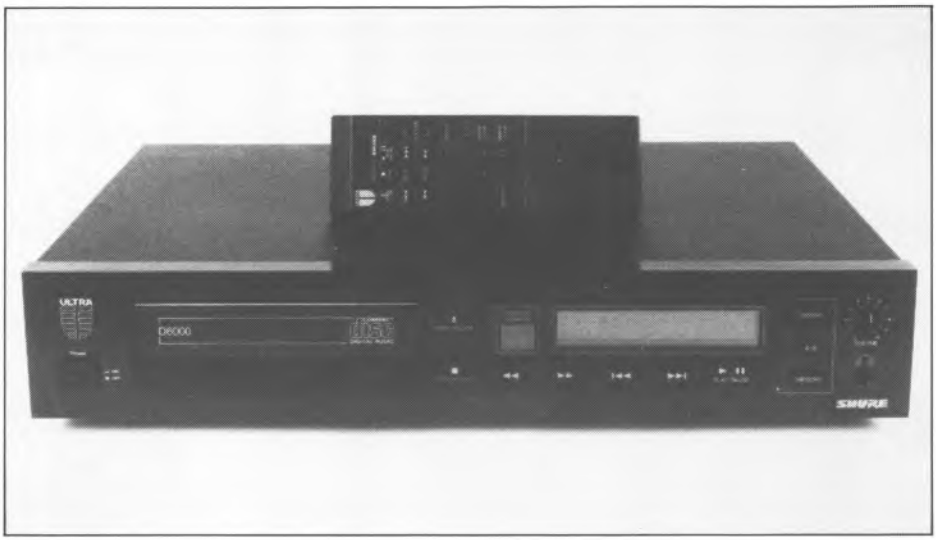




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

SHURE ULTRA D6000

HW INTERNATIONAL LTD, 3-5 EDEN GROVE, LONDON N7 8EQ.
TEL: 01-607 2717



Known first and foremost for their evergreen range of cartridges, US company Shure Brothers have fingers in various other pies, notably the professional market for microphones and sound reinforcement, plus such devices as surround sound processors for domestic 'home cinema' applications.

Now they have added a luxury CD player to the roster, the *Ultra D6000*, recalling the name of their top cartridge and selling at a similar £500. Shure rationalise their involvement by questioning the sound quality of other current players, claiming to have made significant sonic improvements through careful filter design and quality DACs amongst other factors. A useful safety net is a five-year guarantee on the laser, a device which should give 8,000 hours of use but whose premature failure could result in a substantial bill.

Though expensive, it does not suffer from the disease which requires such devices to be littered with a corresponding number of buttons. The machine itself is an object lesson in clear presentation, gold legends and symbols clearly identifying the seven large transport keys, with just three smaller subsidiary buttons and a variable headphone socket. The display is neat and unobtrusive, with three separate, rather small digital readouts covering time, track and index, plus a number of status indicators.

This is a full remote control unit, so the handset provides these various functions, plus two more thoroughly useful facilities besides — a direct entry 11-digit keypad, plus remote control volume. Build quality is to top Japanese standards, with a substantial machined front panel, though no evidence of any particular anti-vibration techniques.

LAB REPORT

With a 16-bit 2× oversampling conversion system, the 6000 has dual DACs that eliminate interchannel phase shifts. The frequency response was pretty damn good, flat and smooth with just a touch of channel imbalance at the high frequency rolloff. Channel balance showed a 0.5dB difference, indicative of normal commercial tolerances, while separation was good in the midband, but rather less so at high and low frequencies. Harmonic and intermodulation distortions all measured well, with a generally clean spectrogram but some channel imbalance at low levels on the harmonic measurements.

The output level is higher than the CD spec., which can be useful if driving power amplifiers directly (perhaps *via* the variable output sockets fitted to this player), but which can also flatter the 6000 during A/B comparisons if appropriate compensation is not made. Track access times were not particularly fast, but mechanical noise was low and rejection of shock and vibration excellent. Error correction and tracking tests were passed without drama, ultrasonic spuriae were well suppressed, and electrical noise levels very good. Low level linearity achieved a very reasonable 15.3-bits.

Sound Quality

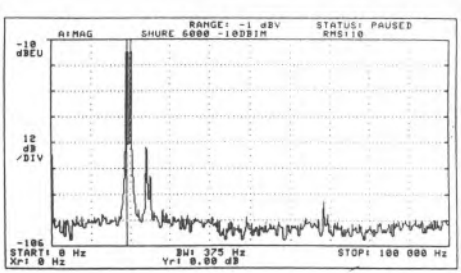
An above average rating is respectable enough, though rather more might have been expected. The bass sounded sharp and clear, the midrange a little lean and hard, while the treble seemed a trifle bright and over-emphasised. Stereo focus was good, but with some loss of depth and width. The overall sound had something of the character of the top Shure cartridges: it conveyed good and convincing dynamics, but was also considered potentially a little fatiguing.

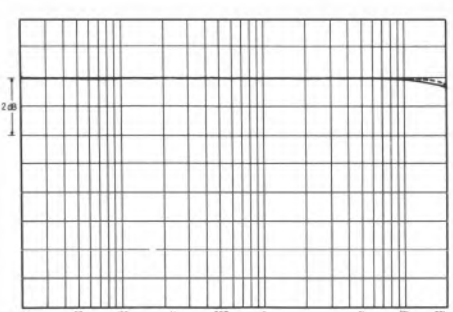
Conclusions

The Ultra 6000 is evidence enough that Shure are taking CD very seriously. The build quality and ergonomics are both excellent, particularly in the extra features fitted to the remote handset which keep the machine itself uncluttered. The lab performance was thoroughly respectable, though the results of the listening tests might have been better considering the high price of the machine.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.5dB	0.5dB	0.31dB
Stereo separation	87dB	100dB	74dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−91.5dB	−91dB	−83.4dB
Total harmonic distortion, −10dB	—	−86.9dB	—
Total harmonic distortion, −60dB	—	−42.1dB	—
Total harmonic distortion, −80dB	—	−21.9dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−85.9dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−91.4dB	—
Frequency response, left channel	+0.03dB, 0, −0.32dB		
Frequency response, right channel	+0.03dB, 0, −0.14dB		
Signal-to-noise, 20Hz-20kHz unweighted	104/99dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	97/92dB		
Output level, 0dB, left/right	2.5V (var=2.5V)		
Output impedance	570(var 1.5ktyp)ohms		
De-emphasis	1kHz, 0.25dB; 5kHz, 4.3dB; 16kHz, 8.9dB		
Track access time	5.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−102.5dB		
Resolution at −90dB	−86.3/−83.4dB		
Headphone socket	yes (variable output) 150ohms		
Dimensions (w×d×h)	43×8.5×33cm		
Estimated typical purchase price	£495		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

SONOGRAPHE SD1 (by Conrad Johnson)

AUTOMATION SCIENCES CO, 20 LITTLE GADDESDEN, BERKHAMSTED, HERTS HP4 1PA.
TEL: (044284) 2786

The Sonographe (by Conrad Johnson) SD1 CD player has recently become available in the UK, and may be seen as something of a US equivalent to the UK specialist machines. A basic Philips (in the US Magnavox) chassis has had customising touches here and there, plus 'audiophile' analogue pre-amp circuitry. The price of £799 is unusually low by C-J standards, hence the Sonographe identity, a US turntable brand which C-J acquired quite recently and which makes a suitable identity for good quality products at more modest prices than their normal amplification equipment.

The styling changes consist of a substantial metal fascia plus oak end-cheeks. The result looks satisfyingly substantial and distinctively American, though one might question the overall elegance. An additional simple internal circuit board substitutes the normal output filter with a Bessel filter with different Q and rolloff point. The analogue output uses an FET stage reminiscent of the *Motif* pre-amp, and further modifications include a good quality dual-rail power supply and the replacement and use of high quality C-J specified capacitors.

The basic machine is similar to the familiar drawer-loading Philips 350, and can be upgraded to remote control operation using the Philips remote/receiver kit. All the usual search, program and timing features are included. The conversion circuitry is the 14-bit four times oversampling which is still used in some of the best players around. The chassis is a plastic moulding, using a single beam laser.

LAB REPORT

The frequency response showed the same mild high frequency ripples as other related machines: they can look a little alarming under high scale magnification but there is no evidence of an adverse effect upon sound quality. Phase difference at high frequencies was zero, due to the two D/A converters. Stereo separation was satisfactory, but rather poorer at high frequencies than the standard models which use the same chassis. Similarly, distortion results were rather poorer than the standard achieved by other machines, both for harmonic and intermodulation. Despite the evidence of some distortion, white noise at 0dB was handled fine, and resolution at −90dB was good.

Error correction was very good on all tests, while mechanical noise was low and the unit

showed generally good resistance to shock and vibration. Track access took a satisfactory 4.5secs, while output was a little below the standard, and further hampered by a highish source impedance — a little care may be needed to ensure amplifier compatibility here.

Sound Quality

Highly rated in auditioning, the SD1 is bettered by very few, mostly more expensive, competitors. Effectively confirming its illustrious heritage, its great strength was sheer 'listenability' in a top class replay chain, the sound described as engagingly sweet and unfatiguing, if slightly 'soft' and lacking 'attack'. The midrange, vocal regions were particularly good, but the treble showed a little grain and was a trifle 'shut in'. Bass sounded slightly 'heavy', lacking a little 'grip' and 'slam'.

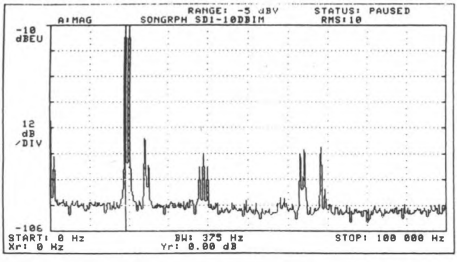
Conclusions

Despite the cost penalties inevitably incurred by shipping a unit halfway round the world, the Sonographe still delivers a fully competitive sound quality that comes very close to our reference yardsticks irrespective of price. Conrad Johnson's engineers have come up with a sonic recipe that gives an attractively relaxed 'musical' result, the only penalty being facilities and presentation which are rather mundane when compared with the immediate competition.

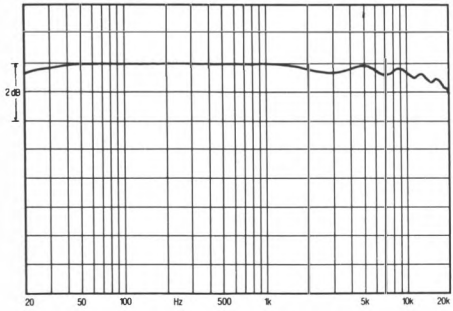
Test Results

	20Hz	1kHz	20kHz
Channel balance	0.18dB	0.17dB	0.19dB
Stereo separation	95.2dB	89.1dB	66.5dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−62.3dB	−62.8dB	−78.6dB
Total harmonic distortion, −10dB		−71.2dB	—
Total harmonic distortion, −60dB		−38.7dB	—
Total harmonic distortion, −80dB		−20.2dB	—
Intermodulation, 19kHz/20kHz, 0dB			−52.7dB
Intermodulation, 19kHz/20kHz, −10dB			−61.6dB
Frequency response, left channel	+0.03dB		0 −1.05dB
Frequency response, right channel	+0.02dB		0 −1.08dB
Signal-to-noise, 20Hz-20kHz unweighted			93dB
Signal-to-noise, CCIR/ARM, 1kHz ref			90dB
Output level, 0dB, left/right			1.87V
Output impedance			2.6 kohm
De-emphasis	−0.4dB(1kHz), −4.74dB(5kHz), 9.5dB(16kHz)		
Track access time			4.5secs
Error correction capability			gap>900µm, dot>800µm
Mechanical noise			very low
Spuriae up to 100kHz			−78.9dB
Resolution at −90dB			L −87.9dB, R −93.1dB
Headphone socket			fixed, 150ohms
Dimensions (w×d×h)			46×39×9cm
Estimated typical purchase price			£799

First reviewed The Collection 1987



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



RECOMMENDED

SONY CDP-M20

SONY UK LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: Staines 61688

Sony see this new 1987 midi-sized model as the successor to the highly successful *CDP 35*. (This *Choice* Recommended model was 1986's biggest selling machine.)

The M20 is the cheapest in a range of four midi machines. All share the high standards of quality and presentation that play no small part in Sony's success, but the manually operated '20 has the most basic facilities at the same £199 price point as last year. An extra £30 adds the full-feature remote control of the M30. We had planned to review the M50, but our sample withdrew its labour: this £270 model has a more comprehensive display plus extra technical features. The £350 C5M is a 5-disc autochanger, with the most convenient and ingenious loading mechanism yet.

The M20 is quite well equipped for a baseline model, yet it is also neatly laid out for simple operation. The features include a 20-track programmable memory, skip and audible high speed scan, repeat and shuffle (random) play, plus displayed track, index and disc timing.

LAB REPORT

The basic circuitry is developed from last year's more upmarket machines, using 2× oversampling and digital filtering with a single time-shared 16-bit DAC. The technical performance is generally well balanced, while showing the mild compromises appropriate to a player in the 'budget' category. Frequency response was flat below 1kHz, showing slight ripple and uneveness at higher frequencies but within close limits nonetheless. Channel balance was close, deteriorating slightly at high frequencies, while the interchannel phase difference confirms the shared DAC.

Harmonic distortion was generally good, but weak at low levels. Intermodulation gave good figures but the spectrogram does reveal a number of lurking ultrasonic components. The output impedance was rather high, so this player may not be suitable for direct or *via* potentiometer connection to a power amplifer. Shock and vibration resistance was good, mechanical noise quite low, and track access time a reasonable 5 seconds. Error correction tests posed no

problems, resolution was a decent 15.4-bits at low levels, and signal-to-noise ratios were quite good, but the suppression of ultrasonic spuriae could have been better.

Sound Quality

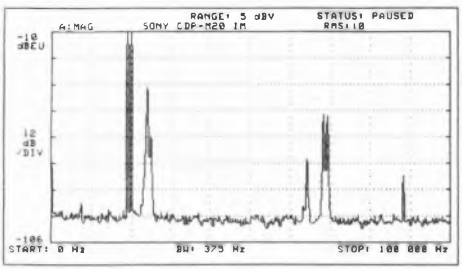
The *M20* scored a straight average on the listening tests, which is a good result for a budget player. The sound was considered a little lightweight but dry and quick in the bass. Mid and treble both sounded reasonably clean with quite good focus and dynamics. The soundstage could have been wider with better depth resolution, but there were no upsetting colorations and imbalances, merely the expected limitations of an essentially competent budget deck.

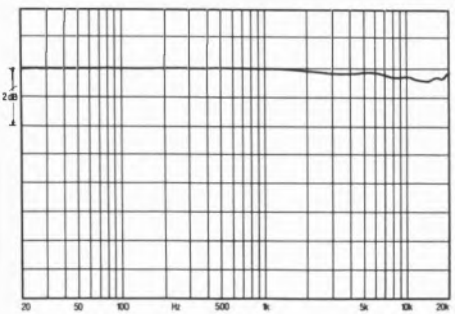
Conclusions

The *CDP-M20* makes a worthy heir to its successful predecessor, fully keeping pace with the improving standards of the marketplace as a whole. It combines decent subjective and laboratory performance in a competitive £200 package, with the bonus of fine Japanese build and presentation quality, and so clearly merits firm recommendation.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.02dB	0.02dB	0.17dB
Stereo separation	92dB	91dB	71dB
Channel phase difference	0°	2°	40°
Total harmonic distortion, 0dB	−82dB	−83dB	−86dB
Total harmonic distortion, −10dB	—	−82dB	—
Total harmonic distortion, −60dB	—	−40dB	—
Total harmonic distortion, −80dB	—	−14.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−86dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−88.5dB	—
Frequency response, left channel	0.04dB, 0, −0.64dB		
Frequency response, right channel	0.05dB, 0, −0.49dB		
Signal-to-noise, 20Hz-20kHz unweighted	89/93dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	84/88dB		
Output level, 0dB, left/right	2.12V		
Output impedance	2.4kohms		
De-emphasis	1kHz, 0.4dB, 5kHz, 4.6dB, 16kHz, 9.3dB		
Track access time	5.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	quite low		
Spuriae up to 100kHz	−76dB		
Resolution at −90dB	−86.9/−86.7dB		
Headphone socket	yes (fixed) 100ohms		
Dimensions (w×d×h)	35.4×27×8cm		
Estimated typical purchase price	£199		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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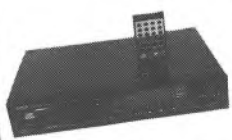

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DENON DCD1500

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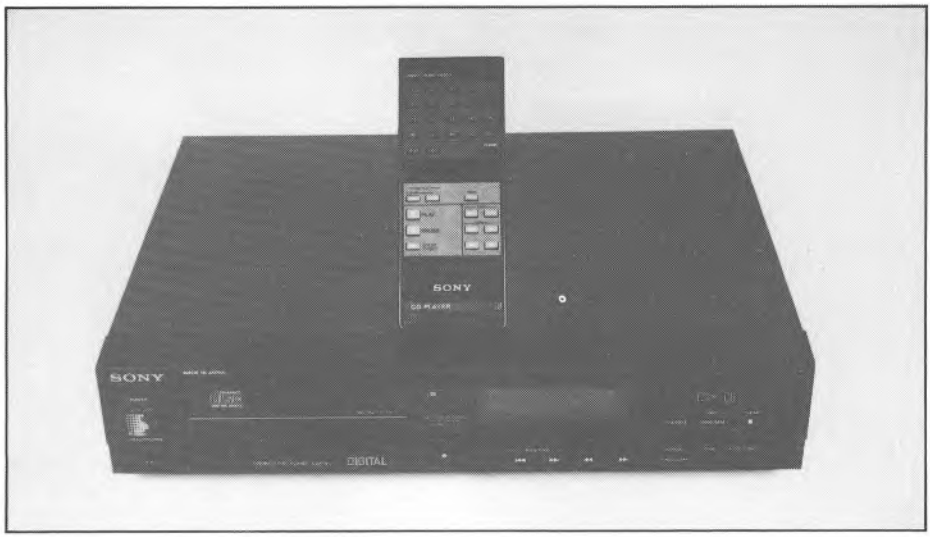
HI-FI MARKETS

RECOMMENDED

SONY CDP-310

SONY UK LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: Staines 61688



Co-inventors of the CD format, Sony are also amongst the market leaders, and have introduced for 1987 some ten mains machines plus several portables to maintain their market position. Disregarding the prestige 'ES models, alongside no less than five midis, there are two full width models, both with full remote control. The simpler £250 *CDP 310* costs £50 less than the more complex and technically more advanced '*710* reviewed in the following pages.

The finish and build quality are both exemplary, even if Sony are able to surpass it with their *ES* series, which are clearly more solidly built overall. Still the '*310* more than passes muster, even if it does represent a more cost effective package. All the usual features are available, and intelligently laid out. Lacking the complexity of the '*710*'s front panel direct entry keypad and displayed music calendar, the '*310* at least offers the convenience of the former on the comprehensive handset.

SOUND QUALITY

Scoring a healthy enough average rating, the '*310* showed a small but worthwhile improvement over the '*M20*, with enhanced dynamic qualities and a more solid extended bass, though it fell substantially behind the '*710* with its more advanced digital circuitry. Focus was quite good, but with some loss in stereo depth and transparency. The treble was quite tidy, but with a mild 'lispiness' or 'edge'. Overall, this is decent commercial sound quality, but nothing special.

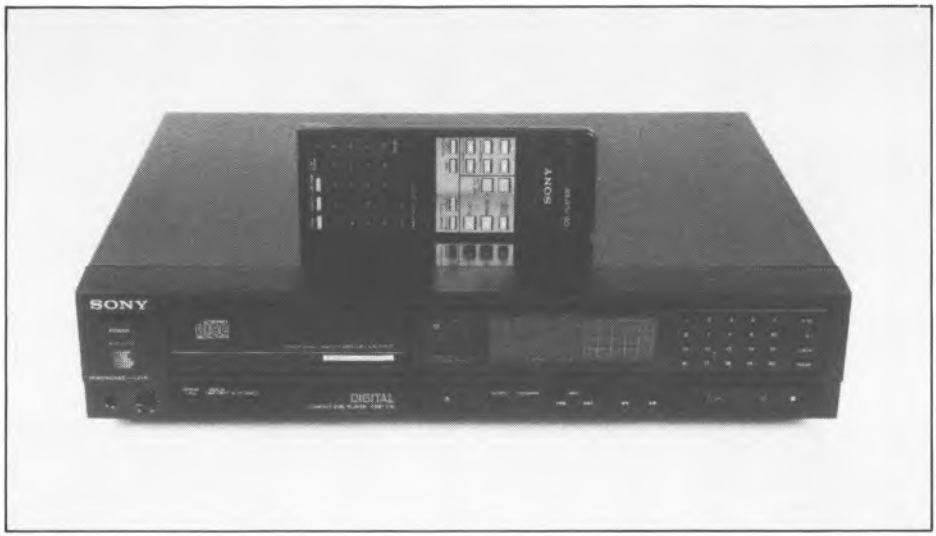
CONCLUSIONS

Fine build quality, facilities and presentation, plus a very acceptable standard of sound quality for £250 make recommendation of the *CDP-310* mandatory. But those who want a full size machine should consider carefully the slightly more expensive '*710*. And if size is immaterial, the *M50* ought to be investigated — though we were unable to test this model, it appears to incorporate '*710* technology in a £270 midi package, which could be a winning combination.

BEST BUY

SONY CDP 710

SONY UK LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: Staines 61688



Co-inventors of the CD format, Sony are also amongst the market leaders, and have introduced for 1987 some ten mains machines plus a couple of portables to maintain their market position. This is the top model in Sony's extensive seven-model standard line-up, disregarding the more exotic *ES* models described elsewhere: alongside no less than five midis, there are two full-width models, both with full remote control, this £300 *CDP 710* costing £50 more than its simpler '*310* brother.

For the extra, one gets additional features like the front panel 20-digit direct entry keypad, plus internal engineering changes to the digital conversion circuitry. The finish and build quality are both exemplary, even if Sony are able to surpass it with their *ES* series which are clearly more solidly built overall. Still the *710* more than passes muster, even if it does represent a more cost effective package. All the usual features are available in full measure, and intelligently laid out, though the degree of complexity might not be to every taste.

Lab Report

This particular model has 'high tech' digital circuitry, with dual 16-bit DACs (from Philips sources) used with 4× oversampling, and Sony's own advanced digital filtering, giving a ruler-flat frequency response with no interchannel phase discrepancy. Stereo separation was very good, deteriorating marginally at high frequencies, while both harmonic and intermodulation distortion measurements gave excellent results.

The output level was near enough correct, but the output impedance was on the high side, which might create the odd problem for dedicated enthusiasts attempting to drive some power amplifiers directly or *via* a passive volume control. Mechanical noise was low, track access speed very fast, shock and vibration rejection excellent, and error correction and tracking tests handled without difficulty. Electrical noise levels were excellent, ultrasonic spuriae were well suppressed, and low level linearity was a very good 15.7 bits.

Sound Quality

Despite its comparatively modest price, this player scored a very impressive and strong overall 'good' rating. Showing excellent vocal focus and stereo staging, with good depth and width, the

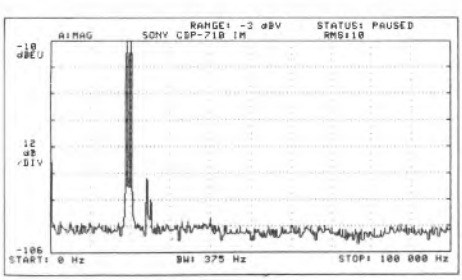
soundstage was slightly 'forward', and tonally mildly 'lean'. Bass was qualitatively good, if a trifle lightweight, and the treble showed fine explicit detail. Though lacking a little 'slam', the *710* provided a fine combination of good dynamics and subtle detail.

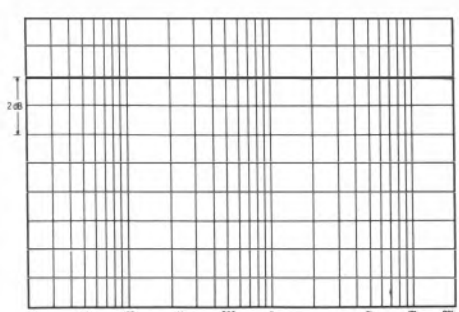
Conclusions

This player proved to be one of the more outstanding new entries for the 1987 edition, Sony's additional 'high tech' fix on this premium model appearing to give a significant boost to sound quality. The build quality may not quite achieve *ES* standards, but it is more than sufficient nevertheless, while the range of facilities and lab performance are both generous at the price, irrespective of the sound quality. The *CDP 710* is therefore an obvious Best Buy.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.22dB	0.22dB	0.3dB
Stereo separation	128dB	110dB	84dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−87dB	−83dB	−87dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−41dB	—
Total harmonic distortion, −80dB	—	−23.5dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−91dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−85dB	—
Frequency response, left channel	0.01dB, 0, −0.03dB		
Frequency response, right channel	0.01dB, 0, −0.11dB		
Signal-to-noise, 20Hz-20kHz unweighted	109/110dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	104dB		
Output level, 0dB, left/right	2.21V		
Output impedance	1.6kohms		
De-emphasis	1kHz, 0.33dB, 5kHz, 4.35dB, 16kHz, 9.1dB		
Track access time	2.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−99dB		
Resolution at −90dB	−87.7/−89.3dB		
Headphone socket	yes (variable output) 100ohms		
Dimensions (w×d×h)	43×33×9.5cm		
Estimated typical purchase price	£300		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

SONY D100

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: Staines 61688

The £300 *D100* is the latest top-of-the-line miniature 'personal' portable CD player from Sony, effectively replacing last year's *D50* but smaller still and lighter in weight. Indeed it is probably the smallest currently available, and certainly makes a slimmer, lighter package than its most obvious competitor (the Technics *XP5*) when both are fitted with their rechargeable 'flatpack' lead acid batteries.

Features and facilities are of limited importance when trying to save as much weight and power comsumption as possible, but the *D100* is still reasonably well equipped. It has a small, simple, power-saving LCD display, the usual play functions including skip and repeat, plus 21-track programmability. The decision to put the play switch on the top surface may have been a mistake, as it is rather too easy to switch the player on accidentally when travelling around. The *D100* comes complete with a good quality set of folding 'in-ear' headphones.

SOUND QUALITY

The engineering constraints of portable packages are clearly reflected in a sound quality which is poor by comparison with stand-alone mains machines, but in a strictly portable context the Sony is as good as anything else currently around (though it represents an actual drop in quality compared with last year's *D50* we have to point out). The sound improved on the cheaper *D30* in terms of definition, treble clarity and openness. Bass was reasonably free from serious censure, focus likewise, but depth and low level detail were both masked to a degree, and there were some compressive effects and midband hardness. Tracking was a little below par, even with the machine stationary.

CONCLUSIONS

The best all round package amongst the 1987 portables we have tried, the *D100* is also the most expensive, and is still no substitute for a conventional mains player. It may be worth considering for those who must have portable CD, and it is reasonably effective *via* headphones, but there is still a feeling of immaturity about this technology that applies less with mains CD machines, or with personal cassette players for that matter.

SONY D30

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: Staines 61688

Sony's introduction of the £230 *D30* brings the starting price for their personal 'portable' CD players down significantly from last year's *D50*, though not without some compromise in size, appearance and 'feel'. This is very much a plastic package, compared with the luxury metal-cased models available at somewhat higher prices. Although somewhat thicker, slipping less easily into the pocket or handbag, it is attractively light in weight and has a certain fashionable style and overall presentation.

Moreover, the *D30* does have one significant advantage over Sony's more expensive machine, inasmuch as it is not solely reliant upon a special 'flatpack' lead acid rechargeable battery. The *D30*'s removable rechargeable power pack is similar in size and shape to a container for four AA cells — and such a container is precisely what can be used as an alternative if and when the rechargeables run out inconveniently. The snag is that the three-hour battery life will cost you 50p+ per hour....

Benefiting from starting with a cleaner sheet of paper, the *D30* is generally rather neater than the more expensive *D100* ergonomically. It has a similar power-saving LCD display, skip, shuffle and repeat play modes, and is supplied complete with good quality, folding 'in-ear' headphones.

SOUND QUALITY

The sound quality is poor by comparison with stand-alone mains machines, indicating that there is no easy solution to the engineering constraints of portable packages. In comparative terms the *D30* fell slightly behind two metal-cased personal portables assessed at the same time, though it sounded reasonably respectable *via* the headphone output. There was little depth, focus was diffuse, low bass was deficient, and upper bass sounded 'grumbly' in character. However, the midband was pleasant, the treble reasonably open, and the overall sound was generally tidy and reasonably competent. Even when static, some mistracking was encountered.

CONCLUSIONS

In many senses the most practical and cost effective of the three personals assessed in this edition, the *D30* makes a good effort at realising a practical *Discman*, though it still falls short of last year's *D50* in terms of sound quality.

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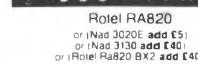

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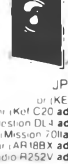

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RECOMMENDED

SONY CDP-222ESD

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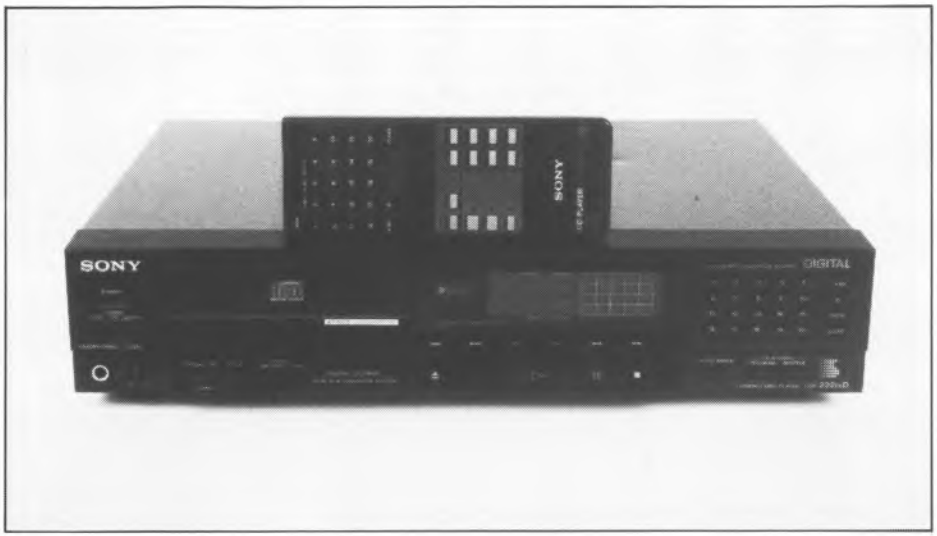

The *CDP-222ES* is the least expensive model in the costly but beautifully presented Sony ES range of three CD players. Features and facilities are too comprehensive to detail without the review taking on the appearance of a shopping list, but this is very much a luxury machine with everything one would expect plus a few more besides — inevitably resulting in a somewhat complex layout, no doubt to the delight of many, but the possible intimidation of some.

Full comprehensive remote control is provided, but this does not have the remote volume of the more expensive models. Other economies have been found in avoiding the elaborate power supply provisions and anti-vibration G-chassis, though the *'222* still makes a serious attempt to combat shock and vibration. A 20-digit keypad gives direct track access and programming on both handset and machine, the latter's music calendar display providing attractive visual confirmation. Under the skin, the *'222* has Sony's 4× oversampling system, based on Philips twin DACs but with Sony's digital filtering technology.

SOUND QUALITY

Despite the luxurious build quality, the *'222* was a mild disappointment in the listening tests, scoring a healthy enough 'above average' rating — better than the *'310* but falling a little short of the non-*ES '710* model. The stereo image had good scale and focus, with fair depth and good low level detail. The sound was inviting and interesting, quite dynamic and authoritative with good bass; overall this is a tidy, clean all rounder.

CONCLUSIONS

The combination of exceptional build and presentation plus respectably good sound quality at a realistic price is sufficient to merit recommendation, but our preference for alternative Sony models either side in the price hierarchy keeps our enthusiasm for the *'222* just a shade lukewarm.

RECOMMENDED

SONY CDP 555esD

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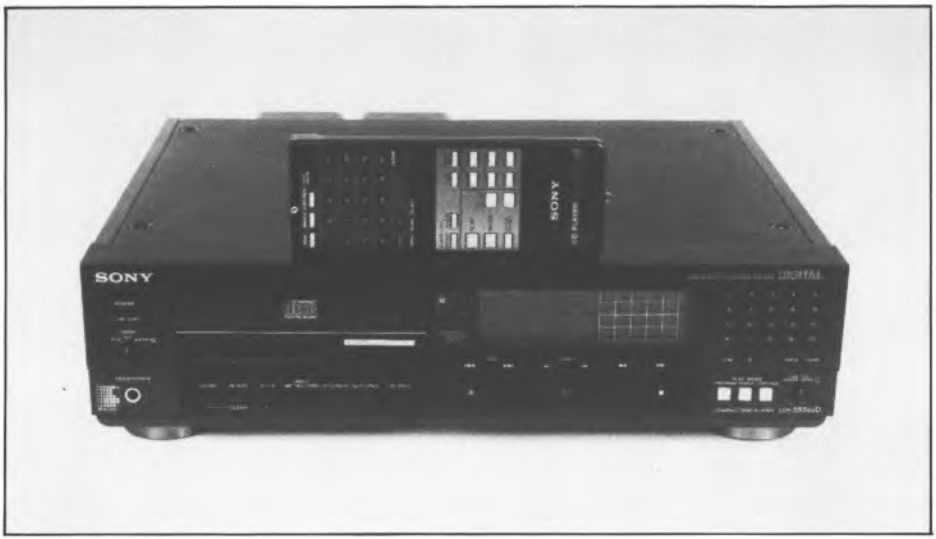


This £1000 luxury model in Sony's *ES* range is something of a flagship amongst single-box standalone players, oozing advanced engineering features to match the very highest standards of finish and presentation.

One obvious characteristic is the massive weight, due to the ceramic 'Gibraltar' chassis on which the unit is founded. This technique is now used to suppress vibration susceptibility in a number of *ES* models: it certainly adds great mechanical solidity, but presumably also plays its part in manufacture and transportation costs. Additional cast front and side panels plus a substantial solid top plate and two heavy, enclosed transformers hanging out of the rear create an 'over-engineered' impression which all helps to build consumer confidence.

Features and facilities are too comprehensive to detail without the review taking on the appearance of a shopping list. Full comprehensive remote control includes volume and a 20-digit keypad for track accessing and programming, with a music calendar display providing attractive visual confirmation.

Under the skin, the *555* has Sony's 4× oversampling system, based on Philips twin DACs but with Sony's digital filtering technology. Separate power transformers handle the digital and analogue signals, and care has been taken in choosing high quality components and wiring in critical areas, and in avoiding cross-interference.

LAB REPORT

A first class lab performance is demanded of a product such as this, and the Sony flagship did not disappoint. The frequency response was smooth and flat, with just the hint of a rise at very high frequencies. Channel balance was good, and stereo separation outstanding at low and mid frequencies, worsening somewhat at high frequencies. Dual DACs ensure phase consistency between channels. Harmonic distortion was low and intermodulation excellent, both on spot measurement and the broadband spectrogram.

Excellent resistance to shock and vibration confirms one benefit of the 'G' chassis. Mechanical noise was held to low levels, but track access times were very quick. State-of-the-art figures were set for noise levels and the suppression of ultrasonic spuriae. Error correction tests were passed without problems and low level

resolution was very good, approximating 15.8 bits.

Sound Quality

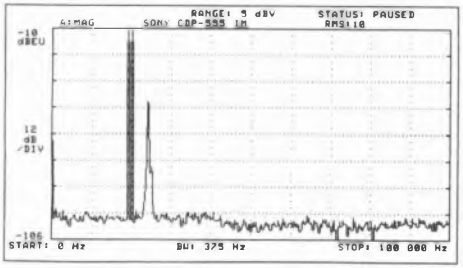
Much again is expected of such a model, and fortunately the delivery was in full measure, the *555es* rating very good overall, offering genuine competition for more audiophile-oriented products from small specialist companies. Described as essentially high class and pleasant with good dynamics, the midrange was strikingly clear with precise focus, while sibilants were clean and the treble pure. The presentation was a touch 'forward', slightly small in scale but secure and coherent, with a mild flattening of perspectives. The overall balance was neutral and attractively easy on the ears.

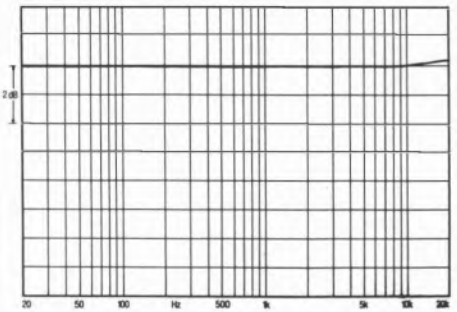
Conclusions

A £1000 pricetag needs some justification, but the 555 proves up to the task — at the same time rather undermining Sony's still more expensive two-box 552/703 combination. It is difficult to put a value on build quality as extravagant as this, but it should certainly inspire confidence and pride of ownership. Sophisticated facilities combine with state-of-the-art measured performance, and although the very fine sound quality fell slightly short of the very best in our reference system, the Sony is well up there competing with still more expensive models, and may be confidently recommended.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.08dB	0.07dB	0.04dB
Stereo separation	120dB	110dB	77dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−89dB	−88dB	−85dB
Total harmonic distortion, −10dB	—	−82dB	—
Total harmonic distortion, −60dB	—	−43dB	—
Total harmonic distortion, −80dB	—	−20dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−104dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−90dB	—
Frequency response, left channel	0dB, 0, −0.05dB		
Frequency response, right channel	0dB, 0, −0.02dB		
Signal-to-noise, 20Hz-20kHz unweighted	111dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	105dB		
Output level, 0dB, left/right	2.15V		
Output impedance	200ohms		
De-emphasis	1kHz, 0.33dB, 5kHz, 4.32dB, 16kHz, 8.81dB		
Track access time	2.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−104dB		
Resolution at −90dB	−88.3/−89.9dB		
Headphone socket	yes (variable output) 110ohms		
Dimensions (w×d×h)	43×39.5×12.2cm		
Estimated typical purchase price	£1000		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

SONY CD-P552 ESII/DA-S703ES

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.
TEL: STAINES 61688

Sony's CD flagship is the elaborately engineered *CD-P552 ESII/DA-S703ES* combination.

The *CD-P552 ESII* is a complete stand-alone player, basically similar to the *502II* but with a higher performance as well as an additional digital data bus output via a single co-axial cable. When used in combination, the *'552 II* is merely a transport, since full high-quality signal demodulation is carried out by the *DA-S703ES* digital processor.

The *'703* uses an oversampling technique with a 96th order digital filter as well as separate high speed digital to analogue converters.

In use, the *'552 II* is linked to the *'703* via a single cable, with the *'703* automatically registering the incoming sampling frequency (the *'703* will also operate on the 32kHz and 48kHz standards). All the normal facilities on the *'552 II* remain operative, including the comprehensive remote control, the latter including power operated level, although this is only available via the lower quality variable level socket.

LAB REPORT

The lab testing included both the *'552 II* proper and the *'703*. The former showed an amazingly flat frequency response; almost ruler flat, it was +0.05dB −0.06dB, 20Hz to 20kHz. The *'703* showed a mild treble lift of +0.24dB resulting from its need to operate over a range of sampling frequencies. Channel balance was excellent for both sections at typically better than 0.1dB. Channel separation was very good on the *'552 II* but the separate converters of the *'703* allowed it to reach 108dB of separation even at 20kHz. Interchannel phase shift is now zero degrees for both models. Downband noise and distortion were very good at 20kHz, reaching −90dB for all outputs and similar for both machines.

Both outputs demonstrated very good figures for high frequency intermodulation, the *'703* again slightly poorer than the *'552 II*. The latter's spectrogram showed at 89.2dB result at the 10dB below peak modulation level. Excellent clarity was shown, with spurious components excellently rejected, both up and down band of the fundamental signals. Ultimate spurious rejection was consistently good at about −100dB.

While both units use two times oversampling, their phase response was not quite as linear as the Philips system, which is truly linear phase within the audible bandwidth. The Sony does however come very close to linear phase, as pulse responses testified. All the fixed outputs provided a nominal 2V, useful for comparative tests, though the *'703* could provide up to 2.5V via its variable output, possibly helpful in studio

applications. For the '703 the output impedance was low and constant at 10 ohms, while the *'552 II* offered 100 ohms on its fixed output, and via its useful variable output an impedance up to a high 1 kohms via its adjustable output. The latter is not really suited to direct power amp connection.

The transport was amazingly fast, reaching chosen tracks almost as one's finger left the button. Mechanical noise was very low. With their new range, Sony now comfortably meet the error correction targets and these units easily covered the worst test error. Signal-to-noise ratios were very similar for both units. The transport proved very resistant to shock, a mark of the fine servo design.

Sound Quality

Listening tests were dominated by the *'703*, via its fixed output, although additional tests were made on the *'552 II* via its fixed and variable outputs as well. In rank order, the *'552 II's* variable came last, its fixed output came second, but the *'703* was a handsome first. The separate decoder clearly provides a worthwhile improvement.

The *'552 II* showed a decent level of bass precision and extension, and it produced well focused stereo images with satisfactory depth. At times it could sound a touch larger than life, this coupled with rather close perspectives on some programme sections. It proved to be lively and open with a high resolution of detail as well as a generally civilised tonal balance.

The *'703* improvement was worthwhile. The tonal balance was slightly lean but remained natural sounding, with an impression of weight and power. Stereo images were solid and depth was well resolved. The bass was 'quick' and articulate, mid transients were clear and the treble was sweet and subtly detailed.

Conclusion

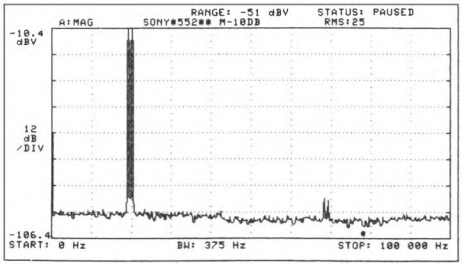
This luxury combination was excellently made and finished, offering every conceivable feature and facility. Error correction was superb, the track access almost spontaneous, while the transfer response was highly accurate and virtually linear phase. Reinforcing these qualities the sound quality was very good.

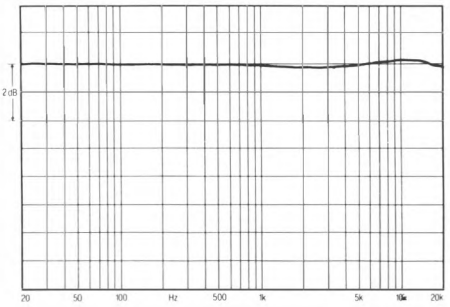
The *CD-P552 ESII/DA-S703ES* is still worth considering, but its value has been undermined somewhat by more recent competition — notably Sony's own *555ES*.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0dB	0.01dB	0.07dB
Stereo separation	−121dB	−114dB	−108dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−91.4dB	−89.3dB	−83.8dB
Total harmonic distortion, −10dB	−82dB	—	
Total harmonic distortion, −60dB	−43dB	—	
Total harmonic distortion, −80dB	−16.2dB	—	
Intermodulation, 19kHz/20kHz, 0dB	−85.1dB		
Intermodulation, 19kHz/20kHz, −10dB	−82.4dB		
Frequency response, left channel	+0.1dB, −0.05dB		
Frequency response, right channel	+0.09dB, −0.12dB		
Signal-to-noise, 20Hz-20kHz unweighted	−101dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	−94dB		
Output level, 0dB,	2.5V (also variable)		
Output impedance	100 ohms (variable up to 5.8 kohms)		
De-emphasis	correct		
Track access time	1.3 secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−100dB		
Resolution at −90dB	−2dB		
Headphone socket	yes (variable)		
Dimensions (w×d×h)	43×44×11cm		
Estimated typical purchase price	£2000		

First reviewed: 1985, II revision 1987.





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

TEAC PD-250

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.
TEL: (0753) 76911

Teac are fundamentally tape recorder specialists, and have enjoyed particular success amongst musicians and engineers in the semi-pro and professional areas of the music business for many years. Cassette decks have been the mainstay of their hi-fi activities, though they also market systems and other components, such as the CD player featured here.

The *PD-250* is a conventional full-width budget player, costing around £250 complete with a simple infra-red remote control. It is well-built, if light in weight, with a good standard of finish and logical presentation. The front panel is particularly well laid out, the larger main operating buttons, distinguished by size, falling easily to hand. The display has a single, rather small, switchable digital readout, plus a variety of status indicators. The normal range of operating features are provided, including audible scan, skip, repeat, programming, and display mode.

LAB REPORT

This 16-bit 2× oversampling design shares a single DAC between the two channels, giving some phase difference at high frequencies. The frequency response was pretty flat up to 5kHz, above which there was some unevenness and a slight overall rise, amounting to 1dB at 20kHz. Channel balance was close, but separation readings were somewhat below average — though good enough in themselves. Harmonic and intermodulation distortions were also below average with high level signals, but harmonic distortion at low levels was good. The IM spectrogram showed a substantial c25kHz component, but little else of significance.

Output level was about right, but the source impedance is rather high, so some care will be needed if planning to connect this player *via* passive potentiometers direct to power amplifiers. Shock and vibration rejection was good, mechanical noise moderate, and track access time a quite rapid 3 seconds. Error correction and tracking tests were handled without problems. Resolution was a very respectable 15.5-bits, with some high level compression noted.

SOUND QUALITY

Just scraping an 'average' rating for sound quality, the *PD-250* neither disgraced nor distinguished

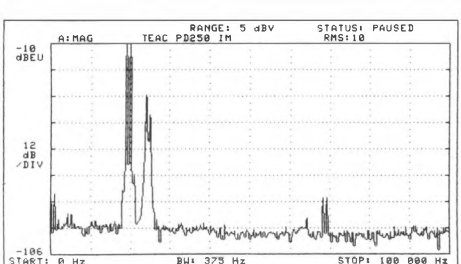
itself in the listening tests. With some midband 'hardening' and an 'upfront' presentation with bright and slightly brash treble, it was praised for good basic dynamics, but was felt to lack subtlety. Stereo focus, width and depth were all fairly good, and clarity was fair.

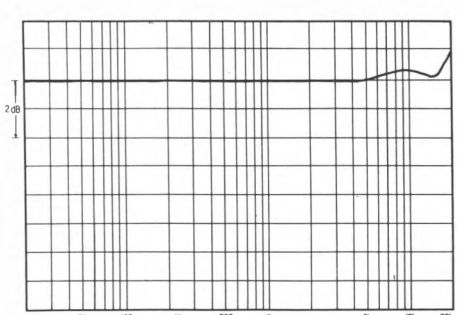
Conclusions

Offering a good range of facilities including remote control, plus a fine standard of finish and Japanese build quality, both lab and listening test results were acceptable rather than exceptional for the price, so the *PD-250* falls a little short of recommendation but is worth considering nonetheless.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.05dB	0.05dB	0.13dB
Stereo separation	84dB	86dB	69dB
Channel phase difference	0°	2°	40°
Total harmonic distortion, 0dB	−70dB	−70dB	−65dB
Total harmonic distortion, −10dB	—	−65dB	—
Total harmonic distortion, −60dB	—	−50dB	—
Total harmonic distortion, −80dB	—	−25dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−69dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−68dB	—
Frequency response, left channel	0.02dB, 0, 0.51dB		
Frequency response, right channel	0.02dB, 0, 0.58dB		
Signal-to-noise, 20Hz-20kHz unweighted	101/104dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	96/99dB		
Output level, 0dB, left/right	2.0V		
Output impedance	1.9kohms		
De-emphasis	1kHz, 0.39dB; 5kHz, 4.16dB; 16kHz, 8.73dB		
Track access time	3.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−104dB		
Resolution at −90dB	−88.6/−88.1dB		
Headphone socket	none		
Dimensions (w×d×h)	42.2×30×9.5cm		
Estimated typical purchase price	£250		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

TEAC ZD5000 (D3000)

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS, SL2 5DD.
TEL: (0753) 76911

Teac's designers have aimed at taking on the best available machines with this pair of upmarket models — the *ZD-3000* costs nearly £800 and the luxury *ZD-5000* nearly £900. While they are nominally of identical construction the '5000 actually has a heavier suspended chassis for the laser transport, and remote control of the audio output level.

Full feature machines, these large automatic drawer loaders both provide a wide range of facilities plus a high standard of finish and construction. Full remote control is provided, the handset including a numeric keyboard facilitating rapid programming. Features include audible music cueing, fast track skip, indexing, 'A-B' repeat plus normal repeat, and random order programming for up to 20 tracks. A short pause may be inserted between tracks if so desired. The clear multi-function display shows the usual data and track number, plus index numerals and playing time, which may be displayed simultaneously. The headphone socket has its own level control while a timer play mode is available, whereby the machine will start play automatically on power up. A subcode terminal is present on the rear panel, for future video graphics. The audio output is present on two terminals, one fixed at 2V and the other variable down to 55mV.

Technically, the machines are quite advanced. They use double D/A converters of 16 bit resolution, twice oversampled. Digital phase-linear filtering is followed by low rate rolloff analogue filtering at the final stage, quoted as seventh order. A special circuit, apparently a form of dither, has been applied to the converters in order to increase their resolution. A high speed transport system is fitted and great care has been taken over vibration isolation, particularly so in the case of the '5000 version, which is the main subject of this review. Our test model was a 110V sample, with an auto-transformer.

LAB REPORT

High linearity and a good resolution was claimed for this player, and was verified on test. The results showed very careful design, with superbly low distortion throughout and a full 16 bit resolution. At low and mid frequencies the distortion at full level measured around 0.001% and was still only 0.003% at 20kHz. Teac have also succeeded in suppressing the associated 24kHz beat component to −86dB.

The rejection of the spurious signals both in and out of the audio band was extremely good. The distortion performance was maintained at all levels and the intermodulation results were also exemplary; for example, −96dB at the −10dB level, which is almost impossible to credit! The impulse response, non-inverted, showed a well behaved, essentially linear phase characteristic. Interchannel phase shift held to a maximum of 40° by 20kHz, while channel balance was superb and the frequency response was superbly flat, barely deviating from the zero line.

Track access was very fast at 1.5 seconds, and mechanical noise rated as very low. Error correction was first rate as judged by the test discs, and a good shock resistance was shown. The signal to noise ratios were very good, reaching 103dB unweighted, with emphasis. A standard 2.1V output was obtained, from a modest 420 ohm impedance. The variable output showed a non-uniform output impedance up to a maximum of 5 kohms.

Sound Quality

Scoring above average, the *ZD-5000* was liked for its fine definition on transients. Edges in musical sounds were 'believable', while the focus was stable and strong. Depth and ambience were quite good, offset by some forwardness in the stereo presentation. The mid sounded a little bright with mild 'hardness', and the treble could also have been sweeter. However, the bass was firm and the overall character was lively.

Conclusions

Both these related machines offer superb technical performances with a near textbook standard of laboratory measured performance. The sound is good too, and was felt to be very precise but not quite as rewarding as the lab results might have suggested.

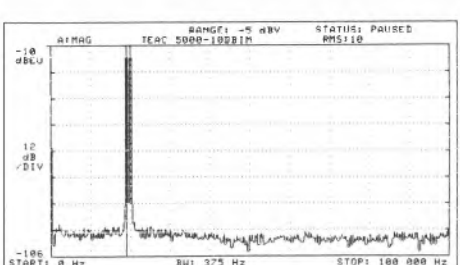
These are good machines but their sonic rating is not impressive enough for any recommendation, though they remain worthy of consideration.

Test Results

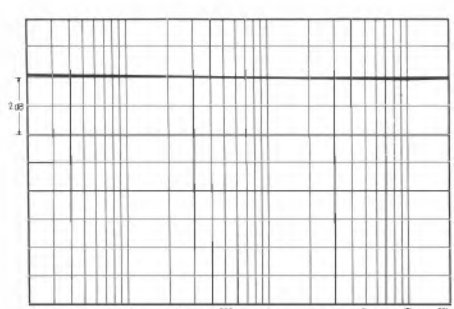
	20Hz	1kHz	20kHz
Channel balance	0.02dB	0.03dB	0.04dB
Stereo separation	−79.3dB	−79.5dB	−75.7dB*
Channel phase difference	0°	3°	40°
Total harmonic distortion, 0dB	−100.7dB	−98.7dB	−90.0dB
Total harmonic distortion, −10dB	—	−90.6dB	—
Total harmonic distortion, −60dB	—	−51.7dB	—
Total harmonic distortion, −80dB	—	−25.0dB	—
Intermodulation, 19kHz/20kHz, 0dB			−96.5dB
Intermodulation, 19kHz/20kHz, −10dB			−96.4dB
Frequency response, left channel			+0.10dB, −0.06dB
Frequency response, right channel			+0.10dB, −0.12dB
Signal-to-noise, 20Hz-20kHz unweighted			−99dB
Signal-to-noise, CCIR/ARM, 1kHz ref			−91dB
Output level, 0dB, left/right			2.1V
Output impedance			420ohms
De-emphasis			correct
Track access time			1.5secs
Error correction capability			>900μm gap, >800μm dot
Mechanical noise			very low
Spuriae up to 100kHz			−104.7dB
Resolution at −90dB			left −0.75dB, right −0.79dB
Headphone socket			yes (variable output)
Dimensions (w×d×h)			44.5×34.5×9.5cm
Estimated typical purchase price			£899, £799

**Left channel 77.8dB, 77.6dB, 72.8dB*

First reviewed 1986



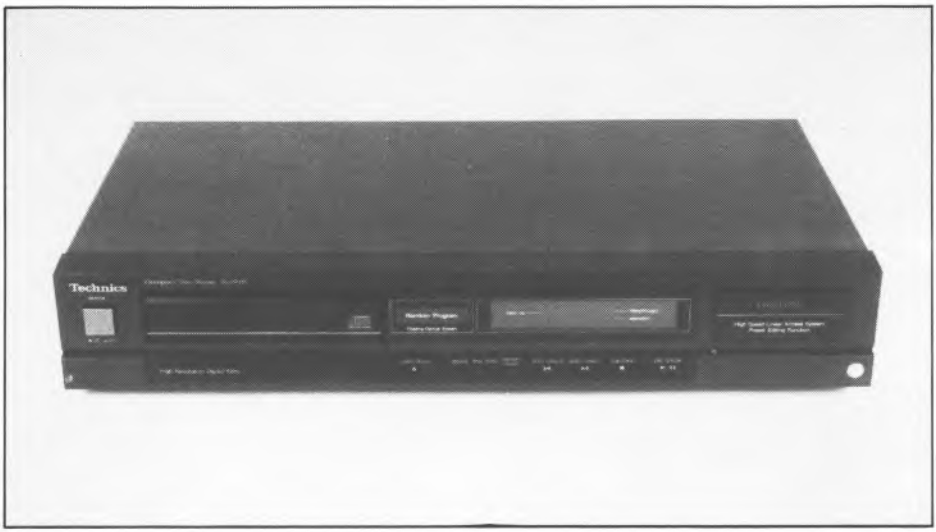
Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



BEST BUY

TECHNICS SL-P 111

PANASONIC UK LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.
TEL: (0753) 34522



The hi-fi brand of the mighty Matsushita organisation, Technics have been market leaders for many years, showing a particularly effective knack for choosing the right compromises when engineering components for the budget sector of the marketplace. This brand new full-width £179 Technics player is a little different from most others of its type in the way in which the controls function, though in other respects it is a conventional enough budget player. Lightweight in construction, it is nonetheless well finished and presented, and is technically based on well established methods seen previously on more upmarket players. In most respects the *SL-PJ22* midi size player is an identical smaller version.

Stark and simple enough to warm the hearts of many an audiophile, the *'111*'s total complement of six large and three small push-buttons makes a dramatic contrast with the Technics' upmarket players like the *'520*, *'720* and *'1200*. Surely Technics have not abandoned the feature race? Of course not! Many of these buttons serve more than one function, providing different facilities according to how they are pressed.

The result is a simple and easily understood configuration for the major tasks, plus the capability to do more for those prepared to crack the detailed code, set out in the even more detailed manual. Though distinctly economy-sized, the display panel has separate track and timing readouts, plus four machine status indicators. Most of the usual functions such as skip, audible scan, program play and repeat are available, plus something faintly bizarre requiring four separate control commands called 'preset edit play'.

LAB REPORT

The practice of applying older technology in budget players can be seen in the use of a single 16-bit linear time-shared DAC, with its attendant high frequency interchannel phase error, but the measurement set overall was pretty well balanced nonetheless, with no particular weakness and some good points. The frequency response was pretty flat, with just some unevenness and channel imbalance at high frequencies. Distortion measurements were good, particularly for intermodulation, while the latter's spectrogram showed just one spurious ultrasonic reflection.

The output level was a little higher than spec. — those who attempt to carry out A/B comparison should be warned that this player may be flattered by additional loudness if levels are not adjusted carefully. Track access was very fast, mechanical noise low, and shock and vibration immunity pretty good. Error correction and tracking tests were handled without problems, electrical noise and ultrasonic spuriae were both fairly low, while the practical low level linearity of our sample was a very good 15.7-bits.

Sound Quality

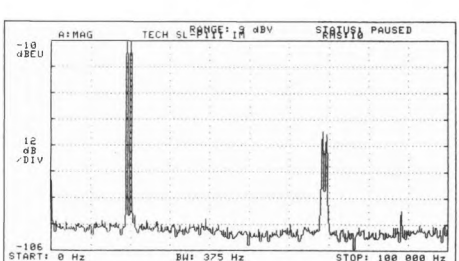
While not setting any new benchmarks for performance against price, the *SL-P111* acquitted itself very respectably in the listening tests, rating above average overall, a very acceptable result for the price. Typically Technics, the tidy sound was coherent and well focused, with an even tonal balance but slightly 'hardened' and a touch forward in the midband. The bass was good, and depth was quite well portrayed, but there was a slight loss of transparency and softening of dynamics.

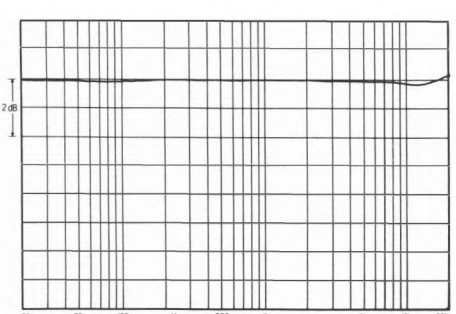
Conclusions

An above average sound quality at a well below average price, coupled with decent lab performance and good presentation and build quality is clearly the recipe for a Best Buy. The ergonomics of this player differ to a degree that may be appealing or infuriating, and the discerning may find the sound of some competitors more attractive, but the Technics scores above all on its good balance — its relative success in being most things to most men.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.08dB	0.09dB	0.27dB
Stereo separation	93dB	93dB	83dB
Channel phase difference	0°	2°	45°
Total harmonic distortion, 0dB	−80dB	−80dB	−83dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−43dB	—
Total harmonic distortion, −80dB	—	−17dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−88dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−100dB	—
Frequency response, left channel	−0.03dB, 0, 0.03dB		
Frequency response, right channel	−0.01dB, 0, −0.16dB		
Signal-to-noise, 20Hz-20kHz unweighted	96/99dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	91/94dB		
Output level, 0dB, left/right	2.5V		
Output impedance	550ohms		
De-emphasis	1kHz, 0.3dB; 5kHz, 4dB; 16kHz, 8.9dB		
Track access time	2.5secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−92dB		
Resolution at −90dB	−87.9/−90.6dB		
Headphone socket	no		
Dimensions (w×d×h)	43×23.5×7.1cm		
Estimated typical purchase price	£179		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

TECHNICS SL-P520

PANASONIC (UK) LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.
TEL: (0753) 34522

Cheaper of a pair of similar mid-priced machines, the full width £350 '520 has luxury features and facilities to satisfy the most eager button pusher, plus full function infra-red remote control (including coarse volume). It also incorporates a number of Technics' proprietary advanced engineering features such as search/dial cueing, high access speed optics, class AA analogue pre-amplification, and anti-vibration construction (comprising insulating feet and internal floating deck insulation). The elaborate display covers machine status, separate time and track/index, plus a disc menu to assist programming.

External 'camouflage' finish and build quality are to very high standards, and the exceptionally fast, quiet transport gives an expensive operating 'feel', but the complexity of controls and display suggest this is not a machine for sufferers of 'technofear'. Furthermore, the ergonomics are perhaps not totally logical, the dominant dial on the front panel merely controlling the fast cueing, a function of limited importance.

The main operating functions are on large buttons situated below the display, interspersed with 1-10 programming keys plus memory, clear and index buttons. Three other separate button clusters provide repeat play functions, volume control on a headphone output, and switch the cueing to high or low scan ratios, and auto space between tracks, and switch the time display mode.

LAB REPORT

Using 16-bit chips with 2× oversampling and digital filtering, it is perhaps a little surprising at this price level to find a single, time-shared DAC, with its inevitable interchannel phase shift at high frequencies. The frequency response was very flat indeed, showing just the suggestion of ripple at high frequencies. Stereo separation was very good, and harmonic distortion was fine at high levels, deteriorating somewhat at low levels. Intermodulation distortion measured pretty low, the ultrasonic spectrogram showing just one area of perturbation at 68kHz.

The quality of the transport mechanism is shown in the low mechanical noise, high track access speed, and very good resistance to external shock and vibration. Error correction tests were passed without fuss, electrical noise was low, ultrasonic spuriae were well suppressed, while low level linearity was a pretty good 15.5

bits. Overall, the *520* is the usual well balanced high quality lab performer we have come to expect from this manufacturer.

Sound Quality

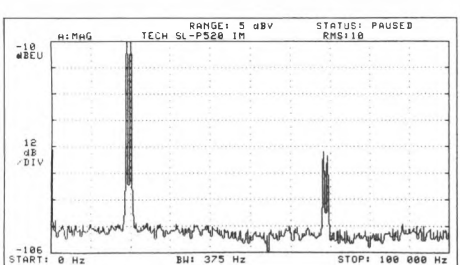
Comfortably rating above average, the *520* was difficult to fault soundwise, but at the same time failed to cause any great excitement or raise particular enthusiasm amongst the listeners. The balance was smooth, even and uncoloured, with a well-ordered, precise soundstage conveying subtle and delicate fine detail. But dynamics and transients seemed a touch muted and softened, giving a slightly bland effect throughout. Nice, polite and essentially very listenable, a slight lack of 'sparkle' held the score back a little.

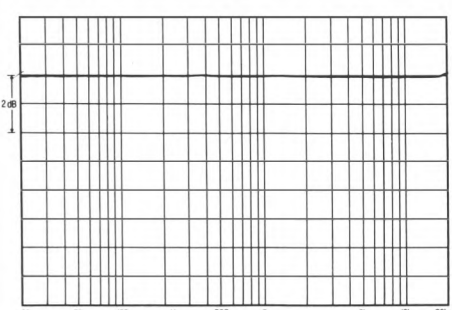
Conclusions

With a particularly fine transport mechanism and generally fine standards of build, engineering and lab performance, the Technics *'520* also offers an extravagant range of features and facilities at a quite competitive price. The sounds produced were also of decent quality, so recommendation is appropriate, while noting that this is a rather complicated machine to use.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.04dB	0.03dB	0.07dB
Stereo separation	103dB	105dB	82dB
Channel phase difference	0°	2°	40°
Total harmonic distortion, 0dB	−82dB	−84dB	−87dB
Total harmonic distortion, −10dB	—	−81dB	—
Total harmonic distortion, −60dB	—	−44dB	—
Total harmonic distortion, −80dB	—	−18dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−78dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−82dB	—
Frequency response, left channel	0.02dB, 0, −0.15dB		
Frequency response, right channel	0.01dB, 0, −0.19dB		
Signal-to-noise, 20Hz-20kHz unweighted	98/103dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	94/98dB		
Output level, 0dB, left/right	2.05V		
Output impedance	600ohms		
De-emphasis	1kHz, 0.31dB; 5kHz, 4.5dB; 16kHz, 8.9dB		
Track access time	2.0secs		
Error correction capability	>900μm gap, >800μm dot		
Mechanical noise	low		
Spuriae up to 100kHz	−101dB		
Resolution at −90dB	−87.1/−86.9dB		
Headphone socket	yes (variable output) 83ohms		
Dimensions (w×d×h)	43×27×8.8cm		
Estimated typical purchase price	£350		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

RECOMMENDED

TECHNICS SLP 720

PANASONIC UK LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB
TEL: (0753) 34522

More expensive of a pair of similar mid-priced machines, the full width £400 *720* has luxury features and facilities to satisfy the most eager button pusher, including full function infra-red remote control (including coarse volume). It also has a number of Technics' proprietary advanced engineering features such as search/dial cueing, high access speed optics, and class AA analogue pre-amplification. The elaborate display covers machine status, separate time and track/index, plus a disc menu to assist programming.

There are two key features over and above those provided on the *'520*: separate analogue and digital power supplies, with special quality circuit components; and even greater attention paid to reducing vibration, *via* an additional, heavy and inert TNRC/metal base. These factors add nearly a kilo to the net weight.

External 'camouflage' finish and build quality are to very high standards, and the exceptionally fast, quiet transport gives an expensive operating 'feel', but the complexity of controls and display suggest this is not a machine for the easily intimidated. Furthermore, the ergonomics are perhaps not totally logical, the dominant dial on the front panel merely controlling the dial cueing, a function of limited importance.

SOUND QUALITY

Though nominally similar in most respects to the *'520*, the *'720* established a clear preference on the listening tests, comfortably rating 'good' overall and clearly justifying its price — indeed the *'720* sounded effectively identical to the substantially more expensive and elaborate semi-pro *'1200*. Distinguished by supreme competence, the sound was remarkably neutral and well balanced, with good definition and control throughout the frequency range, but marginally losing fine focus in the treble. However, ultimately it was considered a trifle bland and uninvolving, with a mild loss of speed and dynamics.

CONCLUSIONS

The *'720* is clearly the best value amongst the top Technics models, and may be confidently recommended for its fine neutrality and self-effacement, plus excellent finish, facilities and build quality, for those who don't mind a little complexity in their lives.

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TECHNICS SL-P1200

PANASONIC (UK) LTD 300-318 BATH ROAD, SLOUGH BERKS
TEL: (0753) 34522

Technics have enjoyed considerable success in the market for professional and semi-professional record playing turntables — everywhere from broadcast stations to mobile discos — so when it came to designing a 'flagship' CD player, it is not surprising that they have done so with more than half an eye on this established stamping ground.

Despite the provision of remote control, the overall layout has been designed for hands on operation, more like a mini mixing desk than the more normal stackable component, and some of the features are outrageously different from any other machines around. Yet there has also clearly been a serious attempt to produce the highest sound quality as well, with a number of innovations designed to keep down error rates and improve tracking.

This machine makes most others feel flimsy and lightweight, paying great attention to excluding unwanted vibration. The top plate is a substantial die-casting, the base a heavy loaded rubber, and the whole unit is mounted on large insulating feet; the optical transport is separately decoupled within this outer shell. Technics 'class AA' hybrid IC amplifiers are used in both the output and the sample-and-hold circuitry.

The most obviously unusual feature is the 'search dial cueing', whereby a large knob electronically locked to the spinning disc can be spun, stopped and reversed, preserving audio output at whatever speed in the forward direction. This provides precise frame-by-frame cueing and also gets halfway towards creating DJ 'scratch' effects. Other useful semi-pro features include a most comprehensive display (to 0.1s timings), while the lightweight, advanced, single beam laser assembly gives remarkably fast access times under linear motor servo control. And this is in addition to all the usual functions carried by CD players, which in this instance are more numerous than most.

LAB REPORT

The frequency response is ruler flat. Despite high scale magnification it was impossible to distinguish from the rule on the graph paper below 5kHz. Channel balance too is remarkably close, with zero phase error at high frequencies. Harmonic and intermodulation distortions are both under closer control, and 0dB white noise showed no evidence of clipping. Resolution at −90dB showed some room for improvement.

Error correction was very good, with the gap, dot and 'fingerprint' tests passed without trouble. General mechanical noise from the player is well suppressed, and immunity from shock or vibration was exceptionally good. Track access was a very rapid 2secs, and the output level met specification, with an additional variable output from the headphone socket.

Sound Quality

Though falling short of more audiophile-oriented players at a similar price, the '1200' still gave a decent account of itself. Nice and 'bouncy', the soundstage was compressed and a little bland. The treble attracted some mild criticism of 'glare' and 'grain', giving a rather 'hi-fi-ish' sort of sound, lacking the full depth and space available elsewhere and showing some loss of air and transparency.

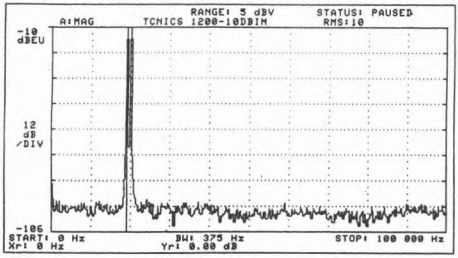
Conclusions

This Technics model provides a wealth of interesting and clever facilities that are quite unique, and therefore should have a particular appeal to the creative recordist and semi-pro user. Furthermore it is built like a brick water closet to an exceptional standard of finish. Though it did fall a little short of audiophile standards, it nevertheless still sounded pretty good, sufficient to merit serious consideration for those who value its particular range of features.

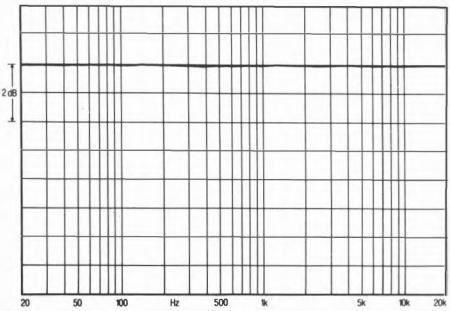
Test Results

	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.01dB	0dB
Stereo separation	90.7dB	107.3dB	85dB
Channel phase difference	0°	0°	0°
Total harmonic distortion, 0dB	−90.9dB	−86.4dB	−85.7dB
Total harmonic distortion, −10dB		−85.9dB	
Total harmonic distortion, −60dB		−38.5dB	
Total harmonic distortion, −80dB		−18.7dB	
Intermodulation, 19kHz/20kHz, 0dB			−85.6dB
Intermodulation, 19kHz/20kHz, −10dB			−93dB
Frequency response, left channel	0		0 −0.01dB
Frequency response, right channel	−0.02		0 −0.02dB
Signal-to-noise, 20Hz-20kHz unweighted			106dB
Signal-to-noise, CCIR/ARM, 1kHz ref			100dB
Output level, 0dB, left/right			1.99V
Output impedance			190 ohms
De-emphasis	−0.33dB(1kHz), −4.4dB(5kHz), −9dB(16kHz)		
Track access time			2secs
Error correction capability	gap>900µm, dot>800µm dot		
Mechanical noise			very low
Spuriae up to 100kHz			−100.8dB
Resolution at −90dB		−84.2dB, R	−83.8dB
Headphone socket			variable, 120 ohms
Dimensions (w×d×h)			43×38×17cm
Estimated typical purchase price			£800

First reviewed The Collection 1987



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



TECHNICS SL-XP5

PANASONIC UK LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.
TEL: (0753) 34522

Though originally shown in prototype form in mid 1986, the £230 *'XP5* only started appearing in the shops at the end of 1986, and is currently very much state of the 'personal' CD miniaturisation art. In Technics' struggle with Sony and Sanyo rivals, the second-generation *'XP5* is certainly one of the strongest contenders for 'world's smallest' honours. But it is bulky and heavy compared with personal conventional cassette players nonetheless, particularly in respect of the elaborate and expensive sealed rechargeable lead/acid battery pack. Separated from its battery unit the unit is very slim and light in weight, and can be used with a mains power supply which doubles as charger when the battery is connected.

One cannot fail to admire the technological skills evident in, for example, the tiny LCD display which mimics much of the information and many of the facilities provided on mains machines, including a music calendar. But the control and transport layouts do not have the same ease of use as the best cassette personals — the volume control is fiddly, for example.

The fixed output can be used for connection to a hi-fi system, or the variable output for driving headphones, the latter having an optional 'high cut' filter to provide more natural tonal balance for headphone listeners.

SOUND QUALITY

Rating only poor on sound quality, the *'XP5* seemed to suffer much the same fate as other super-compact personals, presumably due to the engineering compromises inevitably involved. Furthermore, the *'P5* sounded rather harder and more compressed *via* headphones than from its line socket, which is a trifle unfortunate considering its likely role. It was quite dynamic for a portable, with fairly tight upper bass and some depth, but with a loss of low bass and image scale. The treble was dulled with suppressed detail.

CONCLUSIONS

Though one must marvel at the technical ingenuity represented by such a beautifully crafted miniature, it is still difficult to regard it as much more than an expensive toy at the current level of development — power supplies and ergonomics, not to mention sound quality, still leave much to be desired.

TOSHIBA XR P9 RC

TOSHIBA (UK) LTD, TOSHIBA HOUSE, FRIMLEY ROAD, CAMBERLEY, SURREY.
TEL: (0276) 62222

This unusual player came as a complete surprise when I first set eyes on it. Designed with versatility in mind, it is intended to be used either as a battery portable, or as a fully featured mains machine, complete with remote control.

The main housing is a lightweight plastic affair, somewhat larger than the Sony or Technics miniatures, with the anticipated top loading system and manually operated lid to save space. The control area is realistically sized, with a highly readable liquid crystal display.

Power consumption is claimed to be rather less than the competition, and the battery pack uses the larger 'C' cells, so a battery set life of over nine hours is possible — double that of most other comparable machines. Facilities include the headphone socket and level control, plus audible music search, fast track skip and repeat. Up to 16 selections may be programmed, and a display button selects various modes to show track numbers, elapsed and remaining times.

For home use the battery pack with its shoulder strap is put aside, and the player is fitted to the mains power pack, a wedge-shaped unit which tilts the 'P9 sharply to provide a visually interesting result. The display is at a readable angle, and the controls are conveniently set. A little remote control sensor plugs in at the top, and with the handset the player then becomes a remote control mains machine; in fact the remote control provides more versatility as well as greater operational convenience.

By this means Toshiba has attempted to offer the best of both worlds: an economical battery portable combined with a fully fledged mains deck for easy home use. And the price is no higher than other portables — or indeed mains decks — of similar specification.

The electronics have been physically and electrically pared down, using a new generation of low consumption C.MOS integrated circuits of very large scale in terms of internal complexity. Such a design, where size and power consumption have been pushed to the limit, cannot afford to offer an advanced conversion process, and this machine is a standard 16 bit linear design, with a time-shared D/A converter followed by substantial analogue filtering.

LAB REPORT

While channel balance was excellent, the frequency response showed some rolloff at the

response extremes; not as uniform as usual, by normal standards it was nonetheless pretty flat. Channel separation was a poorer than average 76dB at low and mid frequencies, falling to a weak 54dB at 20kHz. The usual 82° or so of interchannel phase difference was recorded at 20kHz.

The machine was below CD par for harmonic distortion at full level, midband readings of −76dB worsening to −73.7dB at 20Hz and −58dB at 20kHz. Some full level limiting was apparent, since the white noise test signal was visibly clipped on the oscilloscope display. The 1kHz distortion figure improved at −10dB modulation, when in theory it should have been worse. Satisfactory results were obtained for the two-tone high frequency intermodulation tracks. However, at reducing modulation level the distortion rose too quickly, for example only 10dB down at −80dB, while the level error was a serious 24dB at −90dB, these results indicating an impaired resolution of 12 to 13 bits.

The error correction was satisfactory, and to its credit, the *'P9* resisted physical movement and vibration well — as indeed any portable should. The output was a lower than usual 0.82V from a 900ohm source, while electrical signal to noise ratios were just satisfactory, for example −78dB CCIR ARM without emphasis.

Sound Quality

Some essential attributes of the CD medium were present in the sound, but basically the deck fell well below present standard, and was rather disappointing.

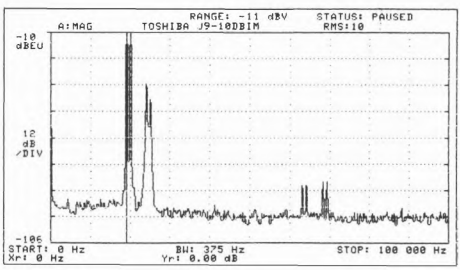
The bass seamed weak and 'softened', lacking tonal information and 'speed'. The mid was rounded and sweet, but lacking in definition, while the treble sounded restrained over most of the range, with some 'wispy' distortion audible in the high treble. Pleasant enough by uncritical standards, this player was uninvolving, and stereo focus bordered on the vague.

Conclusions

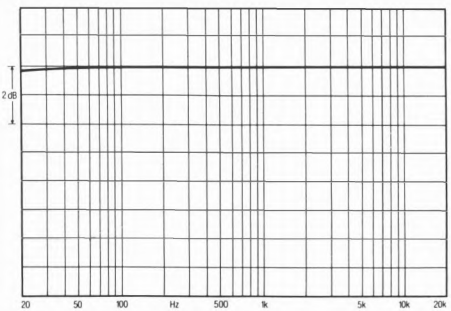
From a design viewpoint this is a very interesting player, and many who saw it liked the overall concept. The price is also realistic for the facilities, and it did work. But both the lab measured and subjectively assessed performance fell short of *Choice* recommendation standards.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.08dB	0.08dB	0.07dB
Stereo separation	79.9dB	75.4dB	54.2dB
Channel phase difference	0°	5°	82°
Total harmonic distortion, 0dB	−73.7dB	−76.1dB	−58.0dB
Total harmonic distortion, −10dB	—	−82.1dB	—
Total harmonic distortion, −60dB	—	−33.0dB	—
Total harmonic distortion, −80dB	—	−10.4dB	—
Intermodulation, 19kHz/20kHz, 0dB	−73.3dB		
Intermodulation, 19kHz/20kHz, −10dB	−87.2dB		
Frequency response, left channel	+0dB, −1.01dB		
Frequency response, right channel	+0dB, −1.16dB		
Signal-to-noise, 20Hz-20kHz unweighted	−75dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	−78dB		
Output level, 0dB, left/right	0.92V		
Output impedance	900ohms		
De-emphasis	correct		
Track access time	5.5secs		
Error correction capability	>700μm gap, >600μm dot		
Mechanical noise	moderate		
Spuriae up to 100kHz	−left −73.2dB, right −85.4dB		
Resolution at −90dB	left −24dB, right −23.66dB		
Headphone socket	yes (variable output)		
Dimensions (w×d×h)	16x20x13cm		
Estimated typical purchase price	£199		



Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



RECOMMENDED

YAMAHA CD-X5

YAMAHA ELECTRONICS UK LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD, HERTS WD1 7JS. TEL: (0923) 33166

This large and diverse Japanese company has a broad range of activities with a number of totally autonomous divisions, mostly reflecting a general interest in different aspects of music (disregarding the motorcycles of course). The hi-fi division has shown increasing strength on the UK market in recent years, with amplifiers and CD players making prominent contributions.

The *CD-X5* is their latest 1987 midi-sized budget player. It is a manual only machine costing around £200 with the usual basic quota of facilities, nicely finished and with good build quality, if rather light in weight and lacking any real anti-vibration measures.

The front panel is simple and straightforwardly laid out, with large buttons for main transport functions like play, skip and scan, and a smaller threesome for programming, repeat and display mode. The display itself is fairly elaborate, with two separate digital readouts for disc information, plus half a dozen status indicators. The rear panel carries just a stereo pair of phono sockets.

LAB REPORT

This Yamaha model uses a single time-shared 16-bit DAC, with 2× oversampling and digital filtering, so there is some high frequency interchannel phase shift. The response was pretty flat through bass and midband, but rose fractionally to a broad treble plateau, +0.4dB across the final octave. Channel balance was very close, and separation about average, deteriorating somewhat at high frequencies. Harmonic distortion was good, and intermodulation acceptable if below average, the spectrogram revealing significant ultrasonic spuriae.

The output impedance is sufficiently high to suggest exercising extra compatibility care if proposing to drive a power amplifier directly or *via* a passive volume control. Mechanical noise was quite low, track access a reasonable 4 seconds, but shock and vibration resistance was poor. Error correction tests were passed without fuss, electrical noise levels were quite low, but ultrasonics showed limited filtering. Low level linearity was a respectable 15.3-bits.

Sound Quality

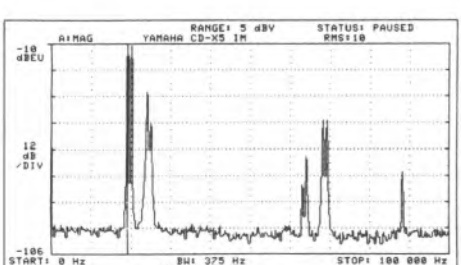
Rating a strong 'average' overall, this is a good result for a low cost player. The *CD-X5* is cheerful and lively, with good dynamics, but the sound was also a touch 'coarse' with hints of 'hardness' on loud sections. The upper treble was oddly projected and defocused from an otherwise good stereo image with fair depth and clarity. The bass showed good drive, but an impression of treble 'grain' and mild sibilant exaggeration remains.

Conclusions

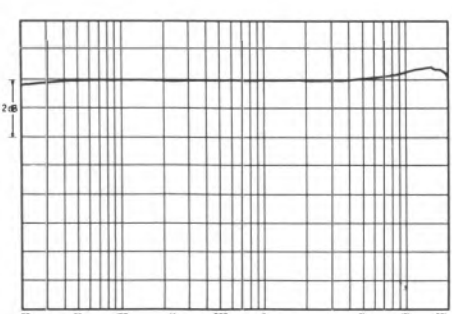
Good build quality, respectable lab performance and decent sound quality at a realistic price ensure that Yamaha's leading budget model continues to merit Recommendation in its latest guise. It is not in our view the best sounding in its class, but offers a fine overall balance taking the construction and finish into account.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.03dB	0.03dB	0.04dB
Stereo separation	86dB	85dB	66dB
Channel phase difference	0°	2°	40°
Total harmonic distortion, 0dB	−83dB	−84dB	−84dB
Total harmonic distortion, −10dB	—	−82dB	—
Total harmonic distortion, −60dB	—	−42.5dB	—
Total harmonic distortion, −80dB	—	−21dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−77dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−83dB	—
Frequency response, left channel	0.01dB, 0, −1.3dB		
Frequency response, right channel	0.01dB, 0, −1.34dB		
Signal-to-noise, 20Hz-20kHz unweighted	99/103dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	94/98dB		
Output level, 0dB, left/right	2V		
Output impedance	2.2kohms		
De-emphasis	1kHz, 0.26dB, 5kHz, 3.81dB, 16kHz, 9.1dB		
Track access time	4.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	quite low		
Spuriae up to 100kHz	−74dB		
Resolution at −90dB	−85.6/−85.4dB		
Headphone socket	yes (fixed output) 100ohms		
Dimensions (w×d×h)	34×7.7×28.5cm		
Estimated typical purchase price	£200		

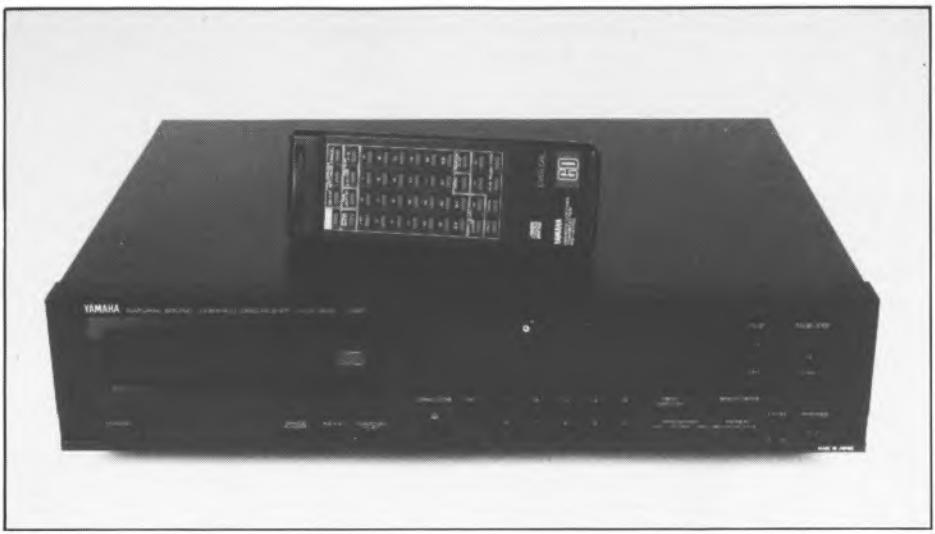


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.



YAMAHA CDX-900

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD, HERTS WD12 7JS. TEL: (0923) 33166



Yamaha have quite an extensive range of CD players at various price points, the £450 *900* sitting next to the top (£700) *'1100*, and above the (£300) *'700*. Though there is some sharing of certain technical features like the 'Hi-bit' 4X oversampling technique, each machine is differently built according to its station in life — the *'900* weighs 50 per cent more than the *'700* but only half the 13 kilo *'1100*, for example.

Though not the top of the tree, there is sufficient in the budget to make the *'900* a solid and hefty package, not to mention a complicated one as well. At least the main operating controls are sensibly placed and nicely accessible, though the layout of the subsidiaries will make most owners anxious not to lose the remote down the side of the sofa.

Like the *'1100*, the features line-up verges on the over-generous, though the *'900* does lack the remote volume control — arguably the two most useful buttons a handset can have. Yamaha's is a real button-bristler, with no less than 26 keys specifically for direct track entry — a superfluity which hardly enhances ease of use. Much the same may be said about the fluorescent display which has thirteen distinct indicators, showing three different (small) digital readouts simultaneously plus an abundance of machine and display status LEDs and a programme calendar — nearly but not quite the overkill of the *'1100*.

SOUND QUALITY

Only fractionally behind the *'1100*, the *'900*'s above average rating was also not all that far behind the budget *'X5* which is a mild disappointment considering the price. Good first impressions, with quite good depth, dynamics and a clear well-focused sound, were replaced by an awareness of some mildly fatiguing effects, with slight upper mid glare and compression, and certain coarseness and 'electronic' character. There was some loss of 'slam' and low level detail, but the treble quality was well liked.

CONCLUSIONS

Though the ergonomics could have been friendlier, one cannot quibble with the build quality or extensive facilities. However, the price level is a little high for the sound quality obtained under our listening conditions.

YAMAHA CDX-1100

YAMAHA ELECTRONICS UK LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD, HERTS WD1 7JS. TEL: (0923) 33166

This large and diverse Japanese company has a broad range of activities with a number of totally autonomous divisions, mostly reflecting a general interest in different aspects of music (disregarding the motorcycles of course). The hi-fi division has shown increasing strength on the UK market in recent years, with amplifiers and CD players making prominent contributions.

The *'1100* is a brand new 'flagship' model which is built to the very highest standards, with the latest technology and a most comprehensive features list. It has full infra-red control from a button-bristling handset which has no less than 26 keys specifically for direct track entry — a superfluity which hardly enhances ease of use. Much the same may be said about the fluorescent display which has fifteen distinct indicators, several of which are multiple groups, showing three different digital readouts simultaneously, an abundance of machine and display status LEDs, output level and laser position bar graphs, plus a programme calendar.

The machine itself is inevitably complex, with the usual standard operating functions plus 'random play' and 'space insert', neither of which are of great consequence. But at least the control surfaces are more intelligently laid out than those on the remote unit: in fact the front panel is ergonomically sensible, and is beautifully finished with a fine 'feel' to the various buttons. The whole unit is quite massively built for a CD player, with multiple power supplies and numerous special technofixes, not to mention feet that provide a measure of isolation.

LAB REPORT

The *'1100* uses Yamaha's new and advanced '18-bit floating' system with 4× oversampling, using two high speed, closely matched DACs to avoid interchannel phase shifts and provide high resolution. One would expect exceptional lab performance for such a flagship model, and the *'1100* in no way disappoints. The frequency response was ruler flat, interchannel phase difference minimal, and channel separation outstanding. Harmonic and intermodulation distortions were excellently low, the IM spectrogram being particularly clean.

Track access speed was fast and mechanical noise levels low, but the resistance to external shock and vibration was disappointingly average. Error correction and tracking tests were passed

without difficulty, and signal-to-noise ratios approach the state-of-the-art. Ultrasonic spuriae were held to very low levels, and low level linearity was a very close 15.8-bits.

Sound Quality

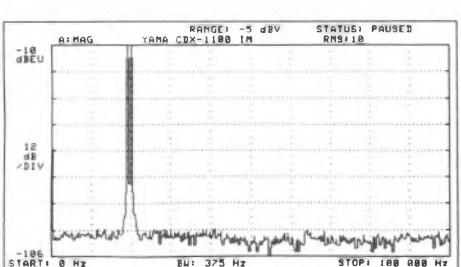
The above average rating gained in our listening tests is no disgrace, but it must also be considered something of a disappointment considering the price. The basic sound was undoubtedly good and exceptionally tidy in all respects, but it was also considered ultimately unrewarding, adding something of a 'mechanical' quality and failing to convey scale, emotion or excitement convincingly. Specific criticisms were few, noting some loss of focus stability in the mid-band, but the panel reaction was more that of respect than enthusiasm.

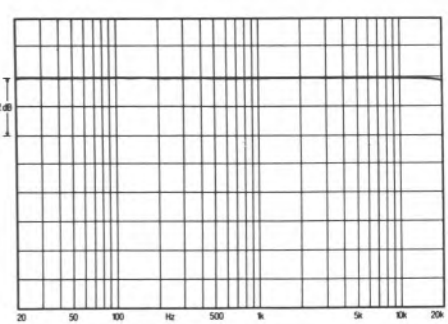
Conclusions

It is difficult not to be swayed by the formidable build quality and feature count on this prestigious model, without taking into account Yamaha's individual contribution to advancing the digitial conversion process. Yet despite an exceptional lab performance, the listening panel were not unduly impressed. Even though the reasons remain somewhat enigmatic, it would seem that recommendation is not appropriate considering the high price, though the *CD-1100* is certainly worth considering.

Test Results

	20Hz	1kHz	20kHz
Channel balance	0.01dB	0.01dB	0.14dB
Stereo separation	121dB	112dB	110dB
Channel phase difference	0°	0°	5°
Total harmonic distortion, 0dB	−84dB	−88dB	−85dB
Total harmonic distortion, −10dB	—	−85dB	—
Total harmonic distortion, −60dB	—	−49dB	—
Total harmonic distortion, −80dB	—	−24.2dB	—
Intermodulation, 19kHz/20kHz, 0dB	—	−85dB	—
Intermodulation, 19kHz/20kHz, −10dB	—	−100dB	—
Frequency response, left channel	0dB, 0, 0.1dB		
Frequency response, right channel	0dB, 0, 0.05dB		
Signal-to-noise, 20Hz-20kHz unweighted	112/113dB		
Signal-to-noise, CCIR/ARM, 1kHz ref	106/107dB		
Output level, 0dB, left/right	2.15V		
Output impedance	50ohms		
De-emphasis	1kHz, 0.3dB, 5kHz, 4.05dB, 16kHz, 9.07dB		
Track access time	2.0secs		
Error correction capability	>900µm gap, >800µm dot		
Mechanical noise	very low		
Spuriae up to 100kHz	−108dB		
Resolution at −90dB	−87.8/−88.3dB		
Headphone socket	yes (variable output) 150ohms		
Dimensions (w×d×h)	43.4×40×12cm		
Estimated typical purchase price	£700		





Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response.

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DEALER GUIDE

CONCLUSIONS, BEST BUYS AND RECOMMENDATIONS

From a historical background of 100 or more, this new edition of CD Players adds 50 new machines to the half-dozen high priced models recently covered in *The Collection*, to give *Hi-Fi Choice's* uniquely broad-based perspective on the current state of the CD hardware marketplace.

As the digital bandwaggon continues to gain momentum, so the prices of machines for a given range of features and facilities gradually drift lower (10-20 per cent this past twelvemonth we estimate). At the same time the sound quality even of cheaper machines continues to improve — according to our scoring system the average sound quality improvement over the past twelve months has been a substantial 10 per cent for CD players as a whole, whereas the year on increase for amplifier and loudspeakers are more of the order of 2-3 per cent.

The current situation finds sub-£200 players that are manual only and usually relying on slightly older technology; £200 brings the latest technology with some quite impressive sound quality ratings but still with manual control; the latest generation remote control players start at around £230.

Further increases in price can of course bring additional benefits in sound quality, build quality and features, and in fact higher price players are proving very popular in the marketplace. It was particularly interesting to calculate that the average price of the various players assessed for this new edition came to a highish £520, though this is due in no small part to the Nakamichi influence.

Certain groups of players have been radically improved. The now established 16-bit Philips technology, found in various guises in some 15 of the models we have tested, shows an improvement of around 15 per cent in sound quality over the equivalent models of a year ago. Individual 'high-end' models show a similar up grade in standards. For example, the Cambridge Audio *CD1* has re-established its top position with a major subjective improvement. Nakamichi are also now establishing reference standards with the *OMS-4E*, followed closely by the uniquely designed and very versatile Meridian *207*, the luxury new Sony *CDP 555ES*, and the competitive Denon *DCD-1700*.

The very good sound quality of some of the cheaper 'budget' models does tend to undermine the position of some mid-priced machines. However, the exceptional sound versus price of many Hasselt/Philips-based machinery can be seen to balance out to some extent against their somewhat more plasticky build quality compared to Japanese models. (Last year's brief rash of unreliability amongst Hasselt mechanisms now seems to have been engineered out of the design.)

On the technical side, a handful of 16-bit linear designs are still holding out at the budget end of the market, but oversampling techniques seem to have effectively taken over. Philips pioneered 4X oversampling, while the Japanese commenced with linear designs and then moved on to the 2X oversampling which is now most widespread.

This year a new generation of 4X oversampling Japanese players are appearing, often making use of some Philips chips, like the Sony incorporating the Philips 1541 DAC. These would seem to show the expected subjective improvements of purer high frequencies and more precise stereo imagery, probably attributable to the use of high performance linear phase digital filters instead of inferior earlier analogue 'brick-wall' designs. For such reasons we are particularly looking forward to the promised but not yet ready new mid-price design from Cambridge Audio, purported to use 16X oversampling!

It will not be long before DAT (digital audio tape) appears on the scene as a tape-based digital alternative/competitor to CD. At initial machine prices of £1000+, DAT will have the ad-

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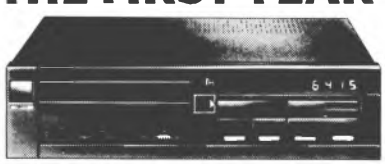

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*Refers to Bristol showroom – branch facilities vary.

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vantage of being able to record (albeit not directly in the digital domain from commercial sources), though pre-recorded material currently remains an unknown quantity — even blank (two hour) tapes are expected to cost £10 initially. Assuming it is not stifled at birth by the current political Copycode shenanigans (which is beyond the scope of this feature), it is still apparent that DAT growth will be much slower than the CD experience.

Bearing in mind that the two formats have generally similar digital coding systems and therefore potentials, we obtained a Japanese home market DAT machine prior to publication, to assess its competitiveness *vis à vis* CD. However, inevitable degradation is introduced by the decoding/encoding operation due to the prohibition of direct digital dubbing. And in our estimate a disc recorded from a £700 CD player will replay from a first generation £1,000 DAT machine at about the quality level of a £200-250 CD player. DAT's initial impetus will clearly be blunted by Nakamichi-type prices, but assuming the format does get off the ground it is more likely to join and complement CD than replace it.

While CD is steadily asserting itself in the audio marketplace, further optical disc systems and applications are appearing. Philips recently announced CD Video, combining video with digital audio in different combinations and with 'single', EP and LP disc sizes. Further activity is expected in CD-I (interactive CD-based electronic publishing), and CD-ROM (computer program and data storage), all of which should help ensure the long term future of optical discs.

There remains a shortfall when comparing the best of CD with the best of analogue vinyl, but the gap seems to be steadily narrowing — partly no doubt because of the increasing difficulty of finding top quality analogue vinyl recordings these days. But to end on a positive note, CD is currently advancing more rapidly than analogue, and as long as reviewers and customers retain a healthy critical attitude this should spur the designers of CD to even greater efforts.

Best Buys And Recommendations

The following machines have been selected first and foremost because of the good performance they deliver for their price (current on going to press, as quoted in the review), particularly on sound quality grounds. We also take account of build quality, lab performance, facilities and presentation, but the customer should decide for him or herself the relative importance of such factors.

Only lower price machines are considered eligible for Best Buy ratings, while sheer value for money is less important than value *per se* when Recommending the more expensive machines in particular. We should also point out that a 'worth considering' rating or even none whatsoever does not necessarily imply condemnation. Some machines behaved perfectly adequately but simply failed to distinguish themselves sufficiently in our listening tests. Under other conditions they could well fit the bill.

The players in each category are listed in ascending order of price.

Best Buys

Technics SLP-111 (£179)
Simply presented manual midi player with good build and fair sound.

Ferguson CD-04 (£199)
A stylish manual midi player which gave good sound from Yamaha technology.

Marantz CD273 (£199)
Fine sounding manual midi-player, though not as ruggedly built as some.

Philips CD160 (£199)
Fine sounding manual midi player, though not as ruggedly built as some.

Philips CD460 (£199)
This full width plastic player gives exceptional sound at a recently reduced price; remote optional.

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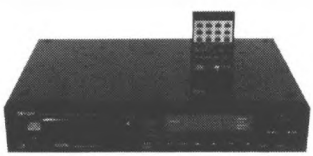
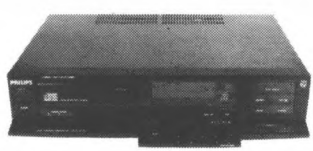
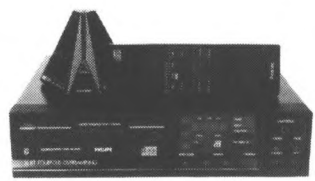


DENON DCD700



PHILIPS CD960



PHILIPS CD360

Other agencies include:

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Denon DCD-300 (£210)
Nicely built manual midi player with well balanced sound.
Marantz CD273SE (£239)
Marantz 'tweaks' enhance '273 sound significantly (see above).
Philips CD360 (£249)
An outstanding plastic midi package with remote and FTS, plus exceptional sound for the money.
Denon DCD-700 (£290)
Good sounding solidly built full width remote control player.
Sony CDP-710 (£300)
Exceptional sound quality for the money, plus lots of features and remote in a well built full width player.
Marantz CD75 (£450)
Near audiophile sound quality at sub-audiophile prices from this remote full-width player.

Recommended Models

Philips CD150B (£180)
The bargain price reflects slighter older technology, but the sound quality is still good for the price.
Aiwa DX-660 (£199)
A decent quality midi player based on older Philips technology, particularly appropriate in an Aiwa system context.
Akai CDM 515 (£199)
Still available, this neat and attractive 1986 Best Buy is now Recommended as a good all round performer.
Sony CDP-M20 (£199)
Sony's leading budget midi machine gave a well balanced performance with good build and presentation.
Yamaha CD-X5 (£199)
Fine construction and finish with decent sound quality put Yamaha's budget midi player into the Recommended class.
Denon DCD-500 (£249)
Decent sounding manual full width player with good build quality.
Rotel RCD-820 (£249)
Rotel's Philips clone gives good sound quality, with promise of imminent remote control.
Sony CDP-310 (£250)
Full size, full remote plus respectable sound quality makes a competitive combination.
AR CD-04 (£289)
AR's remote full-width Philips clone gives good sound quality and adequate build.
Kenwood DP-990D (£299)
Luxury finish, comprehensive features and a respectable enough sound quality.
Denon DCD-900 (£329)
A good sounding full size, full remote machine with well balanced performance and build.
Rotel RCD-820BX (£350)
Rotel's 'tweaked' Philips clone is pretty competitive soundwise, with remote promised soon.
Technics SLP-520 (£350)
A complex full feature remote machine with fine build and respectable sound quality.
Marantz CD65 (£380)
Deservedly popular full width manual machine with superior sound quality, adequate build.
Technics SLP-720 (£400)
Improving significantly soundwise on the '520, the '720 has similarly excellent lab performance and build.
Sony CDP-222ES (£450)
Luxury ES model with beautiful finish and complex facilities, plus reasonably good sound quality.
Denon DCD-1700 (£599)
Very good sound quality distinguishes this fine all rounder from most of its immediate competition.
Mission PCM 7000 (£600)
Significant modifications plus very good sound quality set this remote-volume Philips-based machine ahead of most competitors.
Philips CD960 (£700)
Very good sound quality plus Japanese build plus FTS — what more could one want?
Marantz CD94 (£799)
Luxury Marantz flagship from their Japanese fac-

tory gives very good sound with extensive features and fine lab performance.

Sonographe CD1 (£800)
Basic Philips chassis with the Conrad Johnson touch creates reference standard sound quality with adequate build.

Meridian 207 (£850)
Uniquely versatile and handsome, Meridian's transport and Philips chips create a benchmark for sound quality.

Sony CDP-555ES (£1,000)
Luxury-build heavyweight *ES* model gives very good sound quality with exceptional lab performance.

Nakamichi OMS-4E (£1200)
Nakamichi's unique luxury/specialist appeal is combined with reference standard sound quality.

Cambridge Audio CD1 (£1500)
Build may be bettered elsewhere, but not the sound quality of our reference yardstick.

Worth Considering

Falling only slightly short of formal recommendation and therefore deserving honourable mention are the following models:

Memorex CD1400 (£230)
Teac PD250 (£249)
Mitsubishi DP-290R (£250)
Akai CD-A70 (£299)
Hitachi DA-007 (£330)
Denon DCD-1500 (£480)
Shure Ultra 6000 (£495)
Revox B226 (£754)
Technics SLP-1200 (£800)
Sony CDP-552II/DA-S703 (£2,000)

Sony D30 (£230) (personal portable)

Pioneer PD-M70 (£399) (autochanger)
JVC XL-M700 (£570) (autocharger plus single player)

DEALER DIRECTORY

Choosing a good hi-fi dealer is the most vital step in acquiring the system that is right for you. This uique directory gives full information on dealers in your area.

AVON

ABSOLUTE SOUND AND VIDEO, 65 Park St, Clifton, Bristol. (0272) 264975. A&R, Denon, Dual, Linn, Mission, NAD, Quad, Roksan, Rotel, Yamaha, etc. (closed Weds) BADA MEMBER

PAUL GREEN HI-FI LTD, Kensington Showrooms, London Rd, Bath. (0225) 316197. A&R, Creek, Dual, Heybrook, Linn, Musical Fidelity, Rotel, Systemdek, Wharfedale. Dem facilities available, ring for appointment, car park. Open Tues-Sat, 9-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa. BADA MEMBER.

PAUL ROBERTS HI-FI, 31-33 Gloucester Rd, Bristol. (0272) 429370. Stock a full range of hi-fi from over 60 brands. specialise in C.D. Dem facilities available. Open Mon-Fri 9.30-7.30, Sat 9.30-6;00. Home trial facilities. Free installation. Instant credit. Credit cards: Access, Visa, Amex. Service dept.

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AYLESBURY HI FIDELITY, 98 Cambridge St, Aylesbury. (0296) 28790. Dual, Heybrook, Linn arms, Musical Fidelity, Mission, NAD, Nakamichi, Quad, Rotel. 2 Dem rooms available, ring for appointment. Open 10-6 Mon-Fri, 9.30-5.30 Sat. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Amex, Diner, Visa. Service dept.

CAMBRIDGSHIRE

CAMBRIDGE HI FI, 1 Hawthorn Way, Cambridge. (0223) 67773. AR, Cambridge Audio, Monitor Audio, Panasonic, Pioneer, Sony ES, Technics, Thorens, Trio, Yamaha. Demonstration facilities. No appointment required. Open 9.30-5.30 Mon-Sat. Free installation. Credit facilities. Up to any amount. Credit cards: Access, Barclaycard. Service dept. available. BADA MEMBER

STEVE BOXSHALL AUDIO, 41 Victoria Rd, Cambridge. (0223) 68305. Quad, Rotel, Dual, Denon, Krell, Nakamichi, Marantz, Monitor Audio, Tannoy. Demonstratin facilities. No appointment required. Open 10.00-6.00, Mon-Sat. Home trial facilities, free installation, credit facilities. Credit up to £3,000. Credit cards: Access, Barclaycard. Service dept.

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ASTON AUDIO, 4 West St. Alderley Edge. (0625) 582704. Wide selection of equipment in N.W. Two-year guarantee. Dem facilities: 3 dem rooms, appointment required. Open 10-6 Tues-Sat. Home trial facilities, free installation. Instant credit up to £1,000. Credit cards: Access, Amex, Diners, Visa. Service dept. BADA MEMBER

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HI FI CENTRE, Green Lane, Wilmslow SK9 1LQ. Tel: (0625) 522112/524766. B&O, Technics, Sony, Panasonic, Nakamichi, Quad, Revox, Teac, Harman Kardon, Marantz. Demonstration facilities — no appointments required. Open 9-1, 2-5.30 (closed Wed). Open all day Sat. Home trial facilities, free installation, credit facilities. New customers up to £500 credit. Credit cards: Access, Visa, American Express, Diners Club, Wilmslow Card. Service dept. available.

NEW DAWN HI-FI, 1-3 Castle St, Lower Bridge St, Chester. (0244) 24179. Linn, Quad, Technics, National Panasonic, Denon, Rotel, Dual, Meridian, Aiwa, Philips. Dem facilities: 2 dem rooms. Open 9.00-5.30 Mon-Sat, closed Wed. Free installation, instant credit. Credit cards: Access, Visa, Trustcard. BADA MEMBER

SWIFT OF WILMSLOW, 4-8 St Annes Parade, Wilmslow. (0625) 526213. A&R, Aiwa, Denon, Dual, Marantz, Mission, Monitor-Audio, Pioneer, Trio, Yamaha, NAD. Dem facilities available. Open Mon-Sat 9.15-5.45. Closed 1-2 Lunch. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept. BADA MEMBER

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TRURO HI-FI & E.T.S. Ltd, 25 King St, Truro. (0872) 79809. A&R, Denon, Dual, Heybrook, Linn, Mission Cyrus, Nad, Quad, Rotel, Thorens. Dem facilities: Single speaker studio. Open Mon-Sat 8.45-5.30. Home trial facilities, credit up to £1.000. Credit cards: Access, ETS Visa. Service dept.

DERBYSHIRE

ACTIVE AUDIO, 12 Osmaston Rd, The Spot, Derby. (0332) 380385. Meridian, Mission, Denon, Yamaha, Rotel, A&R Cambridge, Monitor Audio, Trio, Marantz. Demonstration facilities. Open 9.30-6.00 — early closing Wednesday. Home trial facilities: credit up to £1,000. Credit cards: Access, Barclaycard, Diners, American Express. Service dept. BADA MEMBER.

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A.T. LABS, 442/4 Cranbrook Rd, Gants Hill, Ilford. (01) 518 0915. Open Mon-Sat, 10-6. Two single speaker dem rooms. Credit cards: Access, Amex, Visa. BADA MEMBER

BEECHWOOD AUDIO, 6 Market St, Braintree. (0376) 29060. A&R, Ariston, B&W, KEF, Meridian, Musical Fidelity, NAD, Nakamichi, Pink Triangle, Quad, Rotel. Dem facilities 2 single speaker rooms. Open Mon-Sat, 9.30-6.00. Home trial facilities. Free installation, instant credit up to £1,000. Credit cards: Access, Amex, Diners, Visa.

BRENTWOOD MUSIC & HI-FI CENTRE, 2 Ingrave Rd, Brentwood. (0277) 221210. B&W, Denon, Harmon Kardon,

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RUSH HI-FI & VIDEO, 5/6 Cornhill, Chelmsford. (0245) 57593. Akai, Aiwa, JVC, Marantz, NAD, Quad, Rotel, Sansui, Sony, Technics. Dem facilities available, ring for appointment. Open Mon-Fri 9.30-6.00 Sat 9.00-5.00. Home trial facilities, free credit. Credit cards: Access, Amex, Visa, Diners. Service dept.

GLOUCESTERSHIRE

ABSOLUTE SOUND AND VIDEO, 40/42 Albion St, Cheltenham. (0242) 583960. A&R, Denon, Dual, Linn, Meridian, Mission, NAD, Rotel, Technics, Yamaha, etc. (Closed Wed). BADA MEMBER

AUDIO EXCELLENCE, 58 Bristol Road, Gloucester. (0452) 300046. Audio Research, Dual, Krell, Linn, Magneplanar, Naim, NAD, Yamaha and lots more. Closed Mon.

ROBBS OF CHELTENHAM, 3 Clarence St, Cheltenham. (0242) 584404. Sansui pure hi-fi, Kenwood, Sony ES, Dual, Technics, QED, Heybrook. Dem facilities. Open 9-5.30 Mon-Sat. Instant free credit. Credit cards: Visa, Access. Service dept.

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TRUE-FI SOUND AND VISION, 10/12 Grosvenor Rd, Aldershot. (0252) 26390. Akai, Aiwa, B&W, Nakamichi, Hitachi, JPW, Mission, Mordaunt-Short, Nagaoka, Sony, Technics. Dem facilities available. Open 9.30-6.00 Mon-Sat. Free installation, instant credit up to £1,200. Credit cards accepted: Access, Barclaycard. Service dept.

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ACOUSTIC ARTS Ltd, 101 St Albans Rd, Watford, Herts. (0923) 45250. A&R, Audiolab, Beard, Conrad-Johnson, Denon, Heybrook, Magneplanar, Mission, Quad, Rogers. Dem facilities: 2 dem studios, ring for appointment. Open Mon-Sat 9.30-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

THE AUDIO FILE, 40 Hockerill St, Bishops Stortford, Herts. (0279) 506576. Linn, Roksan, Rega, Naim, A&R (Camb), Heybrook, Rotel, Denon, Epos, QED. Demonstration facilities, no appointment required. Open 9.30-5.30 Mon-Sat. Home trial facilities. Free installation, credit facilities up to £1,000. Credit cards: Access, Visa, Diners, Amex. Service dept. available.

W. DARBY & CO. Ltd, St Peter's St, St Albans. (0727) 50961. B&O, SonyES, Quad, A&R Cambridge, Revox, Denon, Yamaha, Luxman, Ariston, Thorens. Demonstration facilities, no appointment required. Open Mon-Sat 9.00-5.30. Home trial facilities, free installation, credit facilities. Credit cards: Access and Barclaycard. Service dept.

KENT

JOHN MARLEY HI-FI CENTRES, 2 Station Rd West, Canterbury. (Canterbury) 69329. Also at Dover — (0304) 207562. B&W, Heybrook, Magnum, M.Y.S.T., Nakamichi, Pink Triangle, Rotel, Sansui, Technics, Quad. Dem facilities available. Open Mon-Sat 9.00-5.30 closed Thurs. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa, Creditcharge. Service dept.

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HI-TECH AUDIO, 7 Moor Lane, Clitheroe, Lancs BBY 1BE. (0200) 26563. Mission, Audio Innovations, Rogers, Quad, Rotel, NAD, Elite Rock, B&W, Castle, Wharfedale. Dem facilities, appointment required. Open 9.30-5.00, closed Wednesdays. Home trial facilities, free installation, credit up to £1000. Credit cards: Access, Visa, Amex, Diners. Service dept. Mail order.

MONITOR SOUND , 54 Chapel St, Chorley. (02572) 71935. A&R, Dual, Mission, Quad, Rogers, Rotel, Spendor, Thorens, Nakamichi, Yamaha, etc. Dem facilities. 2 dem rooms. Open Mon-Sat, closed Weds. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

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SOUND ADVICE, The Sound Factory, Duke St, Loughborough LE11 1ED. (0509) 218254. A&R, Creek, Linn Products, Epos, Mission Cyrus, Naim, Rega, Roksan, Rotel, Yamaha. Dem facilities, domestic size and furnished studios. Callers welcomed. Demonstrations by appointment. Open 9.30-6.00 Mon-Sat. Free installation. Credit facilities. Credit cards: Access, Visa, Amex. Service dept.

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AUDIO T, 190 West End Lane, London NW6. (01) 794 7848. Open Mon-Sat, 10-6.00. Two single speaker dem rooms. Access, Amex, Visa. BADA MEMBER

BILLY VEE, 248 Lee High Rd. Lewisham, London SE13 5PT. (01) 318 5755/852 1321. Aiwa, A&R, Creek, Dual, KEF, Linn, Heybrook, Quad, Naim, Rega. Dem facilities: 2 single system studios ring for appointment. Open Mon-Sat 10-7, closed Thurs. Home trial facilities, free installation, interest free credit up to £750.00. Credit cards: Access, Visa. Service dept. BADA MEMBER

CORNFLAKE SHOP, 37 Windmill Street (just off Tottenham Court Road), London W1. (01) 631 0472. 10am-7pm, Mon-Sat. Cambridge, DNM, Epos, Koetsu, Naim, PS Audio, Roksan, SME, Van den Hul. Excellent demonstrations, 2 demo rooms, full delivery and installation service. Full credit facilities. Credit cards: Access, Visa.

GRAHAMS HI-FI, 86-88 Pentonville Rd, London N1. (01) 837 4412. 'FBA Dealer of the year 1985.' Linn, Naim, Rega etc. £300-£3,000-£13,000. BADA MEMBER

H.L. SMITH & Co. Ltd, 287-289 Edgware Rd, London W2 1BE. (01) 723 5891. Aiwa, B&W, Denon, Dual, KEF, Ortofon, Panasonic, Sony, Technics, Yamaha. Dem facilities available. Open Mon-Sat 9-5.30, Thurs 9-1, instant credit up to £1,000. Credit cards: Access, Visa, Diners. Service dept.

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MUSICAL IMAGES, 45 High St, Hounslow, Middlesex. (01) 570 7512. AR, A&R, B&W, Bose, Denon, Dual, Harmon Kardon, Musical Fidelity, Nakamichi, Quad. Single speaker dem room. Open 9.30-6 Mon-Sat. All credit cards.

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GLOSSARY

ACOUSTIC BREAKTHROUGH: Sound or other vibration reaching the CD mechanism may affect performance, hence manufacturers' attention to isolation of the mechanism by rubber mounts etc. However, CD players cannot suffer acoustic feedback in the sense that analogue turntables do.

AMPLITUDE: Size or magnitude; hence the amplitude/frequency response, known normally simply as the frequency response, which describes the relative loudness of the system at different frequencies with a constant input voltage.

BALANCE: 1) The overall relative loudness perceived at different frequencies (eg bass, treble; 2) the accuracy of the match between the two channels of a stereo component.

BANDWIDTH: A range of frequencies with presumed defined upper and lower limits.

BASS: Lower part of the frequency spectrum.

BIT: Binary digit, either '0' or '1'. In a digital audio system, each instantaneous voltage level measured (see Sampling) by the system is expressed as a binary number (ie a number to the base 2, using only '0' or '1', represented electrically by 'on' and 'off' conditions). With 16 bits this gives a range of values between zero and 65535.

CLIPPING: This is reached when a circuit is overloaded and overdriven, resulting in bad waveform distortion and audibly unpleasant effects.

COLORATION: A general term used to describe the audible effects of distortions, particularly in loudspeakers and record players. These are usually caused by frequency response irregularities and/or resonances.

COMPATIBILITY: The selection of interdependent components to achieve optimum system performance; notably arm/cartridge mass/compliance matching, cartridge electrical loading, or loudspeaker compatibility with amplifiers.

CROSSTALK: The leakage from one channel to the other in a two channel stereo system.

DAMPING: A means of controlling resonances by means of a resistive medium (electrical, mechanical, or acoustic).

DAC: see Digital-to-analogue convertor.

DECIBEL (dB): A logarithmic measure of the ratio between two power levels. A doubling of power (number of watts) in an electrical circuit can be denoted as an increase of 3dB, while a doubling of voltage is denoted by 6dB. The logarithmic scale makes decibels convenient for ratios that span a wide range on a linear scale; for example, an increase or difference of 20dB represents ten times the power or 100 times the voltage. Sound pressure level can be expressed in dBA where 0dBA represents the threshold of hearing and 120dBA the threshold of pain. A 1dB change in sound level is regarded as the minimum change that can easily be detected by a fairly experienced listener, while a 6dB increase can be regarded as a subjective doubling of sound volume.

DIGITAL-TO-ANALOGUE CONVERTOR (DAC): In a digital audio replay system, the signal is retrieved from the storage medium (such as a Compact Disc) in the form of digital code; from this input, the DAC convertor produces an analogue output which represents the music waveform. This can then be fed to a conventional amplifier. (See Technical Introduction).

DIN: German standards body, responsible amongst other things for a popular range of standard plugs and socket specifications.

DISTORTION: Literally this can mean any deviation from the original, but usually refers to harmonic rather than intermodulation distortions when not specified.

DITHER: Very low level noise added to a signal being digitized to reduce the high-order distortion caused by quantisation of very low-level audio signals.

DRIVE UNIT (DRIVER): The term used to distinguish the loudspeaker unit itself, be it bass, midrange, treble or fullrange in application, from the complete loudspeaker system which com-

bines drive units, cabinet and crossover into a total design.

DYNAMIC RANGE: The ratio in dBs between the quietest sound that can be successfully recorded and the loudest which can be accepted without serious distortion on an average programme.

EQUALISATION: The deliberate modification of frequency response, usually in response to some engineering limitation of deficiency.

FARAD: Measure of capacitance.

FILTER: A circuit (normally) used to restrict the bandwidth of a system; may be fixed or switchable.

FREQUENCY RANGE OR SPECTRUM: Can refer to any particular group of frequencies, but commonly applied to the audible band from 20 to 20,000 cycles per second (Hz), extending from the deepest bass to the highest audible harmonics.

FREQUENCY RESPONSE: The variation in output over a frequency range, particularly of a transducer; can be expressed as a range with decibel limits, or depicted graphically.

Hz (HERTZ): 1 Hz = 1 cycle per second and is a measure of frequency which corresponds to musical pitch (the higher the frequency the higher the pitch).

HF: High frequency.

HARMONIC: Harmonics are the whole number multiples of a base frequency called the *fundamental*.

HARMONIC DISTORTION: The addition of unwanted harmonics to a signal.

HUM: A low frequency interfering sound produced by break-through or interference from mains wiring or circuitry.

IHF: American Institute of High Fidelity, an important standards body.

IEC: International Electrotechnical Committee, an international standards body.

INTEGRATION: Used to describe the success with which the output from two drive units combine to give smooth output through the crossover region.

INTERMODULATION (IM): A form of distortion arising from two or more signals producing non-harmonic signals that correspond to the sum or difference of the two frequencies.

KILO (k): prefix meaning one thousand.

LCD: Liquid crystal display, used for non-illuminated or backlit numerical indicators.

LED: Light Emitting Diode; an indicator light.

LF: Low frequency.

LINEAR: A transducer that produces an output that exactly portrays its input over the required operating range is described as linear, and is hence distortion free. Hence also nonlinearities (distortions).

LOAD OR LOADING: The impedance (including resistive and reactive components, ie ohms, mH, pF) seen by one component looking back to its interconnected component; of importance in compatibility of cartridge/amp, and to a lesser extent, amp/CD player.

'LOUDNESS': An equalisation circuit frequency switchable on amplifiers which is designed to compensate for presumed hearing characteristics at low listening levels by boosting bass and treble.

MICRO- (μ): Prefix for units meaning one millionth of.

MICROSECONDS (μs): The time constant of a resistor capacitor combination involving a frequency response change (equalisation).

MIDRANGE, MIDBAND: The central part of the audible frequency range where the ear is most sensitive.

MILLI- (m): Prefix for units meaning one thousandth of.

MODULATION: In analogue systems or circuits, the audio signal is 'stored' by means of modulations within a medium, eg the 'wiggles' in the groove of a plastic disc, or the magnetic coding on a tape.

NANO (n): Prefix meaning a thousandth of a millionth of.

NOISE: Random unwanted low level signals.

OCTAVE: Two-to-one ratio of pitch or frequency.

OHM: Unit of electrical impedance (including reactance) or resistance; also kohm, where 1 kohm = 1,000 ohms.

OVERHANG: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm.

OVERSAMPLING: A technique developed originally by Philips to give greater digital resolution accuracy, and which enabled them to use 14 bit chips but obtain near-16 bit resolution. In their four times oversampling

system, the sampling frequency is multiplied by four to become 176.4kHz, allowing the use of sophisticated digital filtering and overcoming some of the problems of analogue filters used on early players. A number of Japanese manufacturers, led by Yamaha, have adopted a twice-oversampled system, with similar benefits.

PEAK RECORDING LEVEL: A level above which distortion becomes apparent.

PHONO: The most commonly used plug/socket combination in audio components.

PICO (p): Prefix meaning one millionth of a millionth of.

POWER AMPLIFIER: The part of an amplifier that provides power to drive the loudspeakers: usually integrated, it is sometimes a separate component.

PRE-AMPLIFIER: The part of an amplifier that accepts the input signals, sorts them, applies any necessary equalisation, and then passes the signal to the (normally integral) power amplifiers.

PRE-EMPHASIS: Equalisation applied to some (mainly Japanese) discs in mastering, which has to be compensated for de-emphasis on replay. All machines can recognise pre-emphasised discs automatically.

PRESENCE: A quality of forwardness or immediacy in a sound balance, generally related to an upper-middle frequency response boost.

Q: A measure of the magnitude and shape of a resonance; the higher the Q, the sharper and more severe in amplitude the resonance.

QUANTIZATION: The number of possible values available to represent various amplitude levels in the musical signal, which in a 16 bit system total 65535 possible values; or the process of ascribing these values to given amplitude levels.

RESOLUTION: Accuracy with which the digital system quantizes the signal. Since the greater the number of bits, the more accurately the analogue waveform can be represented digitally, resolution can be expressed as a number of bits, which in the case of Compact Disc, should be 16.

SAMPLING RATE (or Sampling Frequency): The number of times the signal is sampled (ie its level is measured) per second, which must be more than twice the highest fequency to be reproduced. In domestic digital audio the sampling rate is 44.1kHz. This means that each second of music signal is encoded as a series of 44,100 numbers for each of the two audio channels.

SENSITIVITY: The volume of sound output for a specific electrical voltage input.

SEPARATION: As between the two channels of a stereo pickup; see *crosstalk*.

SIGNAL-TO-NOISE, SIGNAL/NOISE, S/N: The difference in total output when an applied signal is removed.

SUBSONIC: Below the audible range, ie below 20Hz.

SQUARE WAVE: A signal which consists of a fundamental plus a (theoretically infinite) series of odd (3rd, 5th etc) harmonics in a precise phase and amplitude relationship. It is useful for examining transient performance, symmetry, resonance control and 'ringing'.

THD: Total harmonic distortion.

TIME SHARED CONVERTOR: Many CD players have only a single D/A convertor which is switched at ultrasonic speed between the two channels both left and right channels. This means that the output of one channel is delayed by a few microseconds, and this interchannel time delay can be measured as an interchannel phase difference increasing with frequency to around 75° at 20kHz. It is not believed to have any audible significance, except where the two channels are combined for mono use. Twice-oversampling halves the delay between channels.

TRANSIENT: Signal of very short duration; may be a peak of many times the average signal amplitude.

TREBLE: Upper part of frequency spectrum, typically above about 3kHz.

TWEETER: A small drive unit designed to operate over the high frequency range.

ULTRASONIC: Frequencies above audibility, ie greater than 20kHz; also *supersonic*.

WEIGHTING: A factor or function that is applied to a measurement to increase its relevance and usefulness.

WOW AND FLUTTER: Low and high frequency pitch variations (from poor tape transport or turntable platters with speed drift), theoretically impossible in CD, unless present on an analogue master which has been transferred to CD.

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