HI-FI CHOICE

CD PLAYERS & TURNTABLES

The ultimate guide to buying CD players, record players, turntables and tonearms...whatever your budget.

Best Buys Recommended
Over 100 Models Tested

£2.95

Origin of Speakers.

An Introduction

When on board H.M.S. Bugle as audiologist, I was much struck with certain facts in the nature of high fidelity as it was distributed in various parts of the world. These facts seemed to throw some light on the Origin of Speakers—that mystery of mysteries.

It is quite conceivable that an audiologist, reflecting on the mutual affinities of speakers, might conclude that they had descended from other speakers. Nevertheless, it would also have to be shown how the many speakers inhabiting this world would have been modified, so as to acquire that perfection of structure which justly excites our admiration.

It is thus of the highest importance to understand the order of descendency amongst high fidelity components that leads to modifications within speakers.

In this Abstract, I shall consider the Struggle for Survival arising primarily from the fecundity of manufacturers. I will then demonstrate how any speaker, when it varies in a manner profitable to itself, will survive through Natural Selection, the fittest of these causing extinction of less improved forms.

Furthermore, I can entertain no doubt that the view which most audiologists until recently held—namely that all speakers had been independently created—is erroneous. I am convinced that each speaker is merely a lineal descendent of other high fidelity components, originating with the turntable and following on in a verifiable order to the tone arm, the cartridge, the amplifier and, finally the speakers. Thus do speakers in their resplendent colours and shadings, reveal their adaptation to all that has gone on before.

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By Martin Colloms

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Each turntable review backs listening tests with lab tests, including acoustic isolation, disc damping and other crucial aspects as well as conventional measurements.

199

These reviews cover many additional models whose full reviews could not be included because of space considerations.

BEST BUYS AND RECOMMENDATIONS **205**

Details of the models which did best in our tests and which we have rated most highly in value for money terms. Recommendations are given for every budget.

the current in the Hi-Fi Choice series are available direct from our Mail Order Service. See page 200.

Compact Disc Players

'MIDI' PLAYERS

These models are less than 36cm wide, see review for exact dimensions.

Ferguson CD01; XL-V2B; Marantz CD54; CD84; Meridian MCD; Philips CD104; Pioneer PD-Sony D-50; Sony CD-P102; CD-3

STANDARD SIZE PLAYERS

These models match standard-size hi-fi systems at approximately 43cm wide.

Akai CD-A7; Bang & Olufsen CD-X; Fisher AD840; JVC XL-V300; Mitsubishi DP105; Philips CD204; Philips CD304; Pioneer PD-70; Revox B225; Sony CD-P30; Sony CD-P50; Sony CD-P302ES; Sony CD-P502ES; Sony CD-P552; Sony 702DA-S processor; Technics SL-P1; Technics SL-P2; Technics SL-P3; Toshiba XR-Z50; Toshiba XR-Z60

SUMMARY REVIEWS

Hitachi DA800; Marantz CD63B; NAD 5200; Philips CD101; Philips CD202; Philips CD303; Sony CD-P101; Sony CD-P701es; Toshiba XR-Z70; Yamaha CD-2

Turntables and Tonearms

INTEGRATED PLAYERS

This category includes some models supplied with 'factory fitted' arms, also available as separate motor units.

Acoustic Research EB101; Akai AP-X1; Ariston RD20; Ariston RD80SL; B&O RX2; B&O TX4; Dual CS505-2; Dual CS505S; Harman Kardon T35C; Harman Kardon T55C, Linn LP12; Lux PD290; Michell Synchro; Mission Cambridge NAD 5120; Oracle Pioneer PL340, PL707; QED R232; Planar 2; Rega Planar 3; Revolver; Rotel RP850; Thorens TD166 II; Thorens TD320

UNITS

Ariston RD40AC; Ariston RD40E; Ariston RD80SL, Elite Townshend Rock II; Heybrook TT2; Linn Sondek LP12; Michell Synchro; Michell GyroDec; Oracle Alexandria; Pink Revolver; Sota Sapphire; Systemdek IIX; TD320; Walker CJ61; Walker CJ58

TONEARMS

Alphason HR100S (LC); Linn Basik LV + arm; LVII arm; Mission 774LC; Rega RB300 arm, Series V; Zeta

SUMMARY REVIEWS

Acoustic Research, Ariston Magnum Opus arm; Audio Technica AT1120 arm; Decca International arm, Dual CS514; Dual CS515; Dynavector DV501 arm; Fidelity Research FR64 arm, Grace G707 arm; Linn Basik LVX arm; Lux PD300; Marantz Esotec; Mayware arm; Michell Focus One (S); Nakamichi Oracle Delphi; Revox B791; Rotel RP830; Series III (S); SME 3009R; Thorens 160S; Thorens TD147; Thorens TD126

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"With the RD40 they have beaten all records"
Audio Review

Ariston RD40
Basically the RD40 system consists of three substantial aluminium castings. These catings make up the base, the chassis and the platter which is 'dished' slightly concave. A record clamp, in conjunction with the concave platter, laminates the disc mat and platter interface, reducing the vinyl resonance and creating one impedance for the entire assembly as opposed to the more common two from disc and platter.
£139.95 Without Arm
£189.95
With Opus Arm

"I would not hesitate to recommend this latest

Ariston RD80
The RD80 is a two speed manual turntable with AC Synchronous Motor. There's a two piece fully machined concave platter with record clamp, and precision made single-point bearing.
£239.95
with Opus Arm

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TECHNICAL INTRODUCTION

Our review programme for Compact Disc players, turntables and tonearms included complete laboratory analysis as well as thorough auditioning. This introduction explains the tests.

The coverage of this, the seventh edition of *Turntables* has been overturned by the burgeoning CD market. The revised title of the issue has been chosen to reflect the market importance and wide range of CD players now available, but this should not be taken as reflecting a diminishing of our regard for fine analogue equipment. For those who are interested primarily in choosing or upgrading analogue equipment, the current *Cartridges and Accessories* issue (*Hi-Fi Choice* No 38), written by Paul Messenger, should be taken as the companion edition to the Turntables and Tonearms section in this book.

Around 40 CD players were available when we started work on this *Choice* project, and we managed to secure most of these for review. CD sales are expected to be brisk in '85, this particularly true of the discs, despite their average price of around £10 to £11. Already Pickwick, the biggest UK budget record company, have launched a number of titles at £6.99, and other manufacturers are expected to follow suit; in fact some discounting has already begun in Japan.

Compact disc versus analogue

The sound quality of top quality black disc players remains beyond question, but CD players are now beginning to win 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 already with us, and are arousing great interest.

Since last year the range of available CD machines has widened considerably and competition is becoming fiercer. Prices range from around £275 to as much as £1500, and such a discrepancy has been queried by some, since Philips' original slogan for CD was 'perfect sound forever.' Experience has however shown us that while CD as a whole provides a baseline of good sonic uniformity, there still remain subtle differences between designs, much as many amplifiers can be distinguished from others.

The advantages which indisputably are 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) Sound free from surface noise, clicks and pops.
3) Essentially damage- and wear-proof discs (provided some care is taken).
4) Constant neutral tonal sound quality, throughout disc play.
5) No complications of stylus wear, contamination or alignment.
6) Full automatic facilities, track programming etc, many with comprehensive remote control.
7) Usual 'cheap turntable' problems such as pitch stability, wow and flutter etc, are absent.
8) Small CD player size with easy storage and handling of discs themselves.
9) High level 'flat response' output can obviate pre-amplifier and many also have competent headphone outputs.
10) High lab specifications for distortion, balance, separation and signal to noise ratio.
11) Virtual immunity to acoustic feedback and reasonable levels of shock and vibration resistance.
12) 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.

As regards the more subtle aspects of sound reproduction, players can vary in their stereo presentation — some have a more relaxed distant 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 similarly it is therefore possible to scale and grade CD sound quality. As in the case of amplifiers, it must be stressed that in absolute terms the differences are not great, and may even be considered unimportant by many purchasers.

PURE HI-FI FROM SANSUI

5

6

1 TU-D 33XL TUNER £109 inc. vat

"A couple of plays revealed that the TU-D 33XL's ability to prise decent sound stage, with ample depth to convey 3-D presence and base, from musical instruments or sound effects was, at times, near awesome."

"The Sansui is a devilish successful solution for those of you who can no longer bear to part with a fiver whenever you crave something new."

"And it's pretty to boot."

Ken Kessler, Hi-Fi News, May 1985

2 AU-G 55X STEREO AMP. £249 inc. vat

"Altogether a very satisfying stereo amplifier which I could live with for a long time. Well recommended."

John Gilbert, Gramophone, April

"To most people, names such as Sansui enjoy street credibility while other more esoteric names simply cannot match up."

"The Sansui easily won out in the specific area of maximum loudness, which was achieved in a seamless and unstrained manner."

"I like the Sansui. In addition to its superb build, finish and flexibility, it was capable of real quality music making."

Alvin Gold, What Hi-Fi? February 1985

5 SR-222 MkV BELT DRIVE TURNTABLE £109 inc. vat

For many years the Sansui SR-222 series of turntables has been critically acclaimed by the Hi-Fi Press as the ultimate combination of simple design and superb sound. Now Sansui introduce a completely revised and improved version featuring new heavy, multi-layer plinth; heavy, diecast aluminium alloy platter; improved high-rigidity D.O.B. tone arm; doubly insulated mounted DC servo motor; electronic speed change.

6 D-290 CASSETTE DECK £129 inc. vat

"Overall I felt the D-290 turned in a very respectable performance and would provide a good casual listening source even for the owner of above average systems."

John Nicholson, Hi-Fi for Pleasure, March 1985

A full logic cassette deck with Dolby C / B noise reduction systems. Mic. mixing facility with volume control offering the advantage of adding commentary to tapes while recording from another source. The D-290 also offers automatic music programme search for cueing convenience. Precise LED meters, a timer switch, and headphone socket are the finishing touches to this cassette deck.

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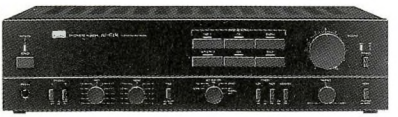

4

BEST BUY HI-FI CHOICE

7

8

3 AU-G 33X STEREO AMP. £169 inc. vat

"Sansui AU-G 33X is pretty damn good. In fact it's a cracker."
"I have the distinct impression that here, at last is one main stream manufacturer making a concerted stab at closing the gap with the best of the audiophile orientated competition."
"The Sansui does go louder – much louder – than the £100 to £120 models, and it has that rare and precious facility of staying in perfect control of the loudspeakers to which it's presented."
"Recommended"
Alvin Gold, New Hi-Fi Sound. February 1985.

4 TU-D 99X TUNER £229 inc. vat

SANSUI TU-D 99X Best Buy, Hi-Fi Choice March 1985.
"With a front rank sound quality and a very strong RF performance, this is clearly a fine tuner design. Suited, with the 'local' switch, to both fringe and high strength locations, a versatile performance is offered"
Conclusion "The TU-D 99X represents very good value in its price sector, and qualifies for a Best Buy rating."
Martin Colloms, Hi-Fi Choice.

The TU-D 99X incorporates a super linear digital decoder which eliminates beat interference. It does so effectively and without creating its own audible beat since no harmonics are generated.

7 PCV 100 COMPACT DISC PLAYER £339 inc. vat

PCV 100 new Compact Disc Player (replaces PCV 300)
The PCV 300 was reviewed by Stan Curtis in Which Compact Disc? and the verdict was "A competently engineered, pleasant sounding CD player. The Sansui PCV 300 offers good value, good looks, and good performance. Strongly recommended."
The Sansui PCV 100 is a completely revised version of the PCV 300 which is not only improved but better value at around £339.

8 AU-G 11X STEREO AMP. £109 inc. vat

The AU-G 11X is an affordable amplifier offering the same technology as models AU-G 33X and AU-G 55X. The X Balanced Amp Type II is designed to eliminate all ground related problems so music is reproduced with unbelievable purity and clarity.
In the event of speaker impedance becoming low, the AU-G 11X is equipped to supply ample current to the power output stage and can deliver as much as 75 watts of dynamic power into 2 ohms.

Sansui

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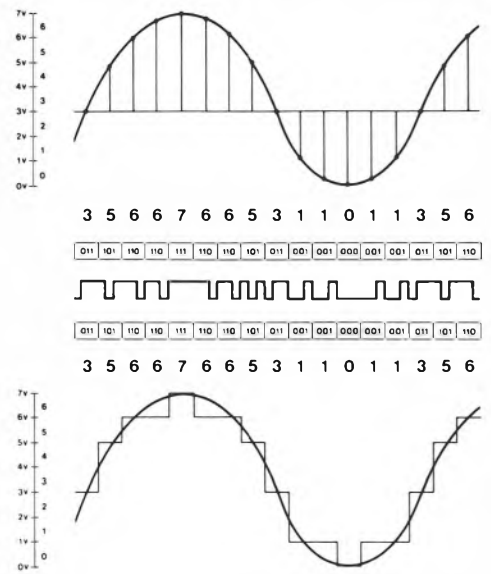
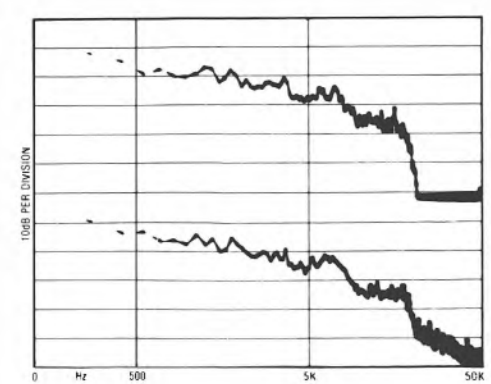
TECHNICAL INTRODUCTION



Analogue signal is converted into digital form by sampling the signal to give a binary number (examples use 3 bits). Thus analogue 6v becomes binary 110. High-speed sampling, 16 bit measurement and filtering gives good fidelity to the original waveform.



Spectrum of music output from CD (top) and (LP) below. The LP output towards 50kHz consists of distortion spuriae.

I use a good amplifier and like to use a CD player of compatible sound quality as far as possible. As such I have been prepared to make these distinctions in sound quality and where possible, back them with searching lab tests.

Analogue developments

The analogue review section has a good sprinkling of major brand names, plus some important new introductions from the 'specialist' manufacturers. Once again, Linn have revised their *LP12*, which now sports a new bonded subchassis, plus refinements to the plinth as well as the mounting bolts. A new Linn arm, the *Basik Plus* is also on test. Alphason have improved their *HR100S* and have added a luxury version using mono crystal wiring, while B&O have a modestly priced linear tracker complemented by an updated budget player. Walker, Dunlop, Ariston and Helius have all carried out extensive revisions to their products, while Thorens have a brand new range. Rega have extensively revised their *Planar II* and Mission have also reworked their *775* player, though the long promised Mechanic arm is not yet available.

LABORATORY TESTS: COMPACT DISC

An established test programme was employed for the CD players. In general, these tests check whether the samples supplied were free from manufacturing defects and were up to spec. Further tests, operating outside of the nominal specifications, also 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

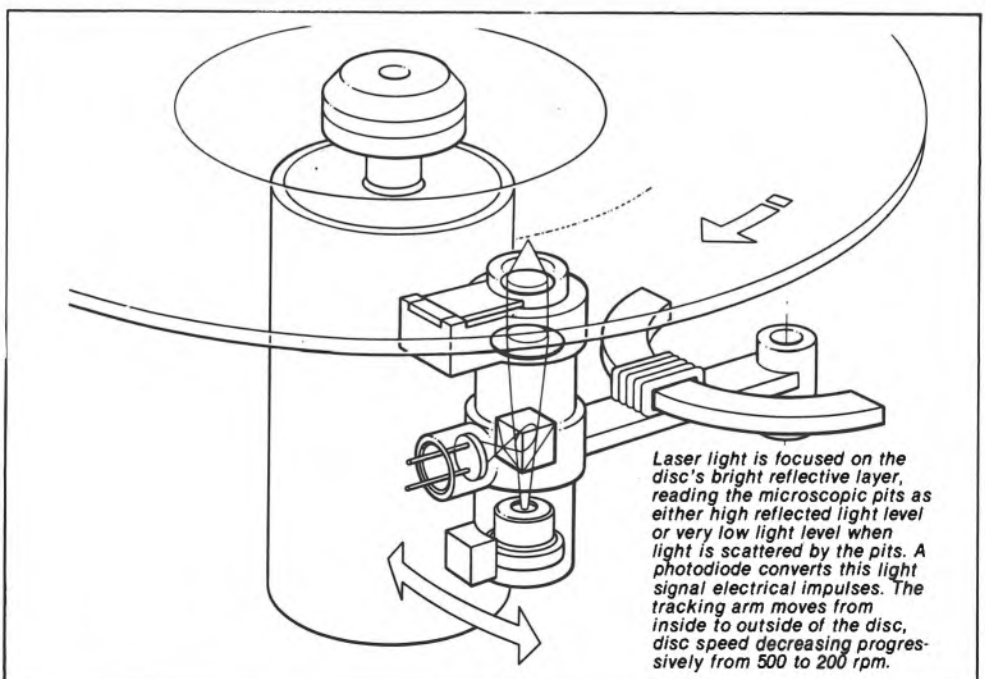
factor in the CD's durability, and is further believed to exert a marginal effect on sound quality. A machine operating at a low internal error rate may sound better than one with a high error rate, even when the errors are fully corrected. This is believed due to the error correction processing, which affects the whole machine via its power supplies.

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 acoustic excitation. In practice noise and vibration both increase the intrinsic error rates and thus may influence sound quality; furthermore players may be very 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. Trials are underway on a small rubber mat, to place over a CD to damp vibration and by implication help lower error rates. 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 as it means that their manufacturing error rate is too high.

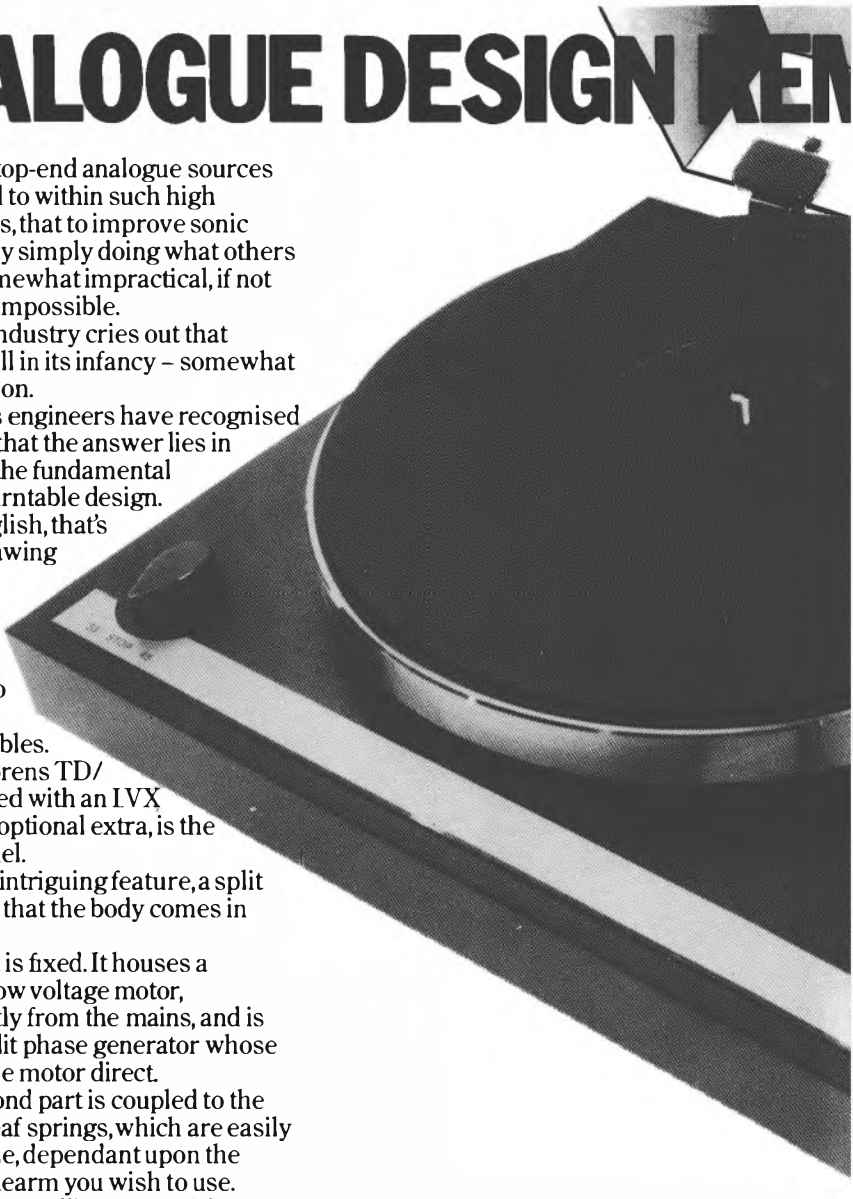
'Aliasing' and spurious tones

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



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 electrical impulses. The tracking arm moves from inside to outside of the disc, disc speed decreasing progressively from 500 to 200 rpm.

ANALOGUE DESIGN



Today's top-end analogue sources are engineered to within such high tolerance levels, that to improve sonic performance by simply doing what others do better is somewhat impractical, if not commercially impossible.

Yet the Industry cries out that Analogue is still in its infancy – somewhat of a contradiction.

Thorens engineers have recognised for some time that the answer lies in re-examining the fundamental principles of turntable design. Or in plain English, that's 'back to the drawing board'.

Today, Thorens is proud (if not a little excited) to present its 320 range of turntables.

The Thorens TD/321, factory fitted with an IVX tonearm as an optional extra, is the showcase model.

Its most intriguing feature, a split chassis means that the body comes in two parts.

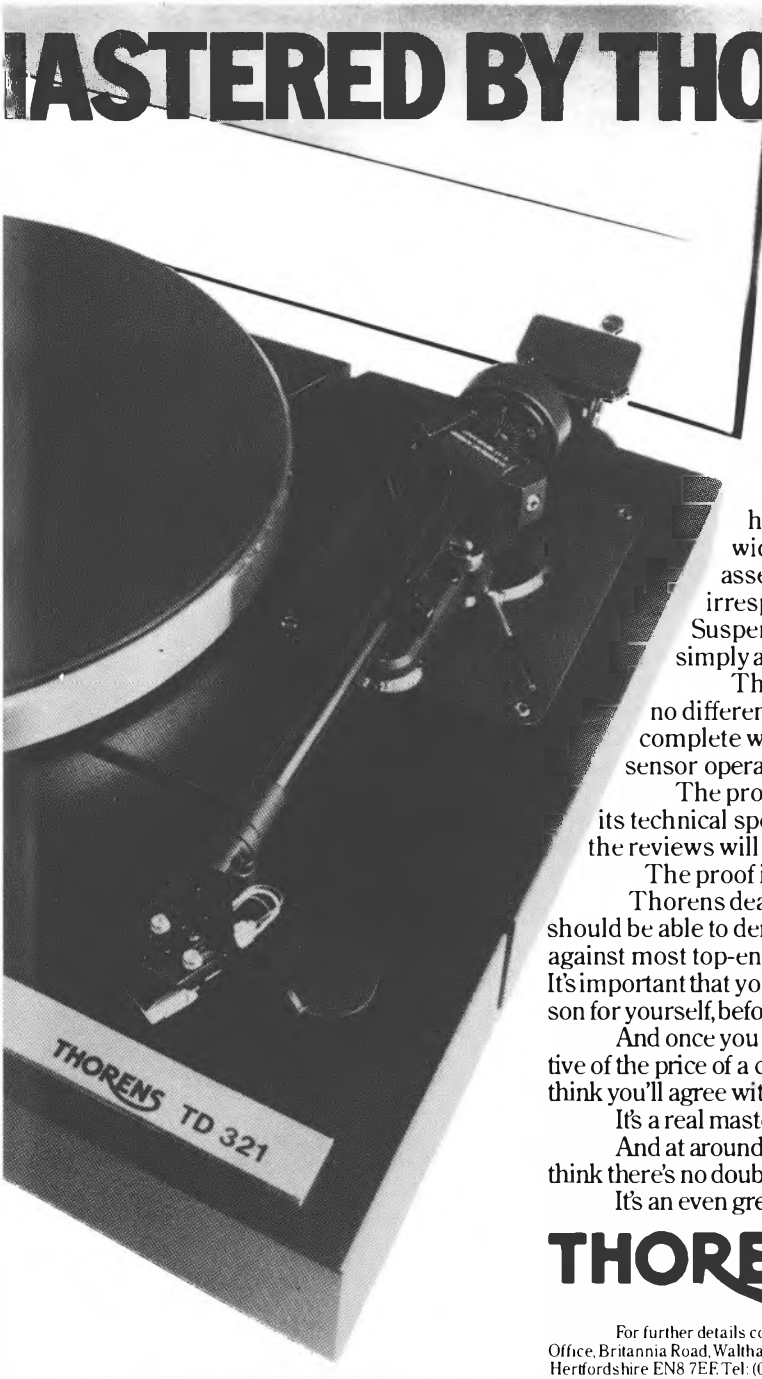
The first is fixed. It houses a synchronous low voltage motor, divorced directly from the mains, and is fitted with a split phase generator whose output feeds the motor direct.

The second part is coupled to the first by three leaf springs, which are easily interchangeable, dependant upon the mass of the tonearm you wish to use.

The non-metallic nature of the two near-independant structures greatly inhibits the annoying resonances with which traditional designs have had to struggle.

The leaf spring suspension also provides ultimate isolation from acoustic

IASTERED BY THORENS



feedback and external shock impulses. Interference caused by the familiar belt-change assembly has also been eliminated. The new range has dispensed with it in order to cater for this two-speed belt driven machine.

The large detached armboard is capable of having an enormously wide range of tonearm assemblies, fitted, irrespective of their mass. Suspension beingvery simply aligned from the top.

The Thorens TD 320 is no different, except that it comes complete with Thorens arm and a sensor operated stop and lift facility.

The proof we know is not in its technical specification, although the reviews will give you an inkling.

The proof is in the listening.

Thorens dealers all over the UK should be able to demonstrate the decks against most top-end turntables. It's important that you make an AB comparison for yourself, before you decide to buy.

And once you have listened, irrespective of the price of a comparative source, we think you'll agree with us at Thorens.

It's a real masterstroke.

And at around £300 complete, we think there's no doubt.

It's an even greater master stroke.

THORENS

For further details contact: The Thorens Sales Office, Britannia Road, Waltham Cross, Hertfordshire EN8 7EF. Tel: (0992) 716666.

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, new CD reviews show 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 new high resolution graph has been used, this to the same scale as the RIAA equalisation accuracy charts in the *HFC: Amplifiers* issue. 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 (figures given in the test results tables are without pre-emphasis), and each player's mechanical noise was also assessed.

LABORATORY TESTS: TURNTABLES

Returning to analogue turntable systems, tests have been devised to bring out, as much as possible, aspects relevant to sound quality. Only in the most simple and obvious cases do conventional measurements such as those for wow and flutter and rumble etc have much relevance to subjective quality. For example, peruse the figures for any modern turntable with pretensions to quality: rumble and wow figures are quoted which surpass even our test methods, and which are below audibility thresholds; yet in practice these tell nothing about sound quality of the deck in question if experienced and perceptive listeners are involved.

Assuming that a turntable's sound quality *does* matter, we can then consider a number of subtle parameters which are notably difficult to qualify. For example, stereo imaging can be flawed in terms of both clarity and the ability to reproduce depth, due to instability in subchassis systems, excessive stored energy or coloration in the subchassis system and unwanted vibrational excitation arriving at the cartridge stylus. The bass may be weakened in both power and definition due to incipient acoustic feedback, also to counterweight resonances in arms, or to weak platter main bearings, which can encourage platter rocking at low frequencies. Sound quality in the midrange may be coloured and masked by structural resonances, plus coupled feedback in turntable lids or plinths, and if poorly isolated, also the shelf on which the deck is placed. Such middle range resonances may also be attributed to structural weaknesses in tonearms, and their mounting board or platform. The platter and subchassis themselves can also 'ring' or resonate in the mid register. The proportionality of plinth and platter mass can also be significant. A light platter on a strong heavy plinth will resonate more than when fitted to a lighter plinth where some mutual damping may be encouraged. Thin platters tend to ring like gongs, their damping partially controlled by choice of mat.

For the best sound quality the platter mass should be sufficient to provide a useful rotational inertia, providing a flywheel energy store, helping the platter resist small speed changes induced by variation in drive power, and the stylus drag which alters with music modulation. If the power is low and the platter light, then dynamic wow can occur as an audible pitch instability following loud programme transients.

Weak main bearings (including the support) can allow rocking modes in the platter to the detriment of coloration levels. Conversely, controlled stiffness and mechanical losses in the subchassis/arm mounting can help to trap and absorb unwanted energy which could otherwise be transmitted or reflected back into the platter or tonearm.

to be – 100dB on the fundamental, or 0.001%! Yet this is no guarantee of perfect sound.

In general, CD designers appear to have got their specification numbers in very good order. But they need to devote more attention to sound quality differences as a whole, if the claimed consistent accuracy of CD is to be achieved. In theory, the digital replication process for CD is nearly perfect, with full correction of system errors.

The execution of the springing associated with a suspended subchassis design is almost an art in itself, and is crucial in determining the operational stability as well as the isolation performance of the whole. The Linn *Sondek* exemplifies a model which may outwardly appear a trifle primitive in design, but which nonetheless incorporates many 'hidden' aspects which enhance its performance: there is hardly any detail of its construction which does not contribute to the whole. For example, the belt is critical in dimensional tolerance, surface finish, elasticity and internal loss factor. Any deterioration can affect speed accuracy, load tolerance, torque, wow and flutter, drive motor breakthrough rumble, as well as subchassis instability and behaviour. The audible repercussions are legion; for example excessive belt tension will mean the motor coupling will be too tight, resulting in worsened rumble and energy coupling to the platter, the subchassis will also be under excess lateral drag, impairing isolation and worsening vibration rejection; finally the belt-subchassis mass resonance may become involved — a factor usually kept at bay due to a minimal belt tension consistent with good drive.

In an earlier issue the 'flexibility' of the *Sondek* arm mounting facility was mentioned, but we now recognise that in practice this flexibility is an advantage rather than a weakness in the case of the *Ittok* arm series (the latest *Ittok* has undergone further revisions, see review). It is now apparent that an important terminating and absorbing function is provided by the 'composition' arm board and its apparently superficial fixing to the subchassis. Energy propagating from the cartridge down to the arm pillar is absorbed here, rather than being reflected back to the cartridge by a misterminated board/arm pillar interface (see Lux *PD300* review).

However we have found it dangerous to use the *Sondek* as a reference turntable for comparative auditioning, due to its unique character and sonic balance; but it does remain useful as a long term reference in view of its musically-balanced and satisfying performance. So far no other turntable has provided the same balance and combination of qualities and weaknesses which would allow an easier A/B comparison test. Good disc players increasingly represent a 'system', where motor unit, arm, cartridge and mat offer an optimised combination. Alter any single part and one's view of the whole can be altered too.

Acoustic and vibration isolation

Returning to the more general discussion of factors affecting subjective performance, we classify energy arriving at the working cartridge from the outside under the heading of 'acoustic and vibration isolation', this including energy emanating from the music reproduced by the loudspeakers. The latter is a feedback-promoting effect which rapidly worsens sound quality with increasing gain, well before the point at which 'howl-round' is reached. The energy enters the turntable *via* two routes, both acting together. Vibration in the room structure is transmitted by the floor and excited in the support cabinet or shelf, entering *via* the turntable feet and base; airborne acoustic energy is intercepted by the entire turntable structure — the lid, the armboard, the plinth, platter, disc and the subchassis.

The isolation performance of a turntable affects other subjective factors as well, these classically described as signal to noise ratio, and more recently noted as dynamic range or more simply still, 'dynamics'. The important distinction here is that traditionally the noise part of the signal to noise measurement was judged in the absence of the signal, this being the easiest way to do it. Take rumble as an example. Conversely, subjective dynamics concern how much unwanted noise is present in the reproduction while the music is also playing through a complete hi-fi system; that is, a judgement of the noise in the presence of a signal. This is much harder and requires some practice. Subjectively, one can learn to recognise the spurious noise which hangs like a coloured (acoustically that is) veil over the sound stage, masking fine musical detail and blurring the definition of sharp sounds or transients, resulting in a flat, two-dimensional image that lack true space, depth and ambience. In addition the dynamic relationship between soft and loud passages appears compressed, detracting from their liveliness and 'attack'. A system with a poor dynamic signal-to-noise ratio sounds as if the subjective volume is more constant, and is usually on the loud side at that.

In the lab it has proved possible to investigate some of those factors which affect

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this dynamic quality, mainly via wide-band isolation tests. The vibration and acoustic isolation performances are assessed separately, and presented on one display where their joint effect may be judged.

For vibration purposes, the turntable was mounted on a reinforced wooden panel, flexibly mounted and driven in the horizontal plane by a small vibration exciter. The flexible mounting was provided by polyurethane foam, which gave an overall lateral resonance at around 3.5Hz. The accelleration at the centre of the tasble was monitored by a B&K accellerometer, and adjusted by an equaliser to show a fairly unform value measured in constant bandwidth analysis over the important isolation range of 10Hz to 500Hz. Above this frequency range, even the worst rubber feet on primitive players are very effective. Below 10Hz questions of subchassis and cartridge resonance excitation arise, and these were dealt with separately.

The printed vibration graph represents the RIAA equalised output from a pickup cartridge on a record and demonstrates the isolation achieved between the vibrating test board and the stylus.

The second factor, acoustic isolation, was analysed in a similar manner, but here the excitation was a uniform pink-noise soundfield generated by a powerful loudspeaker, 1m distant. A B&K microphone system was used to help define a uniform frequency response at the record position over the useful range, 30Hz to 500Hz. A parametric equaliser aided this calibration. The sound pressure was set at 90dB while the measured result was scaled against standard rumble reference level of 10cm/sec lateral at 1kHz. The baseline is equivalent to −80dB.

Inevitably, both the turntable and the baseboard on which the turntable was mounted were jointly excited by this soundfield, and some contribution from the baseboard thus appears in the measurement depending on the vibration isolation characteristic of the turntable under test.

A turntable with excellent vibration and acoustic isolation performance has the potential for good subjective dynamics, though the resonant behaviour of the subchassis/platter arm combination will also play a part here.

For the printed graphs, as already noted, a split display is used. The upper half is a 60dB (six division) section showing acoustic breakthrough with the mid screen representing a baseline of −80dB. The lower 60dB or six divisions are allocated to the vibration isolation, again with a −80dB baseline. The frequency axis is linear 10Hz to 500Hz; note that most other graphs use the usual logarithmic audio frequency scaling.

Suspension modes

Using the spectrum analyser and via selective frequency sweeps into the vibrator exciter, the various subchassis and suspension modes may be explored and noted. In particular, modes which overlap the critical area of arm cartridge resonance 9-12Hz are judged severely, in view of their potential interaction with the cartridge. Rotational modes are important in that scrub flutter may be easily induced, while the effect of general chassis movement on audible wow was also noted.

Disc impulse response

Following Moncrieff's lead on disc impulse response, a 4g plastic rod was allowed to fall at an angle of 45° onto the edge of a record, in position on the platter. The cartridge sensed the transmitted mechanical impulse as it arrived at the other side of the disc and its output was captured for analysis both as an impulse response (reproduced in the reviews) and also for Fourier processing.

This deceptively simple impulse test can produce much information about the whole suspended disc playing unit. The shock is applied to the disc, and how it is attenuated in its path across to the cartridge stylus tells us about the absorption and damping characteristics of the disc support. In addition, part of this excitation is transmitted to the platter, exposing any self resonances here. Via the platter, test energy also arrives at the subchassis via the main bearing. Flexure between platter and chassis can be revealed in addition to intrinsic chassis resonances, including harmonic ringing in the suspension springs.

Tonearm resonances

Tonearms possess an ability to flex and resonate in the audio bandwidth, and are therefore a potential source of coloration, due to their close coupling with the cartridge. Less severe with high compliance models, these resonant effects are most marked using a

close-coupled, less compliant moving-coil cartridge, the Osawa *60L*, used to illustrate resonant interactions with the tonearms we tested, being an example. Its compliance measured 18×10^{-6}cm/dyne (18cu), and the acceleration in the side of its body resulting from a lateral sweep 20Hz-20kHz (*TRS1007*) was sensed by an ultra low mass wide-band accelerometer (*B&K 8307*) which records both bending and rotational modes in fair proportion.

Depending on the tonearm involved, it became apparent that severe resonances at the cartridge could be induced from as low as 30Hz right up to 20kHz, and that major differences in broad-band energy were also observable up to 20kHz. These resonances are akin to be delayed 'decay' energy responsible for the majority of loudspeaker colorations, and may be perceived in much the same way.

Ideally the arm should be infinitely rigid, to perform the task of supporting the cartridge accurately with respect to the record groove throughout the frequency range. At the same time the bearings, while free of slackness, must be of sufficiently low friction not to impede the progress of the stylus across the record, or affect its ability to ride warps and other related imperfections. Play and lack of rigidity in a tonearm not only colours the sound through audible resonance, but this very imprecision also upsets the cartridge/groove relationship, adding spurious intermodulation interference over the whole frequency range, and detracting from clarity and the quality of the stereo image.

We therefore examined arms for quality of headshell fixing, bearing play and friction, as well as for geometrical accuracy, effective mass and resonant properties. The resonance graph is not a linear function of acceleration, due to imperfection in the test cartridge (non-uniform mechanical impedance variation with frequency), and to the pre-emphasis used on the test disc. A theoretical approximation is however given for the ideal tonearm — a uniform acceleration from 20Hz to around 1.5kHz, the trend then rising at 6dB/octave in the 2kHz to 20kHz range.

To gain an idea of a single tonearm's relative performance, a study of several resonance graphs is essential; this allows recognition of common patterns, as well as some of unavoidable test cartridge/arm interactions.

In the case of 'super rigid' designs, the coupling factor from cartridge body to the arm board is sufficiently firm to allow the cartridge to read the terminating absorption properties of the arm mounting itself, which has a noticeable effect on the resonance graph: this effect may be associated with the sound quality differences that occur when an *Ittok* is fitted to different turntables, for example.

Breaks or resonances occuring below 100Hz are usually generated by seismic modes in the counterweight assembly — the rubber decoupling bushes often employed frequently being the cause. From 100Hz to 2KHz, some of the lower level disturbances may result from arm pillar mounting effects, the subchassis structure etc, while from 150Hz to 250Hz flexure at the socket in detachable headshell arms is generally apparent, often as a severe mode with a strong step or 'platform' in relative energy level. Fixed head arms show a smoother energy trend, though bending or torsional resonances in the main tube are still apparent, with the more flexible types breaking up at 250Hz, and the 'ultra rigid' examples deferring this to a high 800Hz or so. Arm designers continue to attach odd appendages which are clearly detrimental to sound quality; these include springy finger lifts and the like. In one example the cue platform was also found to resonate in the mid range.

It is also possible to hear resonances in the internal springs used for bias compensation and downforce with certain arms. Tapping the arm gently with a small screwdriver blade while the cartridge is in place on a stationary record can also help expose such phenomena. Monitoring here is best done on headphones.

Arm effective mass and arm/cartridge subsonic resonance

Earlier issues of this series were rightly concerned over the poor compatibility of many tone/arm cartridge combinations then in use. More specifically, heavy 14-20g detachable head arms were being used with high compliance 30-60cu cartridges from such manufacturers as ADC, Empire, Ortofon and Shure (to name but a few). An unstable performance in many areas was the outcome of the resulting poorly-damped 5-7Hz resonances, lying in the worst range of record warp energy.

Matters are however improving now, with the general trend towards moderate stylus compliance plus reduced tonearm and cartridge mass combining to offer much better mechanical

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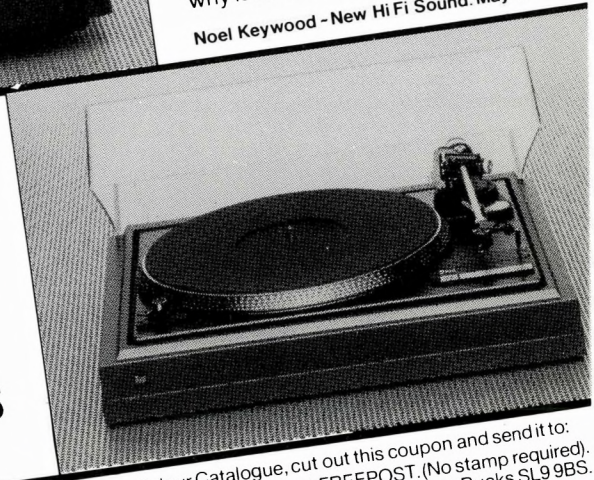

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matching than before.

Conversely the design requirements of the modern moving-coil cartridge seem to result in low compliance values suited to higher mass tonearms; indeed these demand the strength and good resonant characteristics of such designs. The medium mass *Ittok* is well suited to such cartridges, and provides an ideal resonance combination in conjunction with the low compliance *Asak*.

With 'difficult' combinations of arm and cartridge, some method of damping the resulting subsonic resonance was considered necessary. Traditionally, this has involved a dashpot of some sort or another, filled with viscous silicone fluid and mounted in or near the arm pivots. However few arms nowadays still incorporate this feature and it is generally recognised that the correct place for a viscous damper is at the headshell, coupling the cartridge body to the disc surface via a sliding part. Rangabe first produced such a device, (sold as the *Z-Track*) but at the highest quality level, this type of device can cause some minor noises as some of the music energy is inevitably transmitted from the damper to the cartridge adding spurious sounds.

Recently, a new version of the arm damper has emerged on the Elite turntable where the fluid bath is placed over the record and engaged with a paddle mounted on the headshell adjacent to the cartridge. By its location it offers normal arm damping at the subsonic resonance and also a transmission path for structural resonances at the headshell end of the arm. In theory arm coloration is thus reduced, and in contrast to other schemes, the Elite is intended to complement an existing well-matched arm cartridge combination, not to rescue an ill-advised arrangement.

Low frequency sound quality

Really clean bass from a turntable is impossible due to the compromises involved in the complete recording/reproducing chain. For example, as mentioned in a previous issue, twelve low frequency filters are typically present between the original sound and the listener. Those we can pinpoint easily are those due to the loudspeaker itself, the amplifier and the cartridge/turntable combination, and to these we can add the disc cutter, the low frequency filter in the cutter amplifier and the magnetic head on the studio recorder. If a multitrack recording is involved, then several tape stages may also be present, while the microphone capsule plus its preamplifier are also 'in line'. So far we have ten or so filters in cascade (or additive condition); now we can include the small audio transformers used for balanced line coupling of the vast majority of studio equipment namely microphones, noise reduction systems such as Dolby *A* and *dbx*, equalisers, echo, mixers etc. At best we can add five roll-offs due to the LF limiting frequencies of these transformers; at worst some recordings have up to 30; after passing through such stages it is a wonder that the bass sounds are worth listening to at all! As these coupling transformers usually have an HF limit at around 30kHz, their effects are present at the high frequency end of the spectrum as well. Further HF problems would include disc cutter resonance, microphone cut off (typically 16kHz), pickup cartridge tip mass resonance and tracing, plus many, many more.

Fortunately with modern transformerless balanced output amplifiers and digital recording systems, the potential now exists for a reduction in the number of sound degrading interfaces. Assuming a direct-coupled amplifier, and a DC coupled recorder, in principle a digital recording chain could be constructed with only two significant LF roll-offs, namely the microphone system and the loudspeaker. This is why the classic Direct Cut records such as the Sheffield series, using a minimum of ancilliary equipment, have such a good bass.

Compact Disc is clearly at an advantage here since the player has a flat frequency response to below 5Hz and does not suffer problems of RIAA equalisation, subsonic resonance and the like. CD is also virtually immune to low frequency feedback, which is a major factor with many analogue turntables. On good recordings the CD bass compares with the original master and comfortably exceeds the present standard obtainable from analogue players.

Rumble

All these factors do not include the contribution of other mechanical defects in the turntable system which might not be directly audible but which might nonetheless disturb listening satisfaction. It has been suggested that the high transverse forces developed by some direct drive motors on the main bearing can generate a form of rumble which can be

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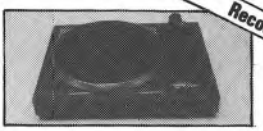

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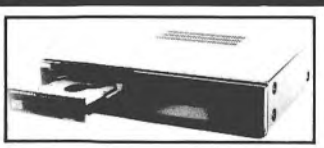

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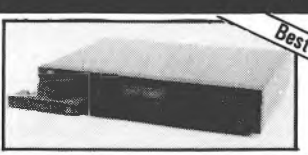

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SPALDINGS

detected as flutter sidebands in the lateral plane.

We have continued where possible to use the precision rumble coupler system which allows a DIN B threshold of measurement of close on – 80dB, rather than the – 65dB attainable from the best records or the – 73dB available on master cut studio lacquers.

It is in precisely this range that one can begin to discriminate between direct drive motors in terms of rumble, and it can be easily illustrated by spectral analysis that many direct drive motors do generate more rumble than comparable belt drive counterparts.

On theoretical grounds it can be argued that a sufficiently low rumble level for direct inaudibility may still not guarantee complete freedom from other rumble induced effects. Whether directly audible or not, any unwanted or spurious displacement due to platter main bearing inadequacy or out of balance motor torque effects will interfere with the accuracy of groove/stylus tracing. After all DIN B rumble is only an arbitrary weighted curve approximating to the directly audible sound or rumble noise. With the help of the 'coupler' we have discovered that while a – 72dB DIN B figure was in some instances insufficient to guarantee inaudibility, with others measurements as poor as – 66dB gave an inaudible background at typical listening levels. This points to a failure of the weighting curve to cope with all types of rumble spectra.

In fact, we found it possible to trace sources of rumble noise for some of the turntables in the report. For example, several direct drive models possessed main bearings with an intrinsic rumble in the – 78dB DIN B region (power off, motor free-wheeled). Reconnection of the supply resulted in degraded figures, not due to hum, but generated by the torque pulses in the motor. This interference was also observed with at least one belt drive design, the source being readily traced to poor isolation of motor vibration from the arm base.

Unweighted DIN A readings were also taken, but inevitably, these results were dominated by the unwanted 'weighting' introduced by the particular subsonic resonance curve of the test cartridge, while the quality of vibration isolation could also contribute.

Wow and flutter

The Matsushita master acetate was used in conjunction with a new generation wow and flutter instrument (model *WM1*) with an automatic reading facility (B&O instrumentation division). DIN specify peak readings which are difficult to estimate from the usually wildly fluctuating meter pointer, while the picture is further complicated by occasional random noise excursions; consequently with a conventional meter one tends to under-read. However, this new instrument has the ability to reject random effects and accurately records the peak periodic wow and flutter over either three selected intervals, or sigma functions. We used 'sigma 2' (5% of the test period).

By comparison with previous results this method yielded 20-30% higher readings with commensurately greater accuracy and consistency. Linear peak readings were also taken for wow below 6Hz, as well as for flutter above this frequency (with a poorly damped arm/cartridge subsonic resonance these measurements can be in error and accordingly a Shure *V15IV* with damper was mainly employed for the flutter tests, in place of the Osawa 60L). The finest example recorded 0.04% DIN peak-weighted (sigma 2), and this level is probably close to the residual flutter on the test disc itself. Therefore models reading 0.05% or below are simply quoted as measuring less than 0.05%. Denon claim very low wow and flutter measurements using a magnetic shaft encoder, a derivative of their magnetic pulse speed control method encoded on the platter rim.

While still on this subject it is particularly interesting to note that some 0.1% unweighted peak wow can be produced by an off-centre displacement of the record of as little as 0.1mm which can be the result of poor record manufacture, an oversized or inaccurately placed centre hole (the standard specifies 7.24-7.33mm diameter) or even an under-sized turntable spindle. For an off-centre record rotating at 33⅓ rpm, the wow frequency is 0.5Hz approximately, a rather slow rate.

The ear is most sensitive to wow in the 4-7Hz range; frequencies above this are not perceived in the form of wavering pitch, and even when excessive are only really audible as 'roughening' type of distortion increase. In part this explains why it is desirable to shift any turntable system subsonic resonances away from this region, be it suspension of arm/cartridge in origin. Since the two latter resonances should not coincide, we are left with the suggestion that the subchassis

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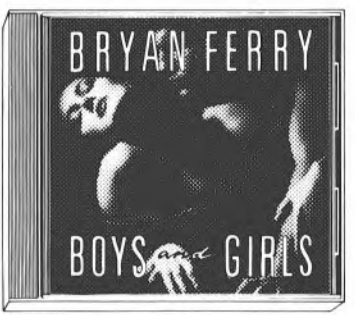

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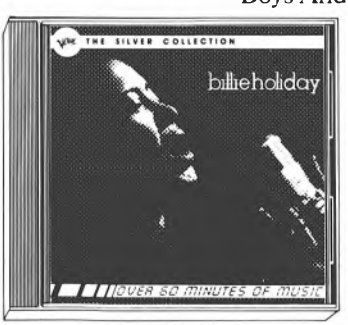

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resonance should be below 6Hz and that of the arm/cartridge above 8Hz. The maximum incidence of record warp amplitudes also falls within this critical 3-8Hz region, and further reinforces the suggestion.

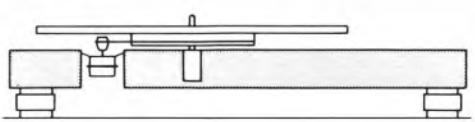
Arm Geometry and Cartridge Alignment

Another important area concerns arm geometry and cartridge alignment. There are two extremes, one a system of mediocre quality where comparatively large errors in cartridge alignment may pass unnoticed, and the other an up-to-date high performance system, where poor adjustment will significantly degrade the potential end result. The automobile analogy is an elegant one; a family runabout with allow compression engine is fairly tolerant of poor engine tune, but a higher performance model is utterly dependent on accurately set timing, valve openings and mixtures etc.

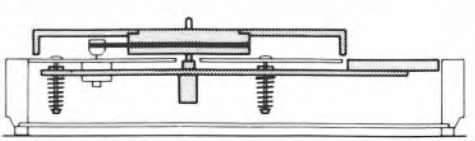
A few degrees of cartridge misalignment will degrade the channel separation of a high class cartridge by a factor of some 15dB, but on the other hand it will produce relatively little impairment of the already moderate separation characteristic of a less expensive pick-up. At present the importance of accurate arm alignment is highly under-rated. Virtually all Japanese arms and turntables are currently supplied with an alignment procedure called 'overhang adjustment', which is accomplished by altering the amount the stylus tip overhangs the record spindle when the cartridge body is aligned immediately above it. But this is next to useless when quality cartridges are involved. While a 1° error can be easily seen and corrected with protractor, a small 1mm overhang error (less than 4/100 of an inch) can produce a similar degree of misalignment. One solution would be to use one of the protractor cards that are supplied with a number of universal pick-up arms, as these have an array of parallel lines against which the cartridge side face can be aligned when the stylus point is in a specified position. However the majority of protractor cards (SME and its counterparts) have a stylus point at a 6cm radius from the spindle, working on the basis that the optimum tracing distortion trade-off will thus be obtained, if using a traditional spherical stylus and a mix of 45rpm singles and 33⅓ LPs. In practice, this is not the best solution for the mean music radii of today's 33⅓ LPs (45s discounted), particularly if used with the now almost universal elliptical and line/hyperbolic styli supplied with hi-fi cartridges.

With a correct offset angle (for which it is often necessary to rotate the cartridge laterally in the headshell, since most headshell offsets are not optimal), and with an accurate overhang for the actual arm length (the pivot to stylus dimension), a condition of minimum tracing error may be achieved. Two points of zero error are used, sensibly positioned between the maximum and minimum playing radii, with the inner zero at a radius of 6.6cm and the outer at 12.1cm. Such precision also suggests that the bias be equally carefully set, so that the stylus is kept as far as possible at its geometrically aligned position (large bias errors permit the out of balance forces to laterally deflect the cantilever, thus adding to tracking error).

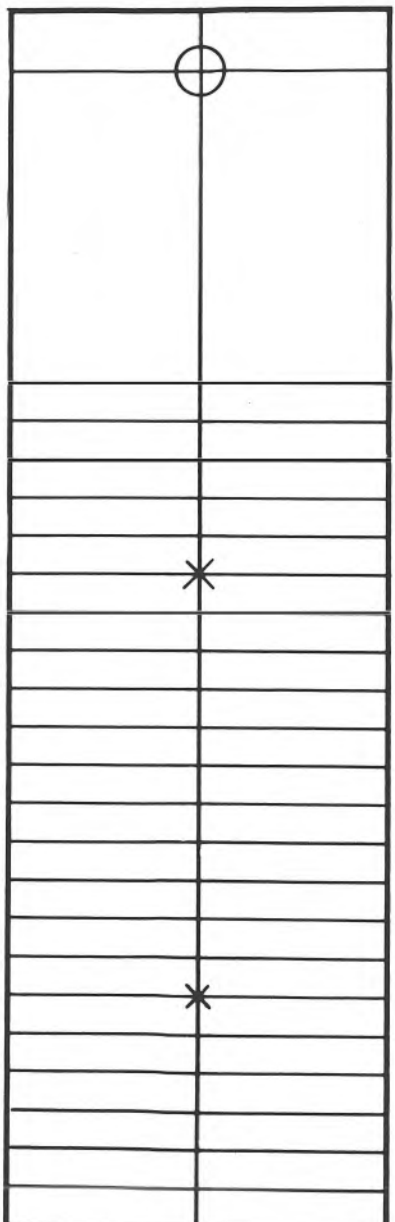
Aside from matters of mass/compliance compatability, damping, tracking weight and bias adjustments, two other alignments are also crucial. One is that the effective axis of the generator system within the cartridge is accurately aligned perpendicular to the record surface; hopefully this is ensured when the cartridge body itself is truly vertical when viewed from the front. Small degrees of tilt of the order of 1° may again degrade separation, and vertical alignment is particularly important with line contact and van den Hul tips where a small tilt will cause the long contact walls to miss the intended groove sections, resulting in an unwanted rake angle between the stylus axis and groove axis, with serious



A solid plinth/belt drive type is often used in cheaper systems.



A decoupled sub-chassis/belt drive system offers good environmental and motor isolation. The entire suspended section is shaded.



Alignment protractor

consequences for groove wear and tracing.

Finally the horizontal axis of the cartridge, that is the angle as seen by the cantilever back to the arm pivot from the stylus record contact point, must agree with the disc cutting standard. Nominally this measures 20° but in practice it is closer to 23°, and if this is not maintained, the stylus side contact line will rake across the cut groove axis at an angle, distorting the playback. Unfortunately it is not enough to simply ensure that the top surface of the cartridge is parallel to the record, as some cartridge manufacturers are not wholly consistent and many pickups when set visually parallel have cantilever/generator axis 'rake angles' as great as 40°.

Correction of this sort of error will require one of two solutions: either a lowering of the arm pivot by as much as 2.5cm (but with many cartridges this will cause fouling of the body on the record surface or complicate arm operation); or alternatively the preferred solution would involve rigid angled spacers at the headshell position, but these are not readily available. The only relevant angle when setting the 'rake' is that made by the cantilever with respect to the disc plane, and allowance needs to be made for higher compliance cartridge styli with their significant change in rake angle with applied tracking downforce.

Where a cartridge manufacturer has chosen to adopt say an incorrect 35° vertical tracking angle and has set the longer tracing edge of the stylus accordingly, no proper correction can be made via arm tilt, because if rake is correct the stylus/groove wall geometry will be wrong, and *vice-versa*.

Leaving aside the doldrums of optimal alignment, it is disheartening to report that not only did the majority of arms examined make no provision for vertical alignment, but also many have their headshells fixed in a permanent 1-2° canted attitude. Likewise, very few of them made provision for height adjustment to optimise cantilever vertical tracking angle, and even the basic lateral correction for tracing angle often relied on an imprecise overhang measurement, which is often theoretically in error for the arm dimensions. It must be admitted that these shortcomings are not wholly of the manufacturer's making, but reflect the inaccuracy of the disc playing system, which is so tolerent of niceties of alignment that despite a compounded-multiplicity of errors the cartridge will

nonetheless continue to play records, and many users remain oblivious to the musical information they are missing!

SUBJECTIVE TESTS

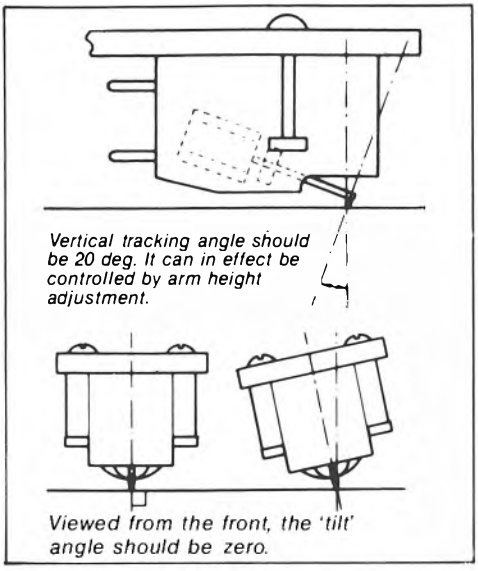
Each turntable was placed on a substantial wooden coffee table, located some 3m from the loudspeakers, on a normal suspended timber floor. The relative performance on acoustic and vibration susceptibility was reliably assessed from physical observation, checking of feedback margins, and auditioning of selected music discs. The assessment of quality for separate component tonearms was undertaken on a rigid wall-mounted platform, well-spaced from the speakers to minimise the turntable colorations.

Two Sound Tables were also used for the testing. Ancillary equipment included Spendor *SP1* and Magneplanar *MGIII* loudspeakers, the Spendors used on heavy sand filled stands with floor-bonded adjustable spikes. Amplification comprised Krell *KSA-50* and Burmester *838*, supplemented by an Audiolab *8000A* for moving magnet cartridge work. Test cartridges included the EMT *van den Hul*, Linn *Asak*, Technics *EPC 205 III*, and Shure *V15V MR*.

For CD, the players were mainly used with a passive control unit, the Sondex *PCU*, working straight into the Krell power amplifier. Initial A/B comparison was all too easy, with easily matched levels and their essentially similar tonal characteristics. As auditioning proceeded, we felt committed to evaluating the subtler differences between the CD players, which proved to be much harder work, comparable to exploring the difference between good preamplifiers, for example.

CD was also compared with vinyl, but only after great care had been taken to ensure a close tonal similarity between the sources. In the case of trials against moving coil cartridges, it often proved necessary to employ a passive shelf filter with CD rolling, off above 800Hz and shelving at −2dB at higher frequencies. It was also essential to confirm the pedigree of the masters uses for CD and vinyl as these often did not match at all.

Comparative and sequential auditioning was undertaken, in an effort to explore the differences and similarities between the various models with 'blind' sessions employed on the most critical 'playoffs'. We found that turntable and tonearm auditioning was particularly difficult at the high quality end of the product spectrum due to the interaction between different components. For example, two tonearms of nominally equivalent merit could affect the sound balance of the turntables to which they were fitted to such a degree that sensible assessment was impossible.



Vertical tracking angle should be 20 deg. It can in effect be controlled by arm height adjustment.

Viewed from the front, the 'tilt' angle should be zero.

My own conclusion is that there is no such thing as a universal high performance motor unit, since the consequencies of leaving other matters of disc support, arm and cartridge in someone else's hands usually prejudices the end result. I believe that a very limited number of options exist for each model to provide a top class performance, and we have tried to identify these, albeit in a limited fashion, for as many models as possible.

ACKNOWLEDGEMENTS

Many thanks are due to Paul Crook, my assistant on this issue; to Marianne Colloms for her help in checking and typing copy, and to the listeners involved in auditioning the product in this and the last issue; Paul Messenger, Alan, McGechan, Steve Harris, David Prakel, John Atkinson and Paul Crook. Thanks are also due to the manufacturers who loaned product to aid evaluation and thanks also to Audio T, our local dealer, for the loan of equipment.

Martin Colloms

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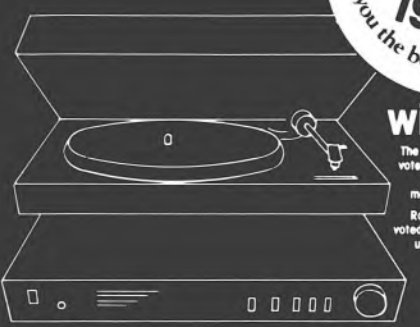

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25 HEATHFIELD, STACEY BUSHES, MILTON KEYNES

COMPACT DISC PLAYERS INTRODUCTION

With the catalogue of available discs running into several thousand titles, CD is no longer just a 'high-tech' alternative to LP records, but is becoming a viable source of music in the home.

There is no doubt that Compact Disc does overcome the conventional LP's major shortcomings — susceptibility to wear and damage, limited playing time, inevitable surface noise, distortion due to stylus mistracking and audible pitch fluctuations due to mechanical imperfections in the record player, record warps or eccentricity.

Compact Disc also claims to give better fidelity to the original sound than LP, for reasons explained in the Technical Introduction. But for all the system's obvious and measurable technical superiority, Compact Discs have not always sounded better than LPs, and in fact sometimes showed an embarrassing tendency to sound positively unpleasant compared with the best that analogue records and players could offer. Some have blamed the hardware, others the software; that is the recording, digital transcoding and disc mastering that had gone into the disc.

A combination of factors has been responsible for these apparent failures. There is now no doubt that many early discs were indeed poor, sounding thin, harsh and unnatural, and miserably failed to do the system justice. It is only with experience of recording and mastering for CD and with improvements in equipment and techniques that record companies have started to come up with consistently good CD product.

On the hardware side, improvements have been discreet but actually very significant, and the best players now have a 'listenable' quality that was all too often lacking before, despite incredibly low distortion figures and ruler-flat frequency responses. In reality the usual steady-state 'analogue' hi-fi lab test measurements do nothing to illuminate the differences between CD players simply because digital audio operates on very different principles, but we have tried to develop some tests which do correlate with audible effects.

Compact Disc can be added to any conventional hi-fi system — the player simply plugs into the amplifier's 'aux' input. But inadequacies of the existing amplifier and loudspeakers can rather easily negate the potential benefits of CD. The dynamic range of actual CD programme may be nothing like the 90dB permitted by the encoding system but it is still often greater than that found in any other domestic sound source. CD can produce transient peaks which though of very short duration are of very high level compared with the average level of the musical signal, and these demand quite surprising amounts of power from an aplifier. On a typical CD listening test, using loudspeakers of average efficiency, it would not be uncommon to see the amplifier reaching peak outputs of 150 watts pwer channel, though the music was being played at very moderate comfortable listening levels! Clearly, the CD signals, when correctly amplified will cause severe overloading and distortion in loudspeakers which are not designed to cope with them.

This helps explain why demonstrations of CD, using large but very coloured speakers and large but poorly-designed amplifiers, and conducted with the misguided idea of showing the medium's 'superior dynamic range' thorugh sheer volume, have so often made listeners wince. It also should explain why a CD player is not likely to sound good if connected into an average rack or midi system amplifier and speakers, and with this in mind those considering the purchase of such a system including CD should proceed with great caution. It's worth noting here that in the *Hi-Fi Choice: Amplifiers* and *Loudspeakers* editions we have carefully assessed the suitability of each model for CD use.

Though the CD system is now fairly well established, the digital-versus-analogue controversy still persists. Anti-digital commentators, claiming to know nothing about A to D but to know what they liked, have tended to drift from technical half-truths to outright mysticism in their attempts to explain what they thought was wrong with the system. Pro-digital pundits could be equally infuriating when they suggested that the unpleasant, fatiguing sounds of some CDs were without exception due to greater accuracy of the medium in showing up defects in the source material, that anyone who preferred analogue was just cosily bathing in the warmth of their system's euphonic colorations and that they should manfully brace themselves for a cold shower of digital accuracy, however unpleasant the shock might be. But backing up the pro-digital position was the observation that listeners could not reliably detect the presence or absence of an analogue-to-digital/digital-to-analogue record/replay chain in the path of a signal.

While CD is quite easily added to any modern hi-fi set-up, it will certainly repay some extra care getting the rest of the system right. Our reviews focus on the relatively subtle differences between competing players, but they also show how steady and significant progress is being made.

Steve Harris

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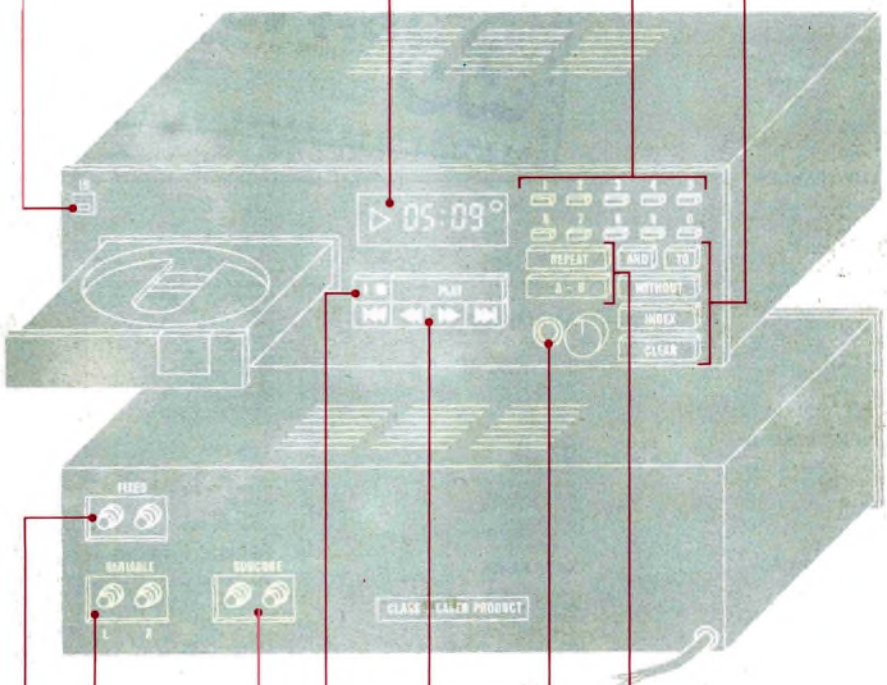
COMPACT DISC PLAYER BUYER'S CHECKLIST

0-9 keypad should offer full programming of Track and Index numbers. How many individual tracks can be held in the player memory? Can the keypad be used to program the player by time as well as by Track or Index numbers?

Display. Track time, total, elapsed and/or remaining time can be displayed. Index points are a subdivision of Tracks – even though they are shown on the display some players cannot search by Index points.

Is remote control offered? If so over how many facilities?

Some players provide Store and Cancel keys, or similar, to aid memory programming.



Variable level output can be useful in matching CD player to other inputs. Can also be used directly into a suitable power amplifier.

Some machines feature sound during fast forward and review. Track Skip On and Skip Back is a helpful feature.

Repeat function for Tracks, Programmes, whole Discs or sections between user-programmed points. Check flexibility.

Can the player be pre-paused?

Fixed level output for connection to any line level input (tape, aux/CD, tuner, but 'phono') on amplifier.

Subcode output gives signal for CD graphics – provision for developments yet to come.

Headphone socket with variable level. This control may also set the level of the Variable output phono sockets on the back panel as well.

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- Marantz CD74 ☐
- Marantz CD84 ☐
- Mission DAD7000R ☐
- Phillips CD104 ☐
- Sansui V100 ☐
- Sansui V300 ☐
- Yamaha CDX2 ☐
- Yamaha CD3 ☐

TURNTABLES

- Acoustic Research ☐
- Acoustic Research Futura ☐
- Aristan RD40 ☐
- Ariston RD80SL ☐
- B&O RX2 ☐
- Dual CS505/2 ☐
- Dual CS505/2 Delux ☐
- Lux PD300 ☐
- Mission Cambridge 775 ☐
- NAD 5120 ☐
- QED R232 ☐
- Revolver ☐
- Rotel RP850 ☐
- Thorens TD320 ☐
- Thorens TD147 ☐
- Walker CJ61 ☐
- Walker CJ58 ☐

PICK-UP ARMS

- Audio Technica AT1120 ☐
- Audio Technica AT1100 ☐
- Linn LVX ☐
- Mission 774LC ☐
- Mission 774SM ☐
- SME S1IS ☐
- SME Series V ☐

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- Audio Technica AT33E ☐
- Audio Technica AT110E ☐
- Audio Technica AT33MI ☐
- Coral MC88E ☐
- Denon 103 ☐
- Goldring G920 1GC ☐
- Golding G910 1GC ☐
- Goldring Epic ☐

- Grado GT Super ☐
- Mission 773HC ☐
- NAD 9100 ☐
- Nagaoka MP10 ☐
- Ortofon OM10 ☐
- Ortofon OM20 ☐
- Ortofon MC10 Super ☐
- Shure MP2E ☐
- Shure ML140HE ☐

AMPLIFIERS

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- Mission Cyrus 1 ☐
- Mission Cyrus 2 ☐
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- Proton 520 ☐
- QED A230 ☐
- Rotel RA820 ☐
- Rotel RA870 ☐
- Rotel RA820BX ☐
- Rotel RC870/RB870 ☐
- Sondex S230 ☐
- Sansui AU-D101 ☐
- Yamaha A320 ☐

SPEAKERS

- A&R Arcam 1 ☐
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- BBC LS35A ☐
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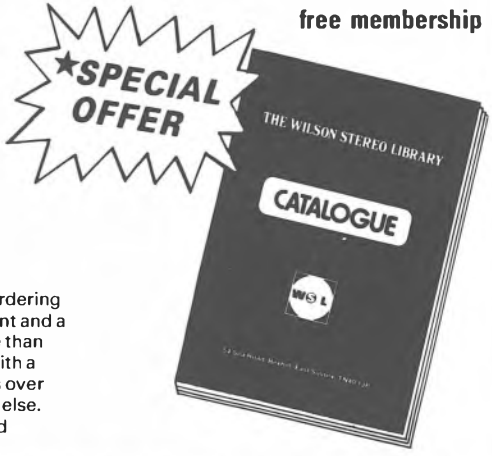

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Aiwa DX-1200

Aiwa (UK) Ltd, Unit 2, Dukes Estate, Western Avenue, London W3 0SY
Tel 01-993 1672

A midi-sized model, finished in satin black, the Aiwa *ADX-1200* incorporates a drawer loading mechanism which is distinguished by its need to insert the disc upside down. (Rumour has it that the early B&O *5000* series player was also based on this Aiwa mechanism.)

The front panel is dominated by a large fluorescent display providing track number and timing in minutes and seconds, both per track and for the overall disc. In index mode the display shows the required numbers. No numeric keyboard is present, but entry is rapid via the F and B 'skip' buttons. Tracks may be programmed and set to repeat in their entirety on or over selected passages — the so called 'A to B repeat' feature. A headphone socket is fitted to the front panel, together with a low profile level control.

Aiwa's rear panel is more complicated than most, and has other facilities in addition to the fixed audio output sockets, which are nickel plated phonos. A small socket is fitted for 'deck sync', and comprises a remote start line for connecting a cassette deck for recording purposes. Another terminal is an 8 pin DIN socket marked 'Digital Out' which is presumably for connection to other digital equipment — display, computers etc. Finally a linear 13 contact terminal marked 'remote' is for connection to the remote unit in Aiwa's matching rack, allowing full remote control of the player via the rack or stack system making the CD an integral part. This facility is however lost when the CD is used outside the Aiwa package.

The Aiwa design uses a single 16 bit shared D/A convertor with 2 x oversampling, this similar to the current Yamaha models. 7 pole discrete LC filters follow the converter's channel separator.

Lab report

Channel balance was excellent throughout, though the frequency response did show a small rise to 20kHz, this being a maximum of +0.6dB and probably inaudible.

Channel separation was also very good at typically 97dB. The usual interchannel phase difference due to the time-shared converter was reduced to 45° by the two-times over-sampling.

At peak level the total harmonic distortion was good but unexceptional at −98dB, 1kHz and showing −80dB of beat noise at 20kHz. However, at reducing modulation levels, very good figures were displayed showing the full 16 bit linearity. This was confirmed by the minor +1.5dB level error at a set −90dB. The high frequency intermodulation results were good, at almost 100dB down at full level, and close to the limit at 10dB below peak.

Output level was standard at virtually 2V with a higher than average output impedance of 922 ohms — close enough to 1k ohm. De-emphasis was fine while the track access was fairly rapid at 6.5 seconds. Mechanical noise was

moderate and the machine performed excellently on the error correction tests. Signal to noise ratios were better than average and unwanted spurious signals were generally well rejected, at leat to – 112dB.

Spectrum analysis for the – 10dB two-tone intermodulation did show a poorer than average performance on aliasing — the upper difference tone at 24kHz was only 23dB down, which is a little too close to peak level for comfort!

Sound quality

Scoring a little below average, the *1200* proved to be a competent performer, and generally set a good CD standard. Critical analysis suggested that the upper bass lacked a little in definition and attack, with the mid register a touch forward and two dimensional, with the treble slightly brash and exposed. In stereo terms the image was a trifle narrowed and softer in focus.

Conclusion

While this player undoubtedly fulfilled its intended purpose very competently it did not have a sufficiently competitive edge to attain the recommended category. An important component as part of the matching Aiwa stacks, it is nonetheless worth considering, even for independent use.

GENERAL DATA Aiwa ADX 1200

Channel balance
At 20Hz....0.14dB
At 1kHz....0.14dB
At 20kHz....0.14dB

Stereo separation
At 20Hz....97dB
At 1kHz....96dB
At 20kHz....94dB

Channel phase difference
At 20Hz....0°
At 1kHz....2.5°
At 20kHz....45°

Total harmonic distortion at 0dB
At 20Hz....– 88dB
At 1kHz....– 87dB
At 20kHz....– 80dB

Total harmonic distortion at – 10dB
At 1kHz....– 83dB

Total harmonic distortion at – 60dB
At 1kHz....– 48dB

Total harmonic distortion at – 80dB
At 1kHz....– 27dB

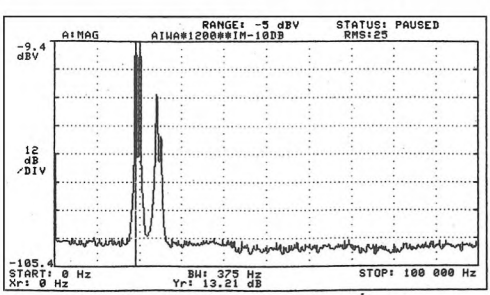
Intermodulation distortion
At 0dB, 19kHz/20kHz....– 97dB
At – 10dB, 19kHz/20kHz....– 90dB

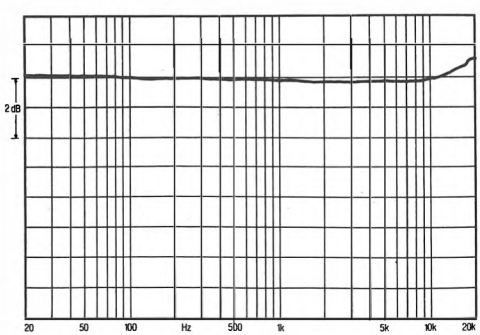
Frequency response
Left channel....+ 0.5, – 0.15dB
Right channel....+ 0.5, – 0.15dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....– 99dB
No emphasis, CCIR ARM, 1kHz ref....– 93dB

Output level, 0dB
Left channel....2.02V
Right channel....1.99V

Output impedance....922ohms
De-emphasis....fine
Track access time....6.5 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....moderate
Spuriae up to 100kHz....– 112dB
Resolution at – 90dB....+ 1.5dB
Headphone socket....yes (variable output)
Dimensions (w × d × h)....33 × 30 × 7.1cm
Estimated typical purchase price....£380

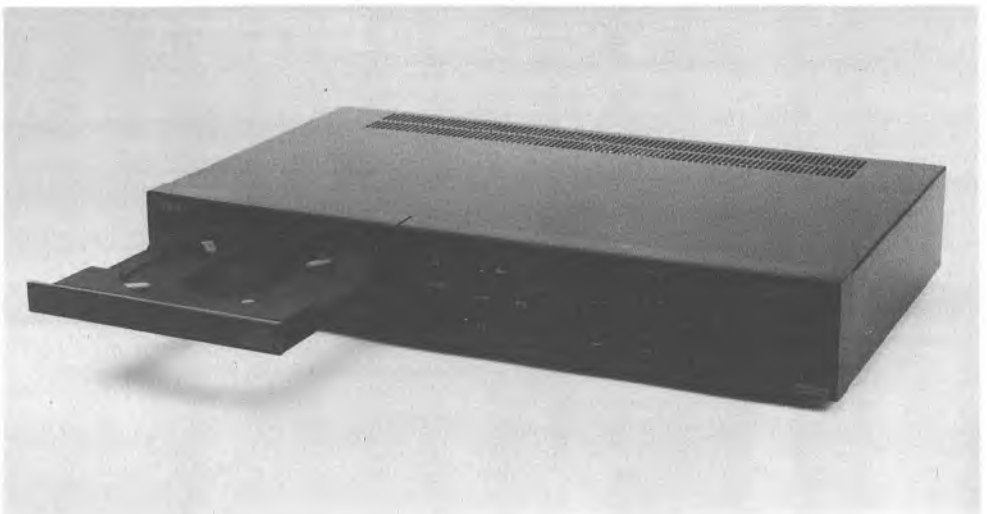




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response

Akai CD-A7

Akai (UK) Ltd, Unit 12, Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388



Sister machine to the *M88*, the *'A7* is presented in a silver hue and a larger case.

While one might have expected an identical performance to the '88, in fact this was not the case. The *'7* did not measure as well as the *'88* nor did it quite match the other machine's sound, but we have no details of internal changes that might be responsible.

The *CD-A7* comes with an infra-red remote control that includes a full numeric keypad as well as direct track access. Audible music cueing was absent. A large fluorescent display is fitted, which gave clear indication of the various states such as track numbers etc. Programming of tracks in any order was also possible, including their indexing.

A headphone jack is provided, operated by a front panel mounted level control. This is also linked to the rear panel phono jacks.

As with the *'88*, the *'7* is a fast drawer loader with a new optical system incorporating vibration-resistant servos. Track access is rapid, though interestingly the mechanical 'swish' level was much less obvious than with the *'88*, perhaps due to the former's different mechanical construction.

As with the *'88*, the *'7* uses normal rate sampling with a single 16 bit Burr Brown digital to analogue convertor.

Lab report

The frequency response showed a little more drift than the *'88*, with a touch of bass loss and on average a little more treble lift, though of a similar nature to the *'88*. −0.45dB of channel imbalance was present at high frequencies — in truth this was comparatively mild. Channel separation averaged 80dB, while the inter-channel phase difference reached the usual 76° at 20kHz, typical of the genre.

Harmonic distortion was low at −94dB 1kHz, and as far as downband noise is concerned, it held to −84dB at 20kHz full level. With reducing test level the distortion rose as usual, but increased to a point indicating poorer than 16 bit linearity. The −21dB distortion at −80dB coupled with the +7.2dB error at 90dB, suggested near 15 bit for this sample. The two tone intermodulation was fairly good at −89dB, full level, and −87dB at −10dB, with the graph for the latter, in common with the '88, being fairly clean, with products at around 25kHz, −46dB. Other spuriae were well suppressed, in fact to −105dB.

At mid frequencies the channel balance was near perfect with an output level that was virtually on target at 1.98V left, 2.005V right. The full volume lowest output impedance was 77 ohms, but depending on the volume control setting, it could rise up to 2.4K ohms. This is still low enough to drive a number of power amps direct if so desired.

Mechanical noise was moderate, and very good error correction was demonstrated, much better than for the original Akai model. The

signal to noise ratio was a little poorer than average, though it was still satisfactory.

Sound quality

Though poorer than the *'88,* the *'7* also did well in exhaustive comparative testing. Slight softening was detected in the bass region; indeed, compared with the *'88* this slight vagueness extended throughout the frequency range. The sound remained pleasant with an easy, relaxed quality, while stereo focus and depth were both good, with transient definition rather above average.

Conclusion

Though in general terms the *'7* was a little poorer than the *'88,* its mechanical noise level was lower, while the subjective score was commendable. There was little to criticise in objective terms, and as a result this new Akai comfortably wins a 'Best Buy' rating here on grounds of its sound quality as well as its value for money.

GENERAL DATA — **AKAI CD-A7**

Channel balance
At 20Hz 0.05dB
At 1kHz 0.1dB
At 20kHz 0.4dB

Stereo separation
At 20Hz 82dB
At 1kHz 84dB
At 20kHz 75dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 0°
At 20kHz ..... 76°

Total harmonic distortion at 0dB
At 20Hz ..... – 96dB
At 1kHz ..... – 94dB
At 20kHz ..... – 83.6dB

Total harmonic distortion at – 10dB
At 1kHz ..... – 79.4dB

Total harmonic distortion at – 60dB
At 1kHz ..... – 34dB

Total harmonic distortion at – 80dB
At 1kHz ..... – 21dB

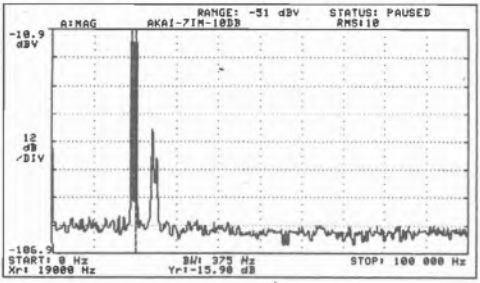
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... – 89dB
At – 10dB, 19kHz/20kHz ..... – 87dB

Frequency response
Left channel ..... + 0.3, – 0.18dB
Right channel ..... + 0.45, – 0.2dB

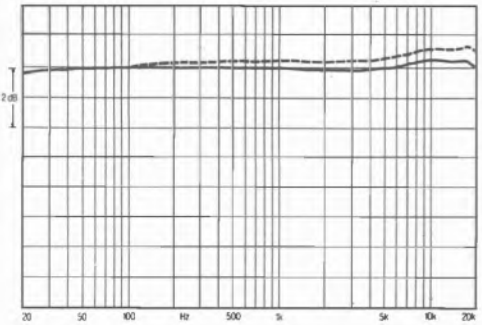
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... – 95dB
No emphasis, CCIR ARM, 1kHz ref ..... – 89dB

Output level, 0dB
Left channel 1.981V
Right channel 2.005V

Output impedance 77ohms
De-emphasis ..... fine
Track access time ..... 5 secs
Error correction capability ..... >900μm gap, >800μm dot
Mechanical noise ..... fairly low
Spuriae up to 100kHz ..... – 105dB
Resolution at – 90dB ..... + 7.2dB
Headphone socket ..... yes (variable level)
Dimensions (w × d × h) ..... 44 × 26 × 8cm
Estimated typical purchase price £400



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



Akai CD-M88

Akai (UK) Ltd, Unit 12, Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388

A compact design, finished in black, the *M88* is a full feature machine with elaborate facilities including an infra red remote control. Early reports suggested that this model sounded competitive, and we were not disappointed on test. Akai machines have come a long way since the original bought-in Kyocera model, and the designers appear to have resolved major problems.

Features include a full numeric keyboard, direct track access, audible music cueing plus a large fluoresent display showing all available information, including indexing.

A headphone socket (mini jack) is provided, and its adjacent recessed variable level control also operates on the output level, this via the single pair of phono sockets.

Track access was rapid in operation, though the machine did emit the odd chirp, plus a constant high pitched 'swish' that I found a nuisance, although others failed to notice it. Akai's comment was to suggest location away from the listening position, thereby exploiting the remote control facility.

Priced at £399, the *M88* occupies a competitive market position, and also complements the current Akai midi stacked systems.

Internally the player showed a good quality of construction, with quite good accessibility. The circuitry was fairly conventional, of standard, normal-time sampling with a single time shared 16-bit digital to analogue convertor chip, this the popular Burr Brown type. The player makes some compromise in its output circuitry whereby the low impedance output is directed around the box to the front panel variable level control. It is then routed back to the rear panel socket. All the results in this review relate to the factory-built as supplied, but we also checked the effect of bypassing the level control and short wiring the output socket to the final integrated circuit output. I am sure that the resulting improvement would be considered worthwhile by an audio enthusiast — we judged about 0.6 of a point in 8. When direct wired a much lower and constant output impedance is obtained, to better drive the interconnect cable.

Lab report

Channel matching and balance were excellent while the frequency response showed just a hint of treble lift — about 0.4dB rise in the final 1½ octaves.

Channel separation was high if not exemplary at around 80dB, while the inter channel phase shift showed the usual 70-80° difference at 20kHz, due to the shared converter. Slight compression was shown at peak level, but this was hardly seen in the −93dB distortion at 1kHz, full level. Good distortion results were maintained at 20kHz, and at reducing output levels, mid band. The −24dB result at −80dB signal level showed close to 16 bit linearity while an odd −90dB

level offset was noted as −4dB left and −1.5dB right, a reversed curvature at the resolution limit. The intermodulation results were about average — very good nonetheless, at −89dB for the full modulation, difference tone product.

Output level was the usual 2V from a variable impedance, typically 100 ohms, but rising to a high 2 to 2.5K ohms at one setting. Track access was fast at 3.8 seconds, while the error protection proved excellent, easily meeting the test disc limits which are themselves rather greater than required.

Signal to noise ratios were quite typical; for example, −92dB CCIR ARM 1kHz without emphasis, while spurious signals up to 100kHz were well rejected by 108dB or more.

Sound quality

Rated well above average, this player was much liked on audition. Despite a hint of brightness and forwardness in tonal perspective, it proved clear and clean throughout the frequency range. Good stereo depth and transparency were its hallmarks, while the bass showed a pleasing extension as well as precise control. By CD standards the treble was also sweeter than usual. Stereo images were well focused and worn discs were played with confidence. It also showed good vibration resistance.

Conclusion

The sound quality alone ensures this machine a Best Buy rating. The lab performance shows a basically good design with a stable, precise optical transport. This one is confidently recommended, providing that its minor mechanical noise does not put you off. Congratulations Akai!

GENERAL DATA — Akai CDM88

Channel balance
At 20Hz 0.02dB
At 1kHz 0.02dB
At 20kHz 0.02dB

Stereo separation
At 20Hz 85dB
At 1kHz 86dB
At 20kHz 77dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 0°
At 20kHz ..... 76°

Total harmonic distortion at 0dB
At 20Hz ..... −96dB
At 1kHz ..... −93dB
At 20kHz ..... −82dB

Total harmonic distortion at −10dB
At 1kHz ..... −84dB

Total harmonic distortion at −60dB
At 1kHz ..... −50.1dB

Total harmonic distortion at −80dB
At 1kHz ..... −24.7dB

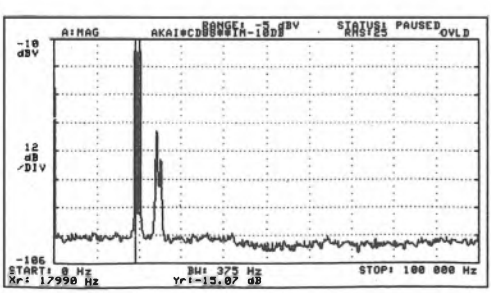
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... −89.5dB
At −10dB, 19kHz/20kHz ..... −88dB

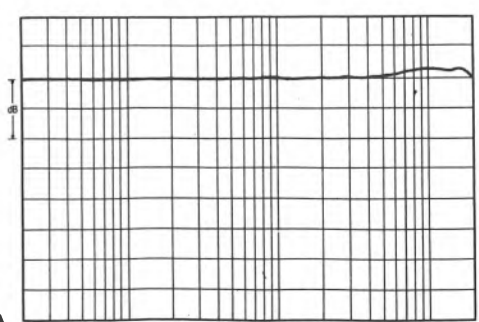
Frequency response
Left channel ..... +0.37, −0dB
Right channel ..... +0.37, −0dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... −98dB
No emphasis, CCIR ARM, 1kHz ref ..... −92dB

Output level, 0dB
Left channel ..... 2.01V (variable)
Right channel ..... 2.01V (variable)

Output impedance 100ohms
De-emphasis ..... fine
Track access time ..... 3.8 secs
Error correction capability ..... >900μm gap, >800μm dot
Mechanical noise ..... mild 'chirps' and high pitched noise
Spuriae up to 100kHz ..... −108dB
Resolution at −4dB ..... +1.5dB
Headphone socket ..... yes (variable level)
Dimensions (w x d x h) ..... 35 x 26 x 7.1cm
Estimated typical purchase price £430

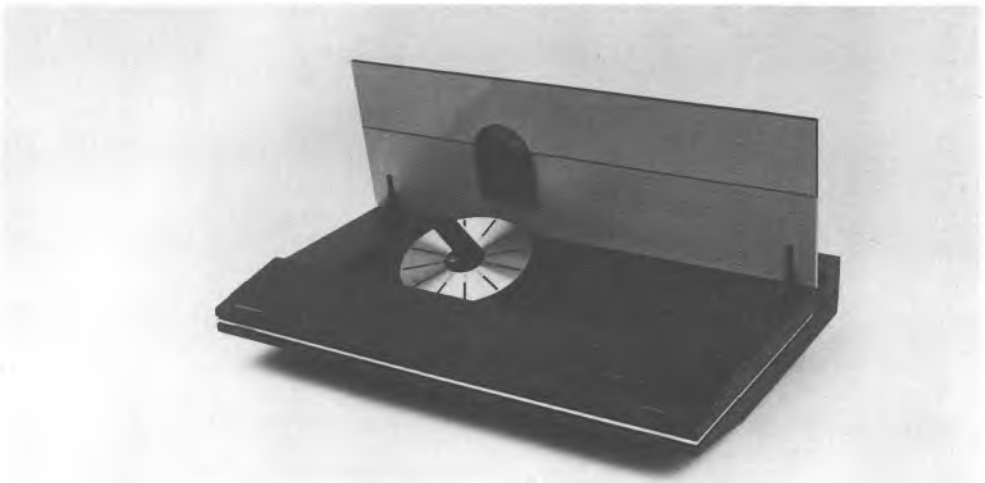




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response

Bang & Olufsen CD-X

Bang & Olufsen (UK) Ltd, Eastbrook Road, Gloucester GL4 7DE
Tel (0452) 21591



B&O are intending to market two CD players — the *CDX,* a modestly priced model of universal application that stylistically matches the 3000 series, and the *CD50,* a remote controlled machine for use with the interfaced *5000* hi-fi series.

By the time the review went to press we had only received a sample of the *CDX,* so the more expensive machine will have to wait until next time. The *CDX* is excellently styled and finished, and although it is based on the Philips *CD101* series bears no physical resemblance to the Philips models.

The B&O control panel is operated by touch only — the surface does not even have to be depressed. Lid elevation is by button, and as the damped alloy lid rises, so the carrier swings up to present you with the disc 'platform'.

Up to 20 tracks can be programmed, with a full-width led indicator to show the entries. A numeric key array provides for quick entry while the souped-up transport gives rapid track access. The large and easily read display shows overall time track and track numbers but audible music cueing and indexing are absent.

Following the Philips system, and using many Philips components, the B&O employs the four times oversampling technique, with a 96th order digital filter, two separate 14 bit digital to analogue convertors, plus slow analogue filtering thereafter.

A performance close to Philips standard was expected and realised. The fixed output cable is in fact of the Philips variety, with the original tinned phono plugs!

Lab results

Channel balance was very good at 0.1dB (the small imbalance shown in the graph was due to faulty registration on the measurement and not the player's fault). On frequency response a very slight bass droop was evident, plus the usual minor ripples of the Philips digital filter. The overall frequency response met fine +0.1, −0.25dB limits.

Channel balance was typically better than 90dB, while predictably, the interchannel phase difference was zero over the entire frequency range. Showing good linearity, the low level distortion figure and the level error at −90dB suggested a good linearity, close to 15½ bit. Midband distortion approached −100dB full level, while at 20kHz, the in band products held to an excellent −94dB.

High frequency intermodulation results were above average although the 100kHz intermodulation spectrogram revealed some beat products up-band. The 24kHz component was satisfactory at −56dB, with additional products in the 60-70kHz region. The result for the spurious outputs on the deck with single tone signals is not shown; but here the spuriae could reach above −60dB, despite an intrinsic suppression close to 100dB. This is typical of the Philips circuit.

Output was standard at 2V, sourced from a low 50 ohms output impedance. Track access was a fast 5.2 seconds, and mechanical noise was fine, with error correction excellent, as usual. Signal to noise ratios were exemplary, quite beyond audible thresholds and of course the demands of any usable programme.

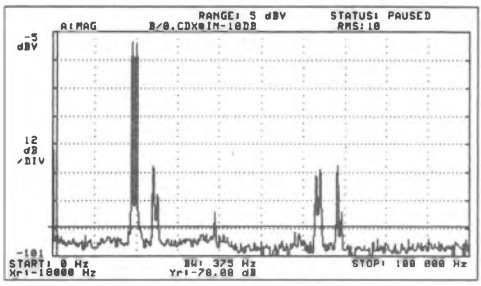
Sound quality

Listening tests indicated a superior performance, a little above that of the Philips equivalents. The bass was firm and secure, while the treble was tidy and well defined. Stereo was well focused, with presentable depth, and the tonal balance was pleasantly sweet, with transients well reproduced.

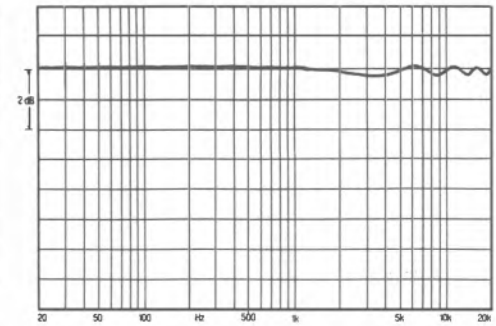
Conclusion

Given its performance, the price, the fine build quality, excellent finish and good facilities, this B&O player scores a Best Buy rating. Let us hope that their bigger CD model also sounds at least as good.

GENERAL DATA	B&O CD-X
Channel balance	
At 20Hz	0.1dB
At 1kHz	0.1dB
At 20kHz	0.1dB
Stereo separation	
At 20Hz	94dB
At 1kHz	96dB
At 20kHz	89dB
Channel phase difference	
At 20Hz	0°
At 1kHz	0°
At 20kHz	0°
Total harmonic distortion at 0dB	
At 20Hz	– 95dB
At 1kHz	– 98dB
At 20kHz	– 94dB
Total harmonic distortion at – 10dB	
At 1kHz	– 76dB
Total harmonic distortion at – 60dB	
At 1kHz	– 41dB
Total harmonic distortion at – 80dB	
At 1kHz	– 22dB
Intermodulation distortion	
At 0dB, 19kHz/20kHz	– 89dB
At – 10dB, 19kHz/20kHz	– 78dB
Frequency response	
Left channel	+ 0.1, – 0.25dB
Right channel	+ 0.1, – 0.25dB
Signal to noise ratio	
No emphasis, 20Hz-20kHz unweighted	– 108dB
No emphasis, CCIR ARM, 1kHz ref	– 109dB
Output level, 0dB	
Left channel	2.09V
Right channel	2.11V
Output impedance	50ohms
De-emphasis	fine
Track access time	5.2 secs
Error correction capability	>900µm gap, >800µm dot
Mechanical noise	low
Spuriae up to 100kHz	– 60dB to – 100dB
Resolution at – 90dB	± 3.5dB
Headphone socket	no
Dimensions (w x d x h)	43 x 31 x 7.5cm
Estimated typical purchase price	£350



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



Ferguson CD01

Thorn EMI Ferguson, Cambridge House, Great Cambridge Road, Enfield, Middlesex EN1 1UL
Tel 01-363 5353

Sporting a famous British brand name, this large, silver-finished CD player sells at a competitive £299. It is not in fact made in the UK, being a custom version of the established Sony *CDP101*, though without the *101*'s remote control facility. It is intriguing to note that the Sony design, with remote, originally sold at £599!

As with the Sony original, the Ferguson employs a mechanically sound laser transport, with excellent push button controls. A numeric keyboard is absent but tracks can be rapidly accessed via repeated key depressions. Programming is also missing, but the location of index points can be accessed. Few discs are indexed at present, however. A further aid to musical section location is provided by the excellent two speed audible music cueing facility. Repeat is also present, both over a selected A-B section as well as for the complete disc.

Engineering and construction quality was very fine, and the generously sized steel case has allowed for a sensible location of major components.

Conversion is via a single 16 bit Sony digital to analogue chip, shared between the channels. A deglitching section follows the convertor, in its turn followed by a monolithic 9 pole thick film active low pass filter. This is the so called 'brickwall' filter to suppress unwanted spurious components above 22kHz.

No headphone socket is provided, this included on the original *101*, and the output circuitry has also been simplified a little, possibly with a resulting sonic improvement — we shall see!

Lab results

An excellent frequency response and channel balance was recorded on test. Held within ±0.2dB limits from 20Hz to 20kHz, the left and right traces were virtually identical. Signal output was a standard 2V from a moderate 440 ohms source impedence. Channel separation was also very good, reaching 100dB mid band and almost 96dB at 20kHz. As usual with a shared convertor, the time delay between channels resulted in an increasing phase difference with increasing frequency. By 20kHz, the difference reached 80°, but at present this is not considered to be of any importance subjectively.

Close to 16 bit linearity, the level error at −90dB was a modest 2.5dB while the mid band harmonic distortion was very low at −100dB. With reducing modulation level, good mid band distortion figures were maintained. At high frequencies the down band products were about average at −85dB; likewise, although the high frequency intermodulation results were undoubtedly good they were nonetheless poorer than average.

Track access was rapid at a typical 4.5 seconds for the 15th track on the Sony test record. Mechanical noise was moderate, and

restricted to an occasional 'ticking'. On error correction the player met the minimum specification, but fell short of the current best standards.

Good signal to noise ratios were shown, while the spurious outputs were also well suppressed, eg: by 110dB by 100kHz.

Sound quality

Scoring a little below average, this player sounded slightly 'dated', though it still conveyed the main strengths of CD reproduction. Providing a competent performance, detail and clarity were both well preserved, at the expense of some mid band forwardness and 'glare'. Stereo images were well focused but showed some loss of depth. Definition at low frequencies was mildly softened, and some grain was evident in the treble register.

Conclusion

The Ferguson CD set a presentable standard, but was outclassed sonically by the Philips machines as well as several other alternatives. Error correction was also not to modern standards. No recommendation is possible here, but the player remains worth considering, possibly as part of a matching Ferguson system.

GENERAL DATA Ferguson CD-01

Channel balance
At 20Hz 0.03dB
At 1kHz 0.04dB
At 20kHz 0.21dB

Stereo separation
At 20Hz 100dB
At 1kHz 100dB
At 20kHz 95.6dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 1°
At 20kHz ..... 80°

Total harmonic distortion at 0dB
At 20Hz ..... – 103dB
At 1kHz ..... – 101dB
At 20kHz ..... – 85dB

Total harmonic distortion at – 10dB
At 1kHz ..... – 85dB

Total harmonic distortion at – 60dB
At 1kHz ..... – 48dB

Total harmonic distortion at – 80dB
At 1kHz ..... – 26dB

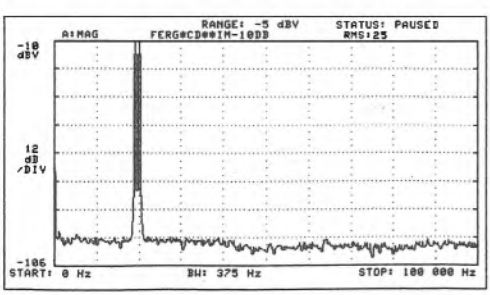
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... – 80dB
At – 10dB, 19kHz/20kHz ..... – 86dB

Frequency response
Left channel ..... + 0.2, – 0.2dB
Right channel ..... + 0.2, – 0.2dB

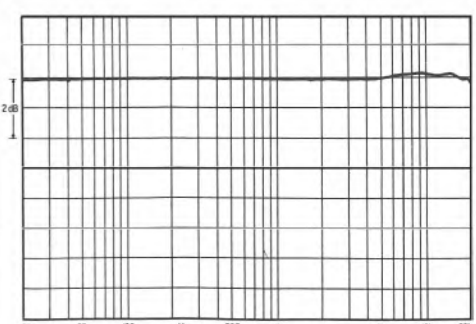
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... – 97dB
No emphasis, CCIR ARM, 1kHz ref ..... – 91dB

Output level, 0dB
Left channel 1.99V
Right channel 2.001V

Output impedance 440ohms
De-emphasis ..... fine
Track access time ..... 4.3 secs
Error correction capability ..... 400µm gap, 500µm dot
Mechanical noise ..... moderate
Spuriae up to 100kHz ..... – 110dB
Resolution at – 90dB ..... + 2.5dB
Headphone socket ..... no
Dimensions (w × d × h) ..... 36 × 34 × 10cm
Estimated typical purchase price £300



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



Fisher AD840

Fisher Sales (UK) Ltd, Bushey Mill Lane, Watford, Herts
Tel (0923) 31974)

Though Fisher's parent company, Sanyo of Japan, have built some of their own players, Fisher have chosen to source this model from Yamaha. Yamaha have enjoyed some success in selling out versions of the *CDX-1* to other manufacturers, this list now including Teac, Sansui and now Fisher. While based on the *'X-1,* the Fisher incorporates some minor changes and the final alignment specification may differ.

A lightweight, compact machine using a moulded plastic case/chassis, the *AD840* is a relatively basic machine in terms of facilities. For example, the usual headphone socket and numeric keyboard are absent, and the player has manual control only. The transport is fast, and tracks may be quickly accessed via rapid key depressions. The display shows elapsed and remaining time, as well as track times and track numbers up to 99. Tracks may be programmed in any order, but no indexing is possible. Finish is predominantly silver grey, with black highlights on the fascia. Output level is fixed at nominally 2 volts, from normal phono sockets.

As with the Yamaha original, this player employs two-times oversampling with a time-shared 16-bit digital to analogue convetor.

Lab results

A highly uniform frequency response was obtained to 10kHz; above this was a slight lift, followed by a mild treble rolloff, well matched between channels and amounting to nearly 0.8dB. This is unlikely to be audible to any but the youngest listeners and even here is probably inconsequential.

Channel balance held to better than 0.05dB overall. Separation was good if unexceptional, down to 71dB at 20kHz. Interchannel phase difference rose to 38° at 20kHz, as expected from this type of design.

Total harmonic distortion was very low mid band, at −100dB, 0.001%, this with the minor level error at −90dB indicating a resolution of better than 15½ bits. The noise modulation at 20kHz was quite good at −84dB, while the intermodulation at high frequencies was also handled very well; for example, −92dB of 1kHz difference tone at a −10dB recorded level. The accompanying spectral analysis showed a clear output below 10kHz, and also above 30kHz; however the 24kHz intermodulation was not so well rejected, here just 27dB down.

For some reason, perhaps a marketing one, the output level is set slightly high at 2.3V from a higher than usual source resistance of 992 ohms. Track access was rapid at 5.5 seconds, while mechanical noise levels were low. De-emphasis correction was very good, easily meeting the full test disc limit.

Signal to noise ratios were more than satisfactory, but in themselves unexceptional. CCIR ARM (1kHz) weighted, the unemphasised result was fine at 93.5dB, while other spuriae signals were well rejected by 116dB.

Resistance to mechanical vibration was about average.

Sound quality

The Fisher player certainly maintained the established high standard for its class. Rated rather above average, it had that lively yet musical quality coupled with a pleasing impression of depth and ambience. The mid and tonal quality was also quite natural, showing good clarity; conversely the definition at the band edges was a trifle soft and untidy.

Conclusion

The Fisher player sets a good standards, both in terms of its sound quality and also it lab performance. The pricing is competitive and consequently this player comfortably scores a recommendation.

GENERAL DATA — Fisher AD-840

Channel balance
At 20Hz....0.02dB
At 1kHz....0.03dB
At 20kHz....0.05dB

Stereo separation
At 20Hz....83dB
At 1kHz....82dB
At 20kHz....71dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....38°

Total harmonic distortion at 0dB
At 20Hz....–100dB
At 1kHz....–100dB
At 20kHz....–84dB

Total harmonic distortion at –10dB
At 1kHz....–83dB

Total harmonic distortion at –60dB
At 1kHz....–48dB

Total harmonic distortion at –80dB
At 1kHz....–25dB

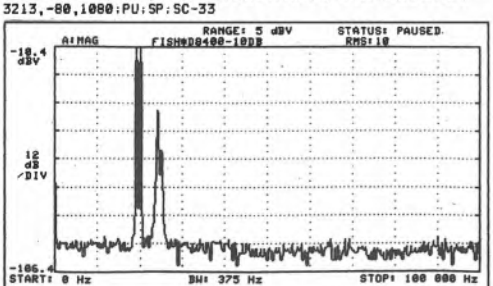
Intermodulation distortion
At 0dB, 19kHz/20kHz....–96dB
At –10dB, 19kHz/20kHz....–92dB

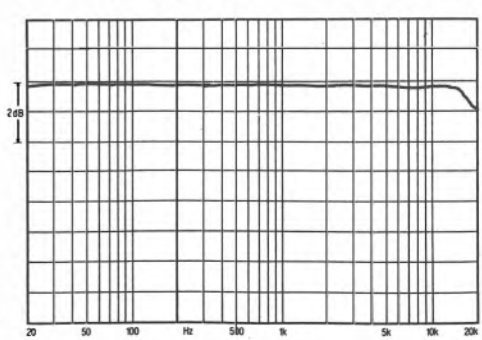
Frequency response
Left channel....+0.1, –0.75dB
Right channel....+0.1, –0.75dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–94.5dB
No emphasis, CCIR ARM, 1kHz ref....–93.5dB

Output level, 0dB
Left channel....2.24V
Right channel....2.28V

Output impedance....992ohms
De-emphasis....fine
Track access time....5.5 secs
Error correction capability....>900µm gap, >800µm dot
Mechanical noise....low
Spuriae up to 100kHz....–116dB
Resolution at - 90dB....+2.5dB
Headphone socket....no
Dimensions (w x d x h)....40 x 25 x 8.5cm
Estimated typical purchase price....£325





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

Hitachi DA4000

Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Hayes, Middlesex.
Tel 01-848 8787

A third-generation model, the drawer-loading Hitachi *4000* is an in-house design in their compact format. It is styled in satin black, to match the current series of midi-stack audio systems which dominate the market.

The fascia is equipped with relatively simple controls. No numeric keyboard is fitted, and track numbers are entered by successive button depressions. A large fluorescent display shows track numbers, overall and individual timings, and although no headphone socket is present, it does have index facilities, plus a memory, allowing programming of tracks in random order.

Providing a fixed output via two phono sockets, the back panel carries an additional 8 pin socket, for the connection of external equipment — accessory data and subcode information.

Internally the machine is pretty tidy although the design is not as well integrated as in the Yamaha machines, for example. Sony error correction ICs are used on a separate ceramic board while the D/A convertor is a single, time shared Burr Brown, this manufactured in a Japanese factory. Discrete LC filters follow.

Pointing to the reduced power consumption of modern machines, the mains transformer is surprisingly small

Lab results

Rather like the previous Hitachi model, this player also showed an increasing channel imbalance at higher frequencies. However, at just 0.4dB it could not in any way be regarded as serious. Both channels showed a hint of treble lift which might just be audible, this amounting to +0.7dB on the left channel. Channel separation was excellent at low and mid frequencies, reducing to a still good −78dB at 20kHz.

Harmonic distortion levels were a little poorer than average, while the downband beat products when energised by 20kHz, 0dB were much worse. These were at a −60dB level with signals at 4kHz and 14kHz. The high frequency intermodulation was also rather poorer than average at just −68dB for full level, with an improvement to −78dB at a −10dB signal level, pointing to some high level dynamic range constriction. The overall linearity and −90dB level error suggested a resolution closer to 15 than 16 bit.

For some reason, Hitachi have chosen to set a higher than usual output level of 2.42V. This might impress a punter in an A/B demonstration but it makes life harder for the reviewer who seeks to remove such variables from the listening test! Output impedance was low at 101 ohms, and the de-emphasis characteristic was followed correctly. The transport was speedy, reaching the test track 15 in 4 seconds, while mechanical noises were fairly low.

On error correction, the Hitachi disappointed. It certainly met the basic standard required but gave little margin for ageing or further disc mishandling Burst error lengths of

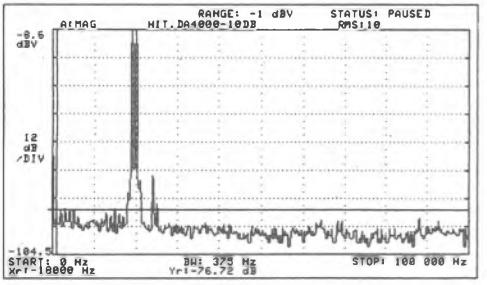
greater than 500μm were audible; many other decks can easily pass the 900μm gap now. Signal to noise ratios were about average, for example, −92.5dB CCIR ARM, (1kHz) without emphasis. Spurious signals were well rejected up to 10kHz, and the immediate side band for the high frequency intermodulation test was 68dB down.

Sound quality

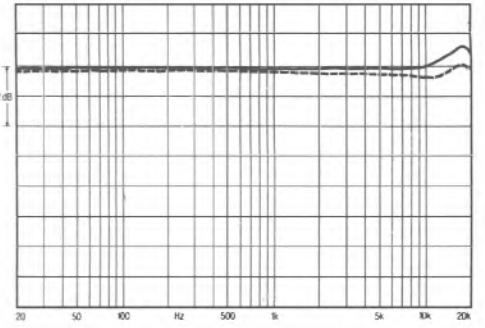
Scoring rather below average, this player was not favoured on audition. It sounded tonally thin with oversharp transients, a brash uneven treble, and a strangely 'noisy' effect. It was not very 'involving', with a two dimensional quality to the stereo image, and with a narrowed, dominant central image. Clarity was just average, with the bass lacked real attack or definition.

Conclusion

This player showed some weakness on the technical lab tests as regards error correction, as well as in its sound quality. It is not really a bad example but it falls rather below the standard set by the competition, and no recommendation is possible.



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



GENERAL DATA Hitachi DA-4000

Channel balance
At 20Hz....0.05dB
At 1kHz....0.05dB
At 20kHz....0.4dB

Stereo separation
At 20Hz....105dB
At 1kHz....105dB
At 20kHz....78dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....80°

Total harmonic distortion at 0dB
At 20Hz....−93dB
At 1kHz....−96dB
At 20kHz....−61dB

Total harmonic distortion at −10dB
At 1kHz....−74dB

Total harmonic distortion at −60dB
At 1kHz....−37dB

Total harmonic distortion at −80dB
At 1kHz....−22dB

Intermodulation distortion
At 0dB, 19kHz/20kHz....−68dB
At −10dB, 19kHz/20kHz....−76dB

Frequency response
Left channel....+0.7, −0dB
Right channel....+0.25, −0.25dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....−99dB
No emphasis, CCIR ARM, 1kHz ref....−92.5dB

Output level, 0dB
Left channel....2.43V
Right channel....2.41V

Output impedance....101ohms
De-emphasis....fine
Track access time....4.0 secs
Error correction capability....500μm gap, 500μm dot
Mechanical noise....fairly low
Spuriae up to 100kHz....−97dB
Resolution at −90dB....+5dB
Headphone socket....no
Dimensions (w × d × h)....32 × 30 × 8cm
Estimated typical purchase price....£450

JVC XL-V300

JVC (UK) Ltd, JVC House, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF
Tel 01-450 3282

Two new JVC machines are reviewed in this issue. Their pricing is similar and yet strangely their internal design is radically different — perhaps JVC are backing two technological horses on the assumption that one must win.

The *XLV300* is similar to the Yamaha designs in that the twice-oversampling system is used, and although the machine is not built by Yamaha, it does use the relevant Yamaha integrated circuits. The shared convertor is the popular Burr Brown, followed by discrete multipole LC filters. The construction is however untidy and I fear servicing will not be particularly easy due to the stacked printed circuit boards.

Inside, the player is fairly compact, but the case has been expanded externally to produce a wider model. A silver finish is used (the *V2* is in black). A drawer loader, the controls are simple and there is no numeric keypad, or index facilities; likewise remote control and a headphone socket have both been omitted. The player can be programmed in a logical order and will also repeat. Track access is fast and the track skip buttons operate rapidly. Audible music cueing is given on the two speed-search buttons.

Lab results

Frequency response was immaculate, falling to within ±0.05dB limits from 20Hz to 20kHz. This has been achieved at the expense of good upband spurious single blocking. For example, the 24kHz product of the −10dB high frequency two tone was dangerously high at just 20dB below signal level. Higher frequency spuriae were also present at higher than usual levels, eg: 68kHz at −52dB, and 88kHz at −81dB.

A mild 0.3dB of channel imbalance was noted, this consistent over the frequency range Channel separation was remarkably good, bettering 110dB over the entire frequency range. Interchannel phase difference rose to a maximum of 40° at 20kHz, as expected in a design using a time shared twice oversampled convertor.

Total harmonic distortion was poorer than average at peak level, suggesting a touch of compression, but it improved at lower levels, illustrating an overall performance very close to 16 bit. The level error at −90dB was just 0.5dB while the −27dB distortion result at −80dB was rather better than usual. The peak level limit was also seen in the poorer than average high frequency intermodulation; here −67dB of difference tone was recorded at full level. In theory it should get worse at the next level down, but was seen to improve as the region of peak limiting was cleared.

Output level was close to standard on both channels at 2.07 and 2.00V, sourced from a higher than average impedance of 1kohm. The de-emphasis curve was met correctly while the track access was rapid. Mechnical noise levels were fairly low and not likely to cause any

subjective problem unless the player is sited very close to the listener.

Signal to noise ratios were quite good, at close to the usual limits, while the player coped well with the error test, meeting the highest standards here.

Sound quality

On listening, the *XLV300* was felt to be most disappointing, scoring well below average. It sounded 'loud', and diluted dynamic contrasts in the mid range. It also exhibited a thinned, hard quality, almost edgy. The treble sounded sibilant and splashy. Stereo appeared to concentrate in the middle and yet did not seem to focus particularly well. Ambience was masked, and the overall effect was rather two dimensional.

Conclusion

In some areas of lab testing the '*300* performed very well, but the tendency for peak limiting as well as the high level of spurious signals were worrying aspects. While the relationships are as yet unproven, the sound quality was undoubtedly a disappointment; JVC need to improve the sound quality greatly if this deck is to come even close to recommendation.

GENERAL DATA JVC XL-V300

Channel balance
At 20Hz....0.3dB
At 1kHz....0.3dB
At 20kHz....0.3dB

Stereo separation
At 20Hz....118dB
At 1kHz....116dB
At 20kHz....110dB

Channel phase difference
At 20Hz....0°
At 1kHz....0.5°
At 20kHz....39.5°

Total harmonic distortion at 0dB
At 20Hz....–94dB
At 1kHz....–92dB
At 20kHz....–77dB

Total harmonic distortion at –10dB
At 1kHz....–81dB

Total harmonic distortion at –60dB
At 1kHz....–55dB

Total harmonic distortion at –80dB
At 1kHz....–27dB

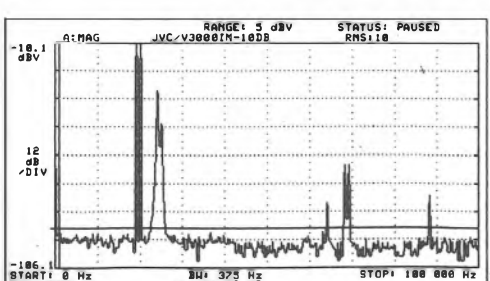
Intermodulation distortion
At 0dB, 19kHz/20kHz....–67dB
At –10dB, 19kHz/20kHz....–78dB

Frequency response
Left channel....+0.05, –0.05dB
Right channel....+0.05, –0.05dB

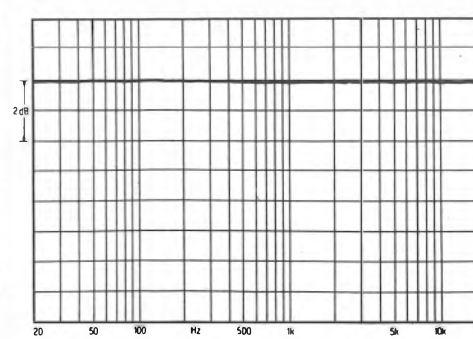
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–99.5dB
No emphasis, CCIR ARM, 1kHz ref....–94dB

Output level, 0dB
Left channel....2.072V
Right channel....2.003V

Output impedance....999ohms
De-emphasis....fine
Track access time....4.0 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....fairly low
Spuriae up to 100kHz....–81dB
Resolution at –90dB....+0.5dB
Headphone socket....no
Dimensions (w × d × h)....44 × 29 × 9cm
Estimated typical purchase price....£440



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



JVC XL-V2

JVC (UK) Ltd, JVC House, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF
Tel 01-450 3282

While the overall design and mechanical system are entirely JVC, the digital electronics inside the '*V2* are based firmly on the work of another company's design team — this model employs the Philips system with four times oversampling, and separate D/A convertors for left and right channels.

Presented in satin black, the 'chunky' design is well equipped although it lacks remote control. A headphone socket is fited, with slider controls for volume, though the main output terminal at the rear has a fixed level of a nominal 2V.

A large display shows track numbers, indexing and stop numbers, plus timings in minutes and seconds, both for the whole disc on first reading and for the track selected. Two-speed search is available, in conjunction with convenient audible music cueing. The display also shows track indicators up to 20, visually marking those performed. Memory A/B and repeat are also included.

Inside, the machine is untidy in terms of the numerous cable forms and it has no less than three stacked printed circuit boards in the main section; not an easy maintenance proposition.

Lab results

This machine demonstrated an excellent channel balance and consistency, to within 0.05dB overall. Likewise the frequency response was very flat, +0.1, −0.25dB with the minor ripples at the high frequencies being typical of the Philips system, and considered at present to be inaudible.

Channel separation was extremely good, reaching an extraordinary 132dB at 1kHz — at the limits of the analyser resolution! With two individual convertors, the interchannel phase difference was virtually zero throughout the range.

Harmonic distortion was low particularly at high frequencies; here the −95dB for in band beats is exceptional, and radically different to the result for the '*300*. With reducing level, the mid band distortion rose as usual, the results indicating a resolution around 15¼ bit. However, the high frequency intermodulation figures were also very good, with −95dB at full level and still −92dB at 10dB down on peak modulation.

From the associated spectrogram, the output could be seen to be very clean down-band, and the tricky 24kHz tone was also well suppressed by 60dB. Further up in the frequency range, the other spuriae are rejected by 105dB, which is rather better than the average Philips, and reflects the steeper rolloff filters chosen by JVC.

Inconveniently JVC have set the output level a trifle high, at 2.38V — so beware on A/B listening tests. Source impedance was moderate at 430 ohms while de-emphasis was correct, and track access was very fast at 3 seconds, difficult to check precisely due to limited hand-to-eye co-ordination. Mechanical

noise levels were fairly low, and JVC have clearly mastered the art of error correction; both test tracks were passed with flying colours.

As usual with the Philips chip set, the signal to noise ratios were exemplary for example, – 105dB CCIR ARM (1kHz) without de-emphasis.

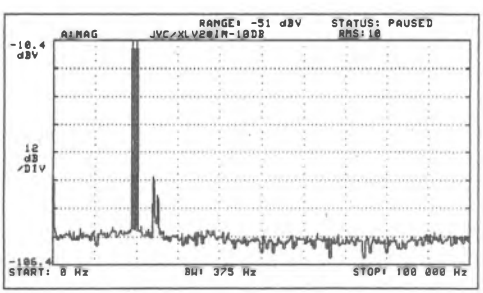
Sound quality

Performing rather better than the *'300* the *V2* scored a little below average on the listening tests. Providing a competent display of all the usual CD qualities, it was considered to be firm and clear in the bass, proving well detailed and focused as well as fairly lively. Conversely, it also tended to sound a little 'loud' and forward (gain correctly adjusted) with a 'steely' sharpness in the upper registers. The stereo did not properly develop its full depth, while transients showed some fatiguing 'crashiness'.

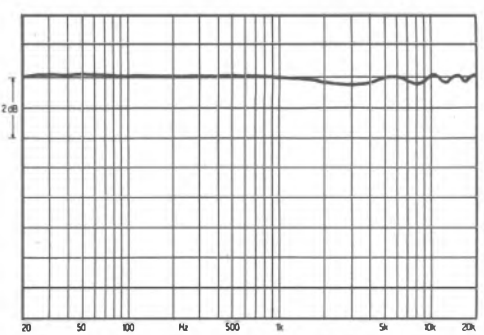
Conclusion

Hard to fault on measurement, in some areas this design was exemplary. It should sound as good or better than Philips own machines, but it doesn't. Perhaps the fault lies in the later stages — filtering and the overall layout. It remains quite a good machine in general hi-fi terms, but is not particularly competitive; no recommendation is appropriate.

GENERAL DATA	JVC XLV2
Channel balance	
At 20Hz	0.05dB
At 1kHz	0.01dB
At 20kHz	0.05dB
Stereo separation	
At 20Hz	102dB
At 1kHz	132dB
At 20kHz	98dB
Channel phase difference	
At 20Hz	0°
At 1kHz	0°
At 20kHz	0°
Total harmonic distortion at 0dB	
At 20Hz	– 98dB
At 1kHz	– 97dB
At 20kHz	– 95dB
Total harmonic distortion at – 10dB	
At 1kHz	– 87dB
Total harmonic distortion at – 60dB	
At 1kHz	– 37dB
Total harmonic distortion at – 80dB	
At 1kHz	– 20dB
Intermodulation distortion	
At 0dB, 19kHz/20kHz	– 95dB
At – 10dB, 19kHz/20kHz	– 92dB
Frequency response	
Left channel	+ 0.1, – 0.25dB
Right channel	+ 0.1, – 0.25dB
Signal to noise ratio	
No emphasis, 20Hz-20kHz unweighted	– 102dB
No emphasis, CCIR ARM, 1kHz ref	– 101dB
Output level, 0dB	
Left channel	2.377V
Right channel	2.375V
Output impedance	430ohms
De-emphasis	fine
Track access time	3.0 secs
Error correction capability	>900μm gap, 800μm dot
Mechanical noise	fairly low
Spuriae up to 100kHz	– 105dB
Resolution at – 90dB	– 0.5dB
Headphone socket	yes (variable level)
Dimensions (w × d × h)	34 × 28 × 10cm
Estimated typical purchase price	£550



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



Marantz CD54

Marantz Audio (UK) Ltd, 15-16 Saxon Way Industrial Estate, More Lane, Harmondsworth, Middlesex UB7 0LW
Tel 01-897 6633

A division of the multinational electrical giant Philips, Marantz now manufacture their players in Japan, and use the Philips decoder system with numerous local design differences. The *'54* is the basic Marantz model, selling at around £300 but is nonetheless very robustly constructed.

A compact 'midi' sized unit, finished in satin black, the *'54* sports Marantz' own interpretation of control layout and labelling. In addition to the numeric display of total and track timing, the programming facility includes a conventional display showing the tracks entered into memory. Repeat is available, but no indexing, headphone or independent remote control are included. However, some remote control commands do become available when the *'54* is used in conjunction with a matching rack system, via the rear panel interface.

In operation, this deck was pretty quiet, and no problems were encountered. Internally the construction was to a good standard, though the two-board construction is a trifle cramped. The Philips four-times oversampling system is used, with 96th order digital filtering, separate and nominally 14 bit D/A convertors, as well as slow rolloff analogue filters following.

Lab report

The left/ right frequency responses showed the good channel balance and matching, here within 0.16dB over the whole 20Hz to 20kHz frequency range. Refered to 1kHz, the response met +0.05, −0.25dB limits, the usual result.

Channel separation was fine, and well into the nineties, while the channel phase match was excellent, again as usual.

Distortion was held to commendably low levels at almost 100dB down at low and mid frequencies. Strictly speaking the 20kHz figure is not distortion but a reading of in-band, potentially-audible beat products. The distortion remained under control at lower levels, indicating a linearity of close to 15¾ bit, and the −90dB level error was small at 1.2dB. At 19/20kHz the two tone intermodulation test, full level difference product was very good at −92dB, while the −10dB level result of −78dB was certainly a better result than the group average.

Meeting the accepted standard, the output level was very close to 2.0V from a low output impedance of 49 ohms. On de-emphasis the spec was correctly met. Mechanical noise levels were low, but track access times were rather slower than usual, at times frustrating after one's exposure to faster machines. As usual with the genre, the error correction was to an excellent standard.

Spurious responses were however to prove its Achilles heel; in the presence of high level modulation the up band signals reached −50dB. The spectrogram for −10dB, 19/20kHz showed the 24kHz signal at a similar −50dB

level, which again is typical of Philips machines, and is not judged too seriously.

Sound quality

Scoring rather above average, the *'54* was liked on audition. It certainly achieved basic CD standards well, but was also favoured for its good stereo focus, its clean and detailed treble, as well as its reasonable presentation of stereo depth. Definition in the bass and on transients was quite well portrayed, but tonally it seemed a touch forward and lightweight.

Conclusion

While this was a basic machine, it did possess certain fundamental strengths. The lab performance was generally very good, especially in the treble, while in mechanical terms it was well engineered, with a fine error correction capability. This, in conjunction with the competitive pricing as well as its good sound quality, ensured the *'54* a 'Best Buy' rating.

GENERAL DATA Marantz CD-54

Channel balance
At 20Hz....0.14dB
At 1kHz....0.14dB
At 20kHz....0.16dB

Stereo separation
At 20Hz....95dB
At 1kHz....96dB
At 20kHz....97dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....0°

Total harmonic distortion at 0dB
At 20Hz....–98dB
At 1kHz....–98dB
At 20kHz....–86dB

Total harmonic distortion at –10dB
At 1kHz....–86dB

Total harmonic distortion at –60dB
At 1kHz....–40dB

Total harmonic distortion at –80dB
At 1kHz....–25dB

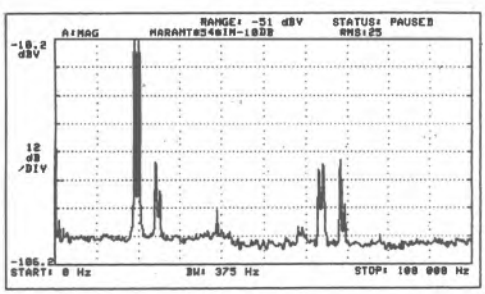
Intermodulation distortion
At 0dB, 19kHz/20kHz....–92dB
At –10dB, 19kHz/20kHz....–78dB

Frequency response
Left channel....+0.05, –0.25dB
Right channel....+0.05, –0.25dB

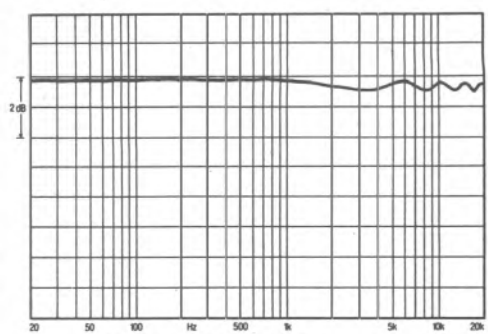
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–109.5dB
No emphasis, CCIR ARM, 1kHz ref....–108.5dB

Output level, 0dB
Left channel....1.996V
Right channel....2.02V

Output impedance....48.6ohms
De-emphasis....fine
Track access time....12.5 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz....–50dB
Resolution at –90dB....+1.2dB
Headphone socket....no
Dimensions (w x d x h)....32 x 29 x 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



Marantz CD74 and CD84

Marantz Audio (UK) Ltd, 15-16 Saxon Way Industrial Estate, More Lane, Harmondsworth, Middlesex UB7 0LW
Tel 01-897 6633

Both of these machines were supplied and auditioned, but proved to be so similar that we felt a single review would suffice for both. While the *'84* comes complete with an infra red remote control, the *'74* has more limited remote facilities, these accessed via connection to the appropriate matching rack system. Both are full-size machines, the *'74* finished in satin black and the *'84* in Marantz champagne gold.

The enlarged fluorescent display can show programme tracks up to a maximum of 24, which is more than enough for any conceivable programme excepted an extended test record.

A numeric keyboard is fitted, with many related facilities such as indexing cueing, fast track jump, auto music start, search, A-B repeat and overall repeat. The display will show indexing, track and remaining times, overall time, track numbers and total tracks. A front panel headphone socket is included, but surprisingly the level controls for these are separate presets fitted, inconveniently, to the rear panel. Control of the phono socket output level is included, though it would have been more useful if these had been separated. Apparently one or two units have been privately modified to hardwire the output terminals in the circuit boards with good cable, with a small improvement in sound.

Internally, the two machines are sturdily fabricated. More complicated than anticipated, they use two mains transformers — a large component for the main system plus a smaller one for the display electronics. Six circuit boards of varying complexity are fitted, but the wiring is tidy and access is good.

Lab report

Taken overall, the results closely parallel those for the *CD 54* though with some minor differences. Frequency response, channel balance and interchannel phase difference were quite standard, while the channel separation had improved relative to the *'54,* reaching an excellent 105dB at 1kHz.

Distortion was very low, with these figures taken in conjunction with the mild level error at −90dB, suggesting a good 15½ bit linearity. A 10dB below full level the distortion held at below 83dB or 0.007% and the downband products of a 2kHz full level signal were excellently controlled at −96dB. Upband products were however less well handled, but hopefully these should not be audible. With signal present, these were in the −50 to −54dB region. On the two tone high frequency intermodulation, the players performed quite well, with the audible spectrum looking clear of 'hash'.

Output was slightly lower than average at 1.85V, variable down to 0.2V. Due to the 2kohm level control, the output impedance depended on a setting that varies from 35 to a maximum of 450 ohms, all pretty reasonable. Bypassing the level controls would presumably result in the original 45 ohms output impedance and a

normal 2V output level. Track access was a reasonable 7 seconds with low levels of mechanical noise generated.

Error correction was ample to deal with all the test tracks. Signal to noise ratios were very good if not quite to the ultimate limits set by the Philips machine or for that matter the *CD54*.

Sound quality

As normally supplied the *'74* and *'84* players deliverd a good sound quality standard which was rated rather above average. The mid tonal balance was pleasantly sweeter than usual, despite a hint of brashness in the upper register. Even so, the treble was rated quite well, and was considered to be both tidy and well focused. Transients were well defined and the players showed a clean, firm bass with good rhythmic drive, sounding lively, and with fair depth imaging.

Conclusion

Marantz have clearly kept up their standards, and have taken some care over both sound quality as well as the engineering of their new range of players. Given their sensible pricing as well as the good facilities offered, these machines clearly merit recommendation.

GENERAL DATA Marantz CD74/84

Channel balance
At 20Hz....<0.2dB
At 1kHz....<0.25dB
At 20kHz....<0.18dB

Stereo separation
At 20Hz....108dB
At 1kHz....106dB
At 20kHz....90dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....0°

Total harmonic distortion at 0dB
At 20Hz.... – 97dB
At 1kHz.... – 96dB
At 20kHz.... – 96dB

Total harmonic distortion at – 10dB
At 1kHz.... – 83.4dB

Total harmonic distortion at – 60dB
At 1kHz.... – 39.2dB

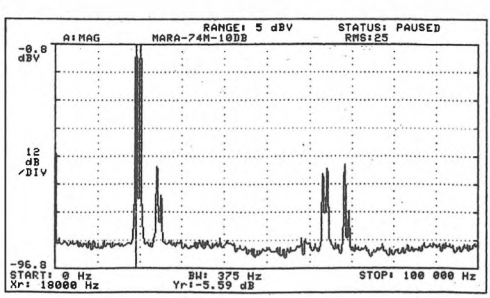
Total harmonic distortion at – 80dB
At 1kHz.... – 25.3dB

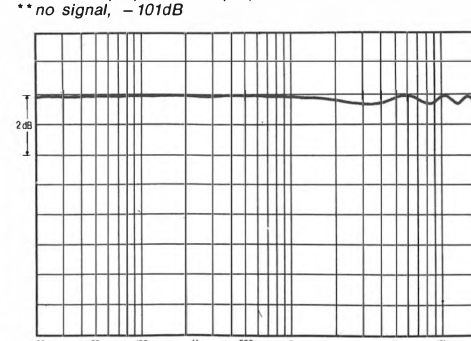
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 90.5dB
At – 10dB, 19kHz/20kHz.... – 80.1dB

Frequency response
Left channel.... + 0, – 0.22dB
Right channel.... + 0, – 0.22dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 105dB
No emphasis, CCIR ARM, 1kHz ref.... – 106dB

Output level, 0dB
Left channel....max 1.85V (variable)
Right channel....max 1.85V (variable)
Output impedance....450ohms*
De-emphasis....fine
Track access time....7.0 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 56dB
Resolution at – 90dB.... + 2.5dB
Headphone socket....yes
Dimensions (w x d x h)....42 x 30 x 9cm
Estimated typical purchase price....CD74 £350, CD84 £400
** at half output; at full output, 35ohms*
*** no signal, – 101dB*





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

Meridian MCD

Boothroyd Stuart Ltd, 13 Clifton Road, Huntingdon, Cambridgeshire PE18 7EJ.
Tel (0480) 57339

This is actually Meridian's second-generation improvement/rebuild of the Philips *CD100* player. The Philips machine is now supplied to Meridian in its revised *101* form, with an improved transport as well as certain other changes, which have in turn necessitated a further cycle of modifications from Meridian in their own version.

The *MCD* is finished in Meridian's grey Nextel livery. The numerous internal modifications include a new output filter as well as new driver circuitry. The output is now direct coupled, with the output d.c. zeroed by new circuits. The filters improve the suppression of out of band spuriae while extensive power supply modifications improve the isolation between stages. Oscillator jitter, error control, servo response and other aspects have all received attention in the pursuit of better and more consistently good sound quality.

For these alterations, Meridian add £100 to the price of the Philips machine. For the same figure, Meridian will modify an existing *CD100, CD101* or Marantz *CD63.* Recapping, the basic machine is a compact top loader, a Philips original design, and has a sensibly sloped angled control panel with a minimum of unnecessary facilities. Up to 15 tracks may be programmed in ascending order, with repeat mode available, as is pause, forward and back cueing (non audible) as well as fast track skip. No headphone socket is fitted although it is rumoured that remote control may appear on the *MCD* at an extra charge some time later in 1985, with no increase in the overall size of the machine.

Lab report

Though heavily based on the production Philips machine, it was interesting to explore the *MCD's* performance to see what changes could be interpreted via measurement.

We could not verify the manufacturer's claim for improved error correction since it was already at the test limit, exceeding the 900μm gap and 800μm dot sector.

No obvious change was evident from the 20Hz to 20kHz frequency response bar a minute extra rolloff at 20kHz. Channel balance remained excellent, with the interchannel phase difference the usual 0°. Channel separation was very good if not quite to Marantz *'63B* standard. Mild compression was evident at peak level, shown by the slightly poorer than usual distortion at full level. Despite this, the 20kHz downband noise products were very good at −92dB. Upband products were also better than usual; for example, better than −68dB. The 24kHz upper component of the 19/20kHz intermodulation at the −10dB level was also quite well controlled, at −54dB.

Neither intermodulation result was particularly good, this perhaps a surprising result. At −10dB the *'63B* measured 8dB better.

Output level was standard at 2.06V, from a low 12.5 ohm output impedance, suited to longish cables and to a control potentiometer as low as 2kohm. The de-emphasis was fine, while track access was somewhat improved to a modest 10 seconds. Mechanical noise was low as usual, while electrical noise was also very low, and rather better than the original *MCD*. In fact, – 109dB was seen without pre-emphasis, CCIR ARM (1kHz) weighted.

Sound quality

Slightly improved over the previous *MCD,* the sound was certainly better than the original Philips. Compared with the earlier *MCD* the latest version has lost some of that slightly 'laid back', softened quality and now sounds both crisper and firmer. It continues to offer good depth perspectives, with a revealing unravelling of depth layering. It sounded more musical than the Philips original, with less coloration and a more neutral character, tonally speaking. Stereo focus was quite sharp and the bass definition improved, although a slightly 'careless' quality was noted in the high treble.

Conclusion

Meridian have maintained sonic headway, helping to counter balance the rather basic facilities offered at the price. The sound quality was sufficient to ensure recommendation, though the *MCD* is undoubtedly coming under increasing pressure from the competition, both in the UK and abroad.

GENERAL DATA — Meridian MCD

Channel balance
At 20Hz....0.04dB
At 1kHz....0.04dB
At 20kHz....0.04dB

Stereo separation
At 20Hz....101dB
At 1kHz....99dB
At 20kHz....77dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....0°

Total harmonic distortion at 0dB
At 20Hz.... – 94dB
At 1kHz.... – 90dB
At 20kHz.... – 92dB

Total harmonic distortion at – 10dB
At 1kHz.... – 82dB

Total harmonic distortion at – 60dB
At 1kHz.... – 45dB

Total harmonic distortion at – 80dB
At 1kHz.... – 26dB

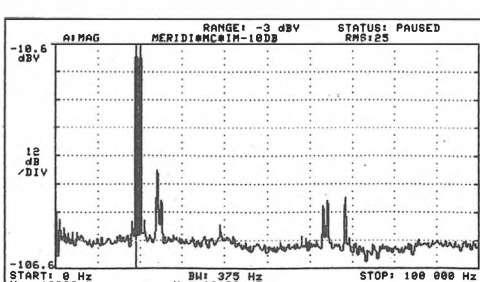
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 85dB
At – 10dB, 19kHz/20kHz.... – 74dB

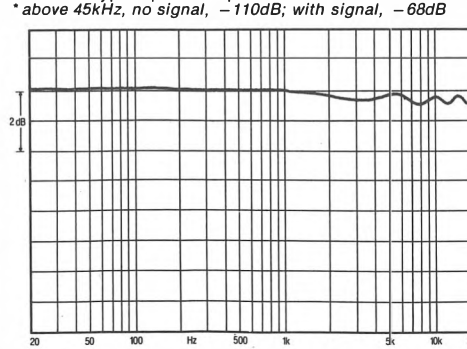
Frequency response
Left channel.... + 0, – 0.6dB
Right channel.... + 0, – 0.6dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 108dB
No emphasis, CCIR ARM, 1kHz ref.... – 109dB

Output level, 0dB
Left channel....2.065V
Right channel....2.057V
Output impedance....12.5ohms
De-emphasis....fine
Track access time....10 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....very low
Spuriae up to 100kHz.... – 100dB*
Resolution at – 90dB.... + 2.3dB
Headphone socket....no
Dimensions (w × d × h)....32 × 24 × 7cm
Estimated typical purchase price....£400

** above 45kHz, no signal, – 110dB; with signal, – 68dB*





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

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Mission DAD7000R

Mission Electronics Ltd, Stonehill, Huntingdon, Cambridgeshire PE18 6ED
Tel (0480) 57477

Like Meridian, Mission have been researching improvements to a Philips CD player, but have chosen the up-to-date *104* model as the basis for their rebuilding. In fact, the two British companies have different views of CD priorities but in our judgement neither can claim superiorty until the CD medium has fully matured; at present the system seems to benefit from a wide range of relatively minor adjustments.

At the outset, Mission felt they could not develop a player from scratch in a reasonable enough period of time, so opted for the alternative of making appropriate changes to an existing machine, using their skills in judging sound quality parameters. The modifications include improvements to the D/A convertor circuitry, the power supplies and the output filtering. Despite its small size, the machine carried an infra red remote control facility as denoted by the 'R' suffix in the title. However Mission are still fitting the low grade output cable present on the original *104,* this known to degrade the sound quality rating (in our tests, by around ½ a mark out of ten) when compared with good cable; Mission have said this cable was to be deleted, but clearly have not yet got round to it. Ratings for this review relate to the machine as supplied, but when fitted with decent cable, LC or van den Hul, its position improves to near the top.

Mission have however changed the appearance of the *104* controls, which initially takes a little acclimatisation. A drawer loader, it has a reliable and quiet transport, with speeded-up access times, and a small digital display of track timings and numbers.

Lab report

Channel balance was practically perfect, with a close overlay of the two response graphs, the solid and the dotted lines. Mission have tailored the response a little and on my test 10k ohm loading, a slight rolloff was evident at both frequency extremes, but small enough to be difficult to criticise.

Channel separation was good but unexceptional, for example 69dB at 20kHz, while the interchannel phase difference remained below 0.5°, which was quite negligible. Total harmonic distortion was low, close to the limit for the Philps system, with a very good −93dB result for the in-band noise products of a 20kHz 0dB tone. Mid band distortion approached 0.0015% at full level, and this together with the level error at −90dB, suggested a good 15½ bit resolution.

This result confirms that the Philips 14 bit convertors approach 16 bit in the oversampled mode. However the higher frequency intermodulation results were just average, though still pretty good. The spectrogram taken at the −10dB test level showed the cleaner down band performance and better filtering of the Mission version compared with the *CD104*; in particular it is worth noting that the spuriae in

the 60-70kHz band are suppressed by 77dB.

The fixed output level was close to standard, sourced from a 308 ohm impedance rising to 2.2K at 100Hz, due to the smallish output coupling capacitor. De-emphasis was fine. Mechanical noise was comparatively low, and track access rapid at 4.5 seconds for the test track 15. The error correction was ample for all the test tracks, and also proved tolerant of well scratched demo discs.

Signal to noise ratios were very good, limited mainly by the output filters and these remained constant with or without pre-emphasis.

Sound quality

As supplied the *7000R* gave fine results on the listening tests. In tonal balance it was a trifle lightweight, if slightly thinned in the upper mid range, but not seriously so. Its strong quality was a lively dynamic nature with clear exciting transients reproduced without grain or blurr. Stereo focus was precise with a good resolution of depth if with a mildly narrowed sound stage. Articulate detail was preserved throughout the frequency range, and the treble quality was well above average.

Conclusion

Given the fine sound quality and the pricing, the Mission *7000* can be warmly recommended. With the use of a good cable, achieved by discarding the one presently attached in the factory, still better results are possible. Flying phono sockets could be fitted to the existing cable cut short, or even better still, a service technician might fit a new cable to the appropriate connections inside.

GENERAL DATA — Mission DAD7000R

Channel balance
At 20Hz 0.02dB
At 1kHz 0.02dB
At 20kHz 0.02dB

Stereo separation
At 20Hz 87dB
At 1kHz 89dB
At 20kHz 69dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 0°
At 20kHz ..... 0.5°

Total harmonic distortion at 0dB
At 20Hz ..... – 97dB
At 1kHz ..... – 98dB
At 20kHz ..... – 93dB*

Total harmonic distortion at – 10dB
At 1kHz ..... – 83dB

Total harmonic distortion at – 60dB
At 1kHz ..... – 43dB

Total harmonic distortion at – 80dB
At 1kHz ..... – 20.5dB

Intermodulation distortion
At 0dB, 19kHz/20kHz ..... – 87dB
At – 10dB, 19kHz/20kHz ..... – 78dB

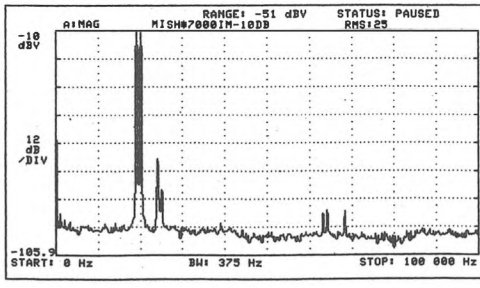
Frequency response
Left channel ..... + 0.05, – 0.8dB
Right channel ..... + 0.05, – 0.8dB

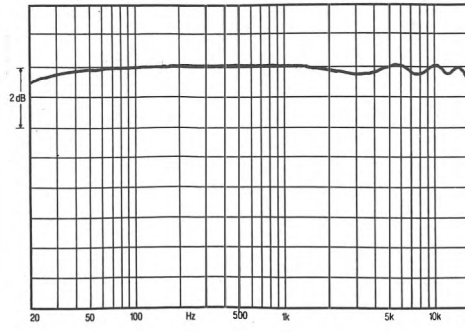
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... – 106dB
No emphasis, CCIR ARM, 1kHz ref ..... – 104dB

Output level, 0dB
Left channel 2.07V
Right channel 2.07V

Output impedance 308ohms
De-emphasis ..... fine
Track access time ..... 4.5 secs
Error correction capability ..... >900μm gap, >800μm dot
Mechanical noise ..... low
Spuriae up to 100kHz ..... – 71dB
Resolution at – 90dB ..... + 3.3dB
Headphone socket ..... no
Dimensions (w × d × h) ..... 32 × 30 × 9cm
Estimated typical purchase price £450

** Footnote missing*





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

Mitsubishi DP105

Mitsubishi Electric (UK) Ltd, Otterspool Way, Watford, Herts WD2 8LD
Tel (0923) 40568

This is a straightforward unit, offering basic facilities. Predominantly silver finished, it employs a large fluorescent display with the usual indications for total number of tracks, track number and index number, with overall timings and individual track timings also given.

A front panel headphone socket is included, with a level control. The rear phono sockets carry a fixed output level at the standard 2V. Programming facilities are provided, together with the usual repeat but no numeric keyboard. It proved straightforward to operate, with rapid key entry as well as quick access.

Traditionally engineered, the *'105* uses the linear 16 bit system without oversampling. The digital to analogue convertor is time shared between the two channels, with subsequent filtering accomplished by a monolithic brickwall filter.

Lab report

As usual, the frequency response was very uniform in the mid band. A mild treble rolloff of around 0.7 to 0.8dB was observed at 20kHz with a mild channel imbalance of 0.3dB as well. Furthermore the beginnings of a bass rolloff was evident, but in truth, the response was only 0.18dB down at 20Hz!

Channel separation was more than satisfactory, with the common decline to 73dB at 20kHz. Interchannel phase shift reached 80° at 20kHz, which is typical for the type. Peak level distortion was quite good, but nonetheless poorer than average, but interestingly, it improved at the next lower level, suggesting an ultimate resolution of 15¼ bits. The down band noise on the 0dB, 20kHz input was unexceptional at −73dB, but it surprised us by producing very good results for high frequency intermodulation, where a fine −98dB suppression of difference tone was measured at the full test level.

The spectrogram taken for the −10dB intermodulation shows a clean output in the audible range, plus a fine rejection of spurious signals at high frequencies around −118dB, but the main component was not well controlled at −42dB.

Output level was on target at 2V, sourced from a higher than usual impedance of 985ohms. The de-emphasis frequency response was close to the required tolerance, while track access was pretty quick — 5.5 seconds to reach track 15 on the test disc YEDS2. Mechanical noise was low.

However, the machine did exhibit a weakness on error correction. In fact it did not cope adequately with the smallest divisions on the error test record, an unsatisfactory performance. Many records were played properly without skipping or locking but this machine left no margin for high-error-rate discs or disc mishandling damage.

It also proved poorer than average on signal to noise ratio, reaching just 90dB for the no emphasis CCIR ARM (1kHz) measurement.

Sound quality

It proved difficult to analyse the sound of the *'105,* since it offered the usual competent CD qualities with no undue bias. But the mid treble sounded a little 'odd', as if a 'highlight' was present around the transient sounds, and this was felt to detract from both clarity and accuracy. Stereo focus was about average in sharpness, but depth was not particularly well reproduced. Some interest was lacking overall, and the final judgement was that of a below average sound quality.

Conclusion

This machine has an unexceptional sound, and while the lab performance was generally satisfactory, it was marred by a weak error correction performance. Despite its quite modest price, these findings unfortunately put the *'105* out of the running as far as a *HFC* recommendation is concerned.

GENERAL DATA Mitsubishi DP105

Channel balance
At 20Hz....0.3dB
At 1kHz....0.3dB
At 20kHz....0.2dB

Stereo separation
At 20Hz....97dB
At 1kHz....96dB
At 20kHz....73dB

Channel phase difference
At 20Hz....0.6°
At 1kHz....0.8°
At 20kHz....80°

Total harmonic distortion at 0dB
At 20Hz....–91dB
At 1kHz....–90dB
At 20kHz....–73dB

Total harmonic distortion at –10dB
At 1kHz....–93dB

Total harmonic distortion at –60dB
At 1kHz....–50dB

Total harmonic distortion at –80dB
At 1kHz....–23dB

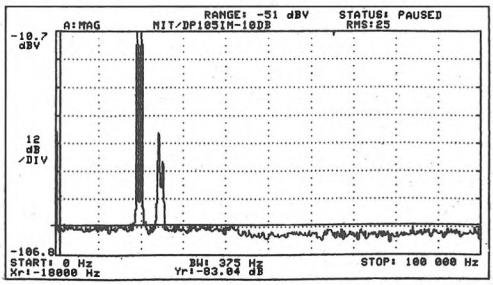
Intermodulation distortion
At 0dB, 19kHz/20kHz....–98dB
At –10dB, 19kHz/20kHz....–85dB

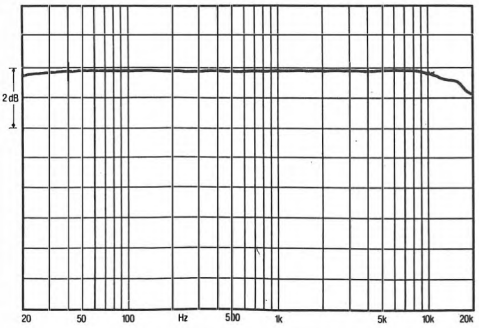
Frequency response
Left channel....+0, –0.8dB
Right channel....+0, –0.7dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–97dB
No emphasis, CCIR ARM, 1kHz ref....–90dB

Output level, 0dB
Left channel....2.00V
Right channel....2.05V

Output impedance....985ohms
De-emphasis....fine
Track access time....5.5 secs
Error correction capability....400μm gap, 300μm dot
Mechanical noise....low
Spuriae up to 100kHz....–118dB
Resolution at –90dB....+2.6dB
Headphone socket....yes (variable level)
Dimensions (w x d x h)....44 x 30 x 10cm
Estimated typical purchase price....£330





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

Philips CD104

Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 3QR
Tel 01

Together with Sony, Philips pioneered the CD medium, launching their first players in March 1983. These first models, the Sony *CD-P101,* and Philips *CD100,* both endured well, but have now been replaced. The *CD104* is the replacement for the base model *'100,* and has gone from top to drawer loading. The old *100* was substantially built on a large die casting, and the 104 is distinguished by the same quality of construction. The transport and laser system are also founded on precision castings, these isolated from the outside by a rubber decoupling system.

The decoding system is original to the first Philips, and consists of four times oversampling, operating with dual 14 bit digital to analogue convertors and a mixture of high slope digital filtering plus low slope analogue output output filtering. Many other manufacturers have adopted or adapted this system, which so far has given a competitive edge to reproduced sound quality.

Finished mainly in black, the *'104* is fitted with a small digital display which may be switched to provide data on the number of tracks, the track number, and the various timings. No headphone outlet, remote control or numeric keyboard are provided.

Operation is relatively simple and straightforward, with low mechanical noise levels — the odd 'chirping' of the earlier *100* is much reduced.

Lab report

As usual with Philips decks, the channel balance was very good — within 0.2dB over the whole frequency range.

Channel separation exploited the dual convertors to the full, with a remarkable 128dB at 20Hz and a still outstanding 98dB at 20kHz. Interchannel phase difference was virtually zero throughout.

Total harmonic distortion at peak level lay in the mid 90s, that is 0.0015% rising to 0.005% at 20kHz, the latter figure representing the small level of beat signals generated within the audible range.

With reducing level, the mid band distortion also increased correctly, reaching −22.6dB at a −80dB recorded level. For a −90dB level the gain error was mild at 3.4dB and the overall resolution was close to 15½ bit, showing the improvement afforded by oversampling.

The high frequency two tone 19/20kHz intermodulation results rated about average and the spectrum analysis is shown for the −10dB test level. Here, downband clutter could be seen below 5kHz, while the 24kHz component was around −53dB. The higher frequency components were not well rejected, and similar signals appeared on lower frequency signal tones as well, a feature typical of the Philips system.

Frequency response met +0, −0.35dB limits from 20Hz to 20kHz, both channels, and the ripple is generally regarded as inaudible.

Output level was standard at 2V from a low source resistance of 33 ohms. The de-emphasis characteristic was fine while the track access from a cold start was fairly slow at 9 seconds. However, once in play mode it skipped to the 15th test track in just 2.5 seconds. As usual the error correction was excellent, easily meeting the maximum limits on the test disc. It measured very well on signal to noise ratio, producing almost identical readings, weighted or unweighted.

Sound quality

Following the Philips tradition for good CD sound, the *'104* scored rather above average, in spite of the generally improving sound quality of the new generation of players. The sound was lively and clear with good focus, convincing transients, and a fair presentation of stereo depth. Stage width was fine, while the mid was slightly forward and nasal in tonal quality. The bass was pretty good, and the treble basically tidy and well defined.

Conclusion

Competitively priced, the Philips is nonetheless under competition from the Japanese machines including the Marantz models. These matters aside, the *'104* gains recommendation in its own right.

GENERAL DATA — Philips CD104

Channel balance
At 20Hz....<0.2dB
At 1kHz....<0.2dB
At 20kHz....<0.2dB

Stereo separation
At 20Hz....128dB
At 1kHz....123dB
At 20kHz....98dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....0°

Total harmonic distortion at 0dB
At 20Hz....> – 94dB
At 1kHz....> – 94dB
At 20kHz....> – 86dB*

Total harmonic distortion at – 10dB
At 1kHz.... – 82.4dB

Total harmonic distortion at – 60dB
At 1kHz.... – 40.6dB

Total harmonic distortion at – 80dB
At 1kHz.... – 22.6dB

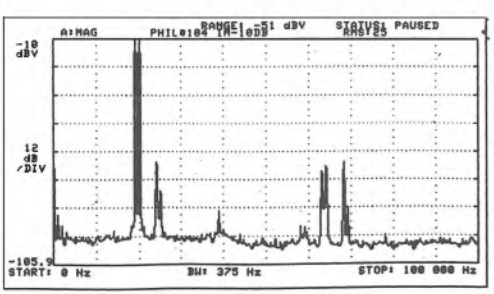
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 89dB
At – 10dB, 19kHz/20kHz.... – 79dB

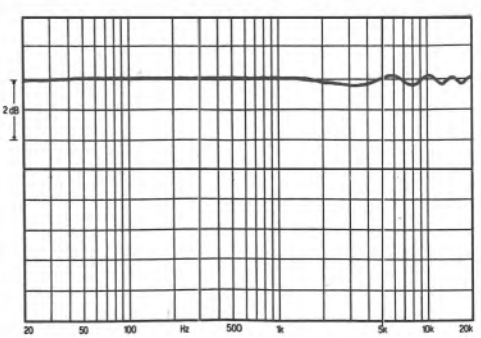
Frequency response
Left channel.... + 0, – 0.35dB
Right channel.... + 0, – 0.35dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 106dB
No emphasis, CCIR ARM, 1kHz ref.... – 106dB

Output level, 0dB
Left channel....2.055V
Right channel....2.074V

Output impedance....33ohms
De-emphasis....fine
Track access time....9 secs (2.5 secs from play)
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz....see text, – 101dB (no signal)
Resolution at – 90dB.... + 3.4dB
Headphone socket....no
Dimensions (w x d x h)....32 x 30 x 9cm
Estimated typical purchase price....£300





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

Philips CD204 and CD304

Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 3QR
Tel 01-

These two upmarket Philips CD players are essentially the same, the *'304* distinguished by the inclusion of an infra red remote control at extras cost. Both machines were auditioned and sounded basically similar to the *'104,* but in the final analysis we felt they were slightly inferior. It was as if the extra features and facilities had somehow prejudiced the sound quality to a small degree.

Taking the *'304* as the main subject of this review, a large fluorescent tube display is featured and shows several items of information. A linear scale shows programmed track numbers in order, with windows to indicate which mode has been selected. It also shows the total number of tracks, track timings and overall programme times. Full control is also available via the infra red coupled hand-held unit; though index facilities are not provided, nor is a numeric keypad. Conversely a front panel headphone socket is present complete with its own level control, and the main audio output is provided on phono jacks, the level set by another volume potentiometer.

A large satin black unit, the *304/204* design is well finished and well built, with diecastings used for important chassis sections. Overall, it was surprisingly heavy.

As with the other Philips players, the decoder runs at four times the normal sampling frequency, placing unwanted alias signals and noise higher in the frequency range where they are more easily filtered. The dominant filtering is carried out by a 96 pole digital chip, which gives the player that familiar mild ripple in the high frequency amplitude response.

Lab report

The player conformed to the general frequency response of the Philips CD group, with closely defined + 0.1, − 0.25dB amplitude limits over the full 20Hz to 20kHz audio range. The mild high frequency ripple is characteristic. Channel balance was excellent, within 0.15dB overall. On channel separation it performed very well, while the interchannel phase displacement was zero as usual.

Total harmonic distortion approached − 100dB, at 0.0013%, and in conjunction with the low + 2.5dB level error at the − 90dB modulation section suggested 15½ bit linearity. The downband noise products of a 20kHz fundamental were of average degree at − 83dB. Likewise the intermodulation results were good in the absolute sense but did not match the best in the issue. At the − 10dB modulation level the high frequency two tone intermodulation was 79dB down though some other components were also present. In the spectrogram these can be seen below 4kHz at − 74dB, with other upband components present at − 52dB.

In the absence of modulation, the Philips' spurious rejection seems good, but upband signals appear in the presence of modulation which are not rejected and are no better than

50-60dB down.

Output level was the usual 2V from a 600 ohm impedance. De-emphasis was fine and access to the test track 15 was moderate at 7.5 seonds. Low levels of mechanical noise were present.

Concerning error correction, the *'204* and *'304* were fully on target, easily meeting the 900μm gap error and the 800μm surface dot error bands. Signal to noise ratios were exemplary, rather greater than the practical bit linearity would provide in a conventional system.

Sound quality

Undoubtedly good Philips CD players, it was surprising to find the *'204/'304* units were marginally less satisfying subjectively than the basic *'104,* though it must be stressed that the difference was very slight. As regards tonal balance, the *'104* was a touch sweeter and easier on the ear; nonetheless the overall quality was good, with clean bass and treble extremes, and notably clear transients, coupled with good stereo focus and fairly good stereo depths.

Conclusion

Compared with the *'104,* you do pay for the extra facilities of the *'204* and *'304* models, and depending on how important these extras are, the value for money rating in absolute terms is not as good as the *'104.* The marking places them on the borderline and in my view, they just qualify for the 'worth considering' category.

GENERAL DATA Philips CD204, CD304

Channel balance
At 20Hz....0.15dB
At 1kHz....0.15dB
At 20kHz....0.15dB

Stereo separation
At 20Hz....110dB
At 1kHz....105dB
At 20kHz....96dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....0°

Total harmonic distortion at 0dB
At 20Hz....> – 98dB
At 1kHz....– 98dB
At 20kHz....– 83dB

Total harmonic distortion at – 10dB
At 1kHz....– 83dB

Total harmonic distortion at – 60dB
At 1kHz....– 42dB

Total harmonic distortion at – 80dB
At 1kHz....– 24dB

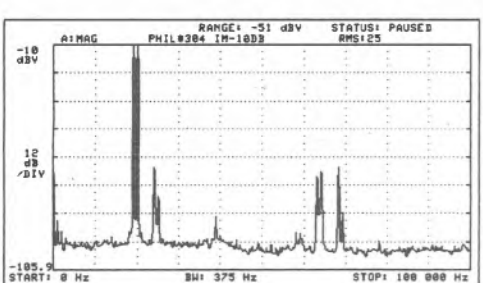
Intermodulation distortion
At 0dB, 19kHz/20kHz....– 88dB
At – 10dB, 19kHz/20kHz....– 79dB

Frequency response
Left channel....+ 0.1, – 0.25dB
Right channel....+ 0.1, – 0.25dB

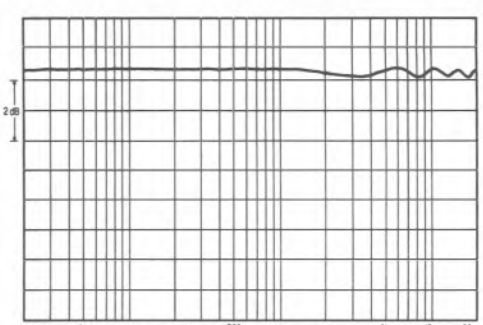
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....– 106dB
No emphasis, CCIR ARM, 1kHz ref....– 105dB

Output level, 0dB
Left channel....2.01V
Right channel....2.01V

Output impedance....600ohms
De-emphasis....fine
Track access time....7.5 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz....– 50dB to – 100dB
Resolution at – 90dB....+ 2.5dB
Headphone socket....yes (variable level)
Dimensions (w × d × h)....42 × 30 × 9cm
Estimated typical purchase price....CD204 £350, CD304 £400

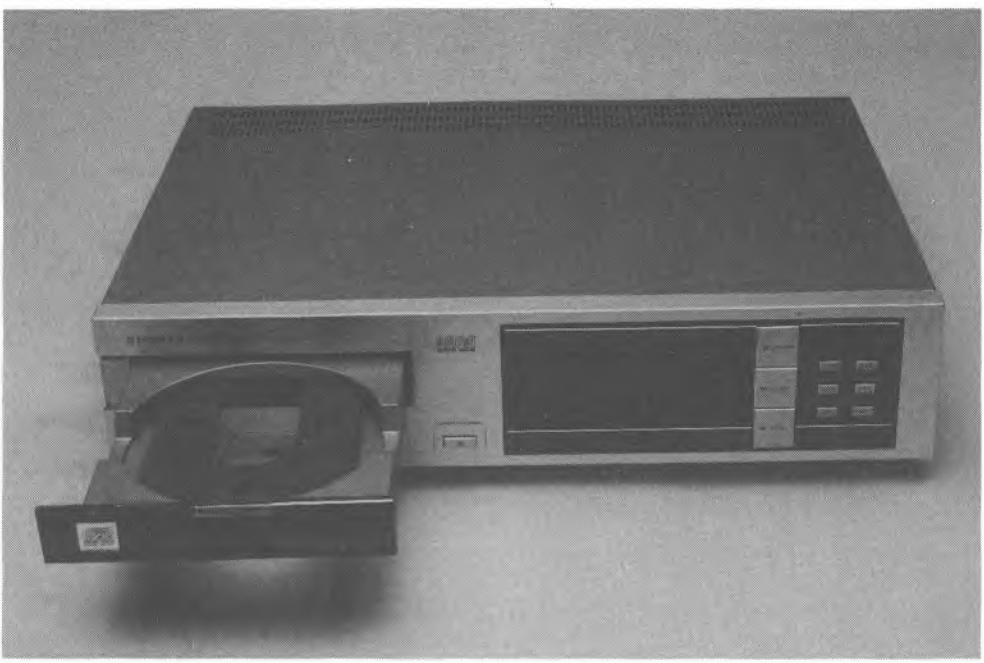


Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response



Pioneer PD-70

Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middlesex
Tel 01-575 5757



Pioneer's first CD Player was based on an early Kyocera design but the new *P-D70* is a so-called second generation type. It is quite a wide machine, but slim in profile, and in conjunction with its sliding-drawer disc loading, is a candidate for stacking systems as well as for free standing use.

Frontal appearance is bright, the pale gold satin alloy metalwork contrasting with the fluorescent display area. It does not use a numeric keyboard; instead, track numbr entry is via multiple key depressions. Among its many facilities, full programming is possible for tracks up to a total of 15 in any order, while sub-indexes may be accessed by number and time. The repeat facility extends notably to programmed selections which is useful for listening tests!

The search key can access complete tracks on a rapid-seek basis, or can scan at a lower speed, within a track. In the latter mode, an audible cue output is produced in short bursts to assist the location of the required place.

Three modes are possible for the digital display. First there is track and timing, second the indexing number and third the total and remaining time reading. Three modes are also present for the two-channel bar-graph level display, and comprise 'off' (most relaxing!); 'binary', a busy display of dubious value, representing the binary coded music data; and finally 'peak' — a normal metered display of programme volume which is potentially useful for monitoring output level in connection with tape dubbing.

Output is fixed and is via gold-plated phono sockets. A front panel headphone socket is also fitted, this offering good sound quality and provided with its own slider type volume control.

In operation, the drawer will shut when 'play' or 'shut' are depressed, but the mechanism was found a bit slow. The optical transport was however quick, while track access was pretty rapid. Mechanical noise was fairly low A wired remote control is available as an optional extra, and a DIN socket to accept this is provided on the rear panel.

Internally, the mains wiring is not shrouded, but otherwise the construction is to a high standard. The audio board uses a single D/A convertor, followed by a multipole modular

filters with the ubiquitous 5534 audio integrated circuit used for the output amplifier. High quality components are used, and the circuits are isolated and powered by a number of regulators 'full depth' error correction ICs are also fitted.

Lab performance

Performing well in the laboratory the Pioneer gave near perfect channel balance with excellent frequency responses, namely +0.2, −0.6dB worst case, 20Hz to 20kHz, with no emphasis in any band.

Channel separation was also excellent. Due to the use of a shared convertor, a mild phase difference between channels appeared with increasing frequency, reaching 77° at 20kHz, this for the moment at least considered harmless. At full output distortion was very low and well below 100dB or 0.001%, rising to a very good −93dB at 20kHz. No discontinuities were present judging by the correct distortion performance at lower signal levels, and even at −80dB the distortion harmonics were held to 24dB down. High frequency intermodulation was fine.

Output was fixed to close accuracy at a nominal 2V rms, and the output impedance was a usefully-low 200 ohms, well suited to passive control units.

The de-emphasis worked correctly, while track access was rapid at a rated 5 seconds, the machine proving pretty quiet mechanically. Spurious signals were fine at −107dB, and below, and the signal to noise ratio was fully to standard at 92dB CCIR ARM (1kHz) or 97dB 20-20kHz unweighted.

Error correction was excellent, with fairly good immunity to shock, and ultimate linearity tests gave a +4dB error at −90dB, indicating a 15 to 15½ bit performance.

Sound quality

Undoubtedly this was one of the best CD players in the group. It certainly sounded like a second generation machine, showing particular strength in the bass and treble, both of which were of very good quality. The mid had only a hint of hardness and a slight loss of depth, while stereo images were superbly stable, with excellent focus and fine perspectives.

Conclusion

Acquitting itself well in the lab and offering a very good all round performance, coupled with a comprehensive set of facilities, the *PD-70* was a strong contender. Recommended last year, the *PD-70* faces stronger competition now, but it is still worth considering.

GENERAL DATA — Compact Disc Player

Channel balance
At 20Hz 0.1dB
At 1kHz 0.05dB
At 20kHz 0.1dB

Stereo separation
At 20Hz 100dB
At 1kHz 101dB
At 20kHz 93dB

Channel phase difference
At 20Hz ..... 0°
At 1kHZ ..... 3°
At 20kHz ..... 77°

Total harmonic distortion at 0dB
At 20Hz ..... −105dB
At 1kHz ..... −105dB
At 20kHz ..... >−95dB

Total harmonic distortion at −10dB
20Hz-20kHz ..... −84dB

Total harmonic distortion at −60dB
20Hz-20kHz ..... −42dB

Total harmonic distortion at −80dB
20Hz-20kHz ..... −24dB

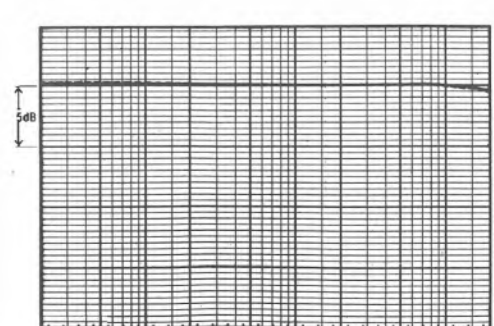
Intermodulation distortion
at 0dB, 19kHz/20kHz ..... >−85dB
At −10dB, 19kHz/20kHz ..... >−90dB

Frequency response
Left channel ..... +0.2, −0.6dB
Right channel ..... +0.15, −0.5dB

Signal to noise ration
No emphasis, 20Hz-20kHz unweighted ..... −97dB
No emphasis, CCIR ARM, 1kHz ref ..... −92dB

Output level, 0dB
Left channel 2.062V
Right channel 2.051V

Output impedance ..... 200 ohms
De-emphasis ..... correct
Track access time ..... 5 secs
Error correction capability ..... 900μm gap, 800μm dot
Mechanical noise ..... fairly low
Spurii up to 100kHz ..... −103dB
Resolution at −90dB ..... +4dB
Headphone socket ..... yes
Estimated typical purchase price £400



Frequency response; dotted trace is right channel

Pioneer PD-X700

Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middlesex UB6 8UN
Tel 01-575 5757

A compact midi sized drawer loader, this inexpensive machine is one of two similar models which are designed to complement stacked Pioneer systems. No remote control is supplied for the CD player itself, but this function can be achieved in the stack, via an auto interface connection, plus the remote control provided for the stack.

This drawer loader has only basic facilities — for example, there is no numeric keyboard or headphone outlet. One the other hand, it does have a large, somewhat blurred fluorescent display which shows considerable information. This includes timings for the individual tracks, total times and remaining time. Track numbers and index points are also shown. Various cueing and other controls are present, such as overall repeat and selected phase A-B repeat, while selected track numbers may be programmed into memory.

Inside, this Pioneer designed machine is something of a handful. Three main circuit boards have had to be stacked with resulting complications in terms of complex cable forms, poor accessibility and potentially difficult servicing. Pioneer need to avail themselves of the next stage of chip integration, in order to simplify this mare's nest — the case is so cramped that the mains transformer is sited outside on the rear panel.

In design the *'700* is a straightforward 16 bit, non-oversampled unit, with a single high-linearity time shared digital to analogue convertor. The usual brickwall filter, a thick film chip, follows the convertor.

Lab report

While showing excellent channel balance, this player had a significant droop in the treble, sloping down from 10kHz to −1dB, 20Hz, but this should not be very important in audible terms.

Channel separation was excellent mid band, deteriorating to a moderate 72dB at 20kHz. The conversion system resulted in a mild phase shift between a few degrees between channel by 1kHz, increasing to 80° by 20kHz.

Distortion at low and mid frequencies was low, measuring 0.002% at 1kHz and with a good linearity maintained at lower signal levels. Considering the mild level error at a −90dB signal modulation, the linearity was estimated at 15¾ bit.

High frequency linearity was inferior with the 20kHz in-band products poorer than average at −72dB. It was also not too happy on the peak level, high frequency intermodulation section, reading a modest −79dB. Contradicting convention, this improved to 87dB at the 10dB lower level. From the corresponding spectrum analysis, the in-band region was notably clear while up band spuriae were suppressed by around 105dB, and the adjacent 24kHz beat was fine enough at −51dB.

Close to standard, the output level was just over 2V, sourced from a moderate 333 ohms

output impedance. De-emphasis was to specification, while track access was slower than usual at 10 seconds to reach track 15 on the test disc. Mechanical noise levels were comparatively low.

On error correction, the performance was unbalanced. It performed well on the data gaps, clearing up to 900μm, but less happy with the surface dot; here it managed 600μm but failed on 800μm. This is probably not a very serious shortcoming. Signal to noise ratios were satisfactory, but nonetheless poorer than average.

Sound quality

Scoring about average, the sound quality was of similar overall merit to the still current and larger *PD-70* machine. Generally presentable in CD terms, the bass was slightly soft while the mid showed some tendency to image narrowing with a loss of stereo depth. Tonally speaking, it was quite sweet sounding, but showed a slightly thickened forward quality, while transients were not quite clear or 'alive'.

Conclusion

This competitively priced player has given a satisfactory performance on virtually all counts. While it will partner Pioneer's matching stack systems well, taking advantage of their remote facilities, as an independent machine, it is not quite to 'recommended' standard and is therefore placed in the 'worth considering' category.

GENERAL DATA Pioneer PD-X700

Channel balance
At 20Hz....0.16dB
At 1kHz....0.16dB
At 20kHz....0.17dB

Stereo separation
At 20Hz....104dB
At 1kHz....106dB
At 20kHz....70dB

Channel phase difference
At 20Hz....0°
At 1kHz....4°
At 20kHz....80°

Total harmonic distortion at 0dB
At 20Hz....– 97dB
At 1kHz....– 97dB
At 20kHz....– 72dB

Total harmonic distortion at – 10dB
At 1kHz....– 84dB

Total harmonic distortion at – 60dB
At 1kHz....– 53dB

Total harmonic distortion at – 80dB
At 1kHz....– 26dB

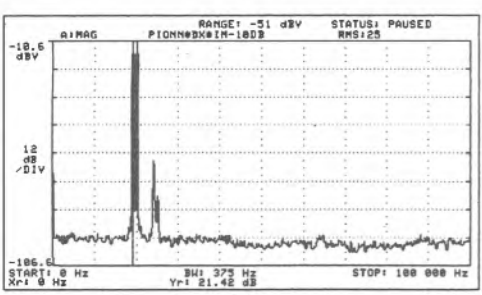
Intermodulation distortion
At 0dB, 19kHz/20kHz....– 79dB
At – 10dB, 19kHz/20kHz....– 87dB

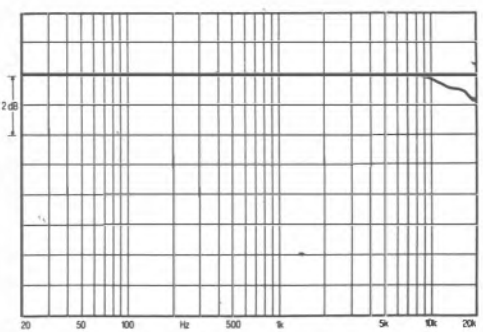
Frequency response
Left channel....+ 0, – 1.0dB
Right channel....+ 0, – 1.0dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....– 97dB
No emphasis, CCIR ARM, 1kHz ref....– 90dB

Output level, 0dB
Left channel....2.05V
Right channel....2.1V

Output impedance....333ohms
De-emphasis....fine
Track access time....10 secs
Error correction capability....900μm gap, 600μm dot
Mechanical noise....low
Spuriae up to 100kHz....– 105dB
Resolution at – 90dB....+ 2.5dB
Headphone socket....no
Dimensions (w × d × h)....32 × 26 × 10cm
Estimated typical purchase price....£300





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

Revox B225

F W O Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ
Tel 01-953 0091

Revox are noted for their superbly engineered and finished up-market equipment, with their range of matched, compatible, remote-controlled audio components proving to be of enduring quality.

With the *B225* CD player, Revox have not attempted to compete in the 'mass market'. Instead they have developed a player which is fully featured, complete with a fine remote control, all of which interfaces correctly with the accompanying audio line. While this player is based on the Philips design, the end product bears virtually no resemblance to the original.

A drawer loader, the door panel comprises a discreet lcd display showing the number of tracks, the programmed tracks in order, index notation and the full range of timings. Full repeat, including arbitrary 'A-B' repeat, is possible, and a clear numeric keyboard allows rapid entry of the desired tracks for programming. Direct track access is offered, but no audible music cueing. The remote handset also controls the volume, including that of the headphone outlet. A calibration tone is provided to aid setting record level on the matching tape recorder. A 'direct' fixed-level output is also available.

Internally, the machine is beautifully laid out with an excellent quality of construction, easy to service. Internal wiring is held to an absolute minimum. As with the Philips machine on which it is based, separate 14 bit digital to analogue convertors are used, with 4 times oversampling, resolution improvement via noise shaping and finally low slope analogue output filters. The output is essentially linear phase.

Lab report

In general terms the lab results closely paralleled those for other generically similar Phlips-based designs, but some interesting differences did emerge. Channel separation was undoubtedly very good, in the mid nineties, but did not match the still better figures for the Philips *104*. Full level harmonic distortion was slightly poorer and this trend was continued with decreasing modulation levels. For example, at −80dB, the distortion at 1kHz was just 16dB down. The level error at −90dB was poorer than usual at +5dB, this together with the distortion level indicating a resolution around 15 bit.

In contrast, the high frequency intermodulation results were very good, these to some degree reflecting the high quality output circuits. A difference tone level of −100dB was achieved at full modulation and a similarly good −93dB at the lower level. The spectrum analysis confirmed the clean nature of the audible band range while the higher frequency spuriae remained at the usual −50 to −55dB level. Revox have not chosen to add any further filtering here.

Channel balance was very accurate, within a fraction of a dB, and the usual close phase

match was demonstrated.

Output level was on target at 2V from a 440 ohm output impedance. The second output was variable from 2V downwards, and came from a 350 ohms impedance.

Revox have designed a rapid transport, with test access achieved in a short 5 seconds. Mechanical noise was pleasantly low, with excellent error correction. Fine signal to noise ratios were achieved, again if not quite to the excellent Philips standards, and overall, no problems were encountered in meeting the Revox's tight specification.

Sound quality

Primarily auditioned via the fixed-output sockets, the Revox scored above average in the listening tests. All the basic CD qualities were present — clean bass, explicit treble, well defined transients and well focused stereo images. Depth presentation was pretty good. As auditioning proceeded, the listeners became aware of a softened blandness about this player where some of the life and interest of the programme seemed to be diluted. This feeling was even still more clearly perceived via the variable output.

Conclusion

Essentially a good CD player, with superb build, engineering, finish and facilities, its market strength essentially rests on its compatibility with the rest of the established Revox range of audio compomnents. However, taken alone it is not outstanding and its comparatively high price means that in real terms it offers relatively poor value; furthermore, in sound quality terms, the basic Philips *'104* unfortunately has the edge.

GENERAL DATA — Revox B225

Channel balance
At 20Hz 0.04dB
At 1kHz 0.03dB
At 20kHz 0.03dB

Stereo separation
At 20Hz ..... – 10dB
At 1kHz ..... – 95dB
At 20kHz ..... – 92.5dB

Channel phase difference
At 20Hz ..... <0.5°
At 1kHz ..... <0.5°
At 20kHz ..... <0.5°

Total harmonic distortion at 0dB
At 20Hz ..... – 93dB
At 1kHz ..... – 94dB
At 20kHz ..... – 86dB

Total harmonic distortion at – 10dB
At 1kHz ..... – 79dB

Total harmonic distortion at – 60dB
At 1kHz ..... – 38dB

Total harmonic distortion at – 80dB
At 1kHz ..... – 16dB

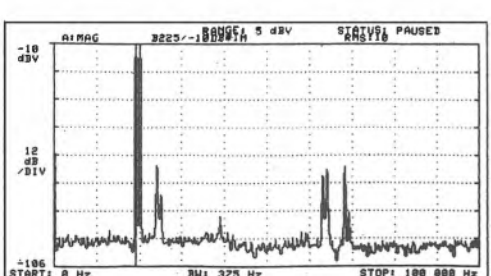
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... – 100dB
At – 10dB, 19kHz/20kHz ..... – 93dB

Frequency response
Left channel ..... + 0.05, – 0.25dB
Right channel ..... + 0.05, – 0.25dB

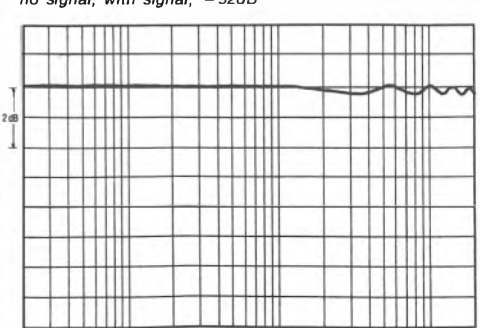
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... – 104dB
No emphasis, CCIR ARM, 1kHz ref ..... – 100dB

Output level, 0dB
Left channel 2.06V
Right channel 2.06V

Output impedance 350ohms
De-emphasis ..... fine
Track access time ..... 5.0 secs
Error correction capability ..... 900μm gap, 800μm dot
Mechanical noise ..... low
Spuriae up to 100kHz ..... – 86dB*
Resolution at – 90dB ..... + 5.0dB
Headphone socket ..... yes, variable level (remote control)
Dimensions (w x d x h) ..... 45 x 33 x 11cm
Estimated typical purchase price £780
** no signal; with signal, – 52dB*



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



Sansui V100

Sansui (UK) Ltd, Unit 10A, Lyon Industrial Estate, Rockware Avenue, Greenford, Middlesex
Tel 01-575 1133

Sansui have been doing well with their moderately priced player, the *V300,* but this has been recently updated by the replacement model *V100,* with a price reduction of some 10%. A still cheaper model will also be available, called the *V750,* built to a different design however.

A significant point concerning the *300* and *100* is their pedigree, the machines being specified by Sansui and built for them by Yamaha, utilising the latter company's twice-oversampled digital to analogue conversion system.

The high production volume chassis allows various 'frills' to be added as desired for different models but in the case of the *'100,* these have been kept to a minimum. This basic machine has a red led display showing all the required information but only one bit at a time. Thus track numbers, elapsed time, total time and track time are shown according to the mode selected by depression of the display key. Tracks can be programmed but not indexed, and no headphone or remote control facility is provided. Good track selection and cueing facilities are present, with audible music in search mode.

Inside, the player is well constructed, using a single 16 bit Burr Brown D/A with two times oversampling and digital filtering. The layout is nicely accessible, easy for servicing with a high level of circuit integration displayed, using custom Yamaha integrated chips.

Lab report

Output level was just slightly below the nominal standard reading and averaged 1.9V. A higher than usual output impedance was noted, of 1kohms. A basically uniform frequency response was obtained, flat from 50Hz to 5kHz, and with a mild lift at higher frequencies, around 0.5dB. Channel balance was fine at 0.18dB or better.

Measured for channel separation the results were good but unexceptional, at 92dB 1kHz, for example, reducing to 83dB at 20kHz. Inter-channel phase differences were as usual for a twice-oversamping design — less than 1° at 1kHz, increasing to a modest 38° by 20kHz.

Turning to the total harmonic distortion at full linearity, at 1kHz a reasonable −87dB was recorded, while up to −103dB is possible. The −84dB downband noise at 20kHz is considered quite reasonable.

Good results were achieved at lower signal levels, indicating 15½ bit resolution, while at −90dB the 7dB of level error was a little high. The machine demonstrated a good high frequency performance with respect to two tone intermodulation. For the full level, 19/20kHz tones the difference product fell to −103dB; in theory the −10dB result should have been −93dB, but in fact it was a little degraded to −86dB. The matching spectrogram showed a clean downband result but the 24kHz rejection was weak at just 24dB. Upper range components were also visible, so the

output filtering is not that strong. Under normal signal conditions, a reasonable −72dB of suppression is typical.

Track access times were rapid with 4 seconds required to reach the test track 15. Mechanical noise levels were low, while the electrical signal to noise ratios were a little poorer than average at −90.5dB, CCIR ARM (1kHz), without pre-emphasis. Error correction capability was fairly good though not up with the best examples.

Sound quality

Aligning with the twice oversampled series in general, this player gave good results on test, rather above average. While a touch of grain and imprecision was noted in the treble, the general tonal quality was pleasantly musical and showed good clarity, detail and stereo depth. Stereo focus was fine while the bass was slightly softened.

Conclusion

These players offer a good sound quality for the money, together with a competent transport claiming fast access times. In common with other related models, the new *V100* has no difficulty in gaining a recommendation in this issue, and in view of the latest pricing, wins a 'Best Buy' rating.

GENERAL DATA — Sansui V100

Channel balance
At 20Hz 0.15dB
At 1kHz 0.18dB
At 20kHz 0.05dB

Stereo separation
At 20Hz ..... −93dB
At 1kHz ..... −92dB
At 20kHz ..... −83dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 0.8°
At 20kHz ..... 38°

Total harmonic distortion at 0dB
At 20Hz ..... −90dB
At 1kHz ..... −87dB
At 20kHz ..... −84dB

Total harmonic distortion at −10dB
At 1kHz ..... −81dB

Total harmonic distortion at −60dB
At 1kHz ..... −35dB

Total harmonic distortion at −80dB
At 1kHz ..... −21dB

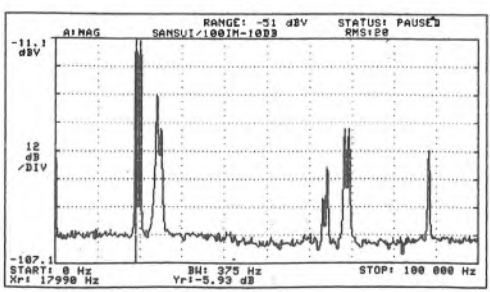
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... −103dB
At −10dB, 19kHz/20kHz ..... −86dB

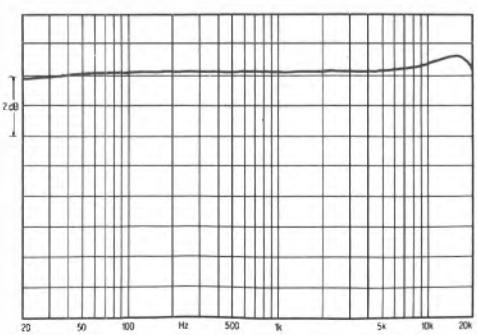
Frequency response
Left channel ..... +0.55, −0.18dB
Right channel ..... +0.55, −0.18dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... −97dB
No emphasis, CCIR ARM, 1kHz ref ..... −90.5dB

Output level, 0dB
Left channel 1.90V
Right channel 1.87V

Output impedance 1Kohm
De-emphasis ..... fine
Track access time ..... 4.0 secs
Error correction capability ..... 800μm gap, 500μm dot
Mechanical noise ..... low
Spuriae up to 100kHz ..... −72dB
Resolution at −90dB ..... +7dB
Headphone socket ..... ????
Dimensions (w × d × h) ..... 34 × 29 × 9cm
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 CD-P30

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Partnered by the similar *CDP50,* the *CDP30* is Sony's least expensive and new mains operated machine, that is if one does not count the portable *D50* with its power pack.

A basic package, the *CDP30* lacks many features — headphone outlet, variable level, numeric keypad and remote control. Included are the fast Sony track access buttons with audible music cueing, while repeat or A-B phase repeat is possible. It can also access index points if programmed into the disc in use. The clear display shows overall as well as individual tracks, indexing, timing in minutes and seconds, plus elapsed and remaining times, the two latter displayed via a touch button. A drawer loader, it is pretty compact and comes finished in the usual satin grey-black.

Inside, the deck clearly has been engineered for mass production. The transport has been simplified, with the reduction in moving mass allowing a fast operation to be achieved although this is at the expense of some mechanical operating noise, mainly from the disc motor. The circuitry is tidy, built on a single board, with much use made of highly integrated circuits. One tiny chip, the main processor, is about the size of a postage stamp, and yet it has 80 lead out wires! This chip is surface bonded to the high resolution printed circuit track.

The convertor system is a conventional 16 bit, time shared, with the usual 9 pole brickwall monolithic output filters. Power drain has been reduced to 13W.

Lab report

A mild 0.6dB channel imbalance was recorded, together with very good channel separation despite the time shared D/A convertor. The latter running at normal rates gaves rise to the usual maximum 80° of interchannel phase shift at 20kHz, but this is not considered to be a problem.

Distortion figures were fine at low and mid frequencies, and together with the level error, suggested a good 15½ bit resolution. At high frequencies, though, some compromise was detected.

Downband modulation products were detected at −86dB for a 20kHz signal at 0dB which is about average, while the full level high frequency intermodulation was poorer than usual, at −81dB. This improved to −89dB at the 10dB lower level, and the corresponding spectrum analysis is shown. Here the down-band area was pretty clean, while the 24kHz product was just −47dB, not outstanding.

Further up the range the spurious signals were very well rejected, with the overall figure rated at −105dB.

Frequency response was quite uniform, perhaps with a hint of treble lift. The output was close to the 2V standard though it was produced from a rather high 1.8 kohm output impedance. De-emphasis was fine, and track

access rapid at 4.3 seconds, like the old *101*. Some mechanical noise was heard — check this out for yourself to see if it is a problem or not. It coped well with the 800μm gap error but disliked the surface dot blemish, sticking at 300μm plus. Some damaged discs might give more trouble here.

Signal to noise ratios were poorer than average, the no emphasis 1kHz CCIR ARM result being nonetheless satisfactory at – 88.5dB.

Sound quality

Establishing a good basic CD standard, the CD *30* and the similar *'50* showed some loss of ambience and depth but with a pleasant overall character. Some degree of fine definition and detail was masked, and both bass and treble extremes have some softening of 'edge' and attack on transients. Overall, it was only a little above average.

Conclusion

Here is a competent tidy little player which does its basic job well, but which does not offer anything special at the price. While it fits nicely in the appropriate rack system, it can only rate as worth considering as an independent.

GENERAL DATA — Sony CDP30

Channel balance
At 20Hz 0.5dB
At 1kHz 0.56dB
At 20kHz 0.6dB

Stereo separation
At 20Hz 108dB
At 1kHz 109dB
At 20kHz 91dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 5°
At 20kHz ..... 80°

Total harmonic distortion at 0dB
At 20Hz ..... – 98dB
At 1kHz ..... – 98dB
At 20kHz ..... – 86dB

Total harmonic distortion at – 10dB
At 1kHz ..... – 92dB

Total harmonic distortion at – 60dB
At 1kHz ..... – 50dB

Total harmonic distortion at – 80dB
At 1kHz ..... – 24dB

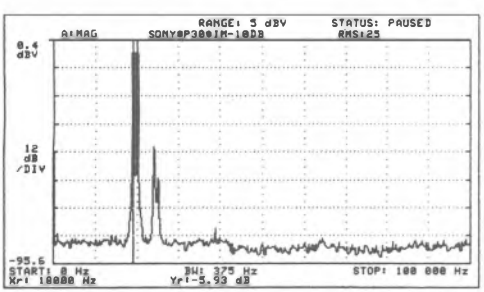
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... – 81dB
At – 10dB, 19kHz/20kHz ..... – 89dB

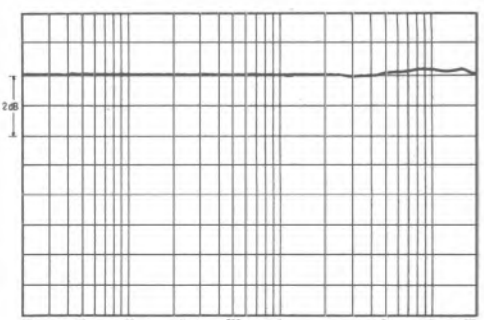
Frequency response
Left channel ..... + 0.2, – 0.1dB
Right channel ..... + 0.2, – 0.1dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... – 94dB
No emphasis, CCIR ARM, 1kHz ref ..... – 88.5dB

Output level, 0dB
Left channel 2.2V
Right channel 2.07V

Output impedance 1Kohm
De-emphasis ..... fine
Track access time ..... 4.3 secs
Error correction capability ..... >800μm gap, >300μm dot
Mechanical noise ..... fair
Spuriae up to 100kHz ..... – 106dB
Resolution at – 90dB ..... + 2.5dB
Headphone socket ..... no
Dimensions (w × d × h) ..... 43 × 26 × 8cm
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 D-50

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Even including its adapter or battery pack, this entire machine is no larger than the motorised loading drawer in a typical mains-only player!

The *D-50* is a dual purpose machine. It can be used as a conventional standalone mains powered player, which is how it is supplied — it comes complete with a 9V mains adapter at a cost of £289. Alternatively it can be used as a 'portable', with the battery pack an extra £45 or so, and it enjoys a fair vibration and swing resistance. It consumes about £4.50 worth of alkaline 'C' cells in around 5 hours, about 90p an hour on average, so you do have to pay for the amazing luxury of 16 bit digital stereo audio while walking about!

All the usual Sony facilities are provided, including fast cueing, rapid access, touch button control and a display, in this case LCD, showing track numbers, play time, remaining time and remaining tracks. Audible music cueing is also present but no programming or indexing. Ample output levels are provided for headphone and line, the latter via a detachable cable supplied with the deck.

The technology is highly integrated and designed for very low overall power consumption of 4 watts. 16 bit linear circuits are used, with a single time shared D/A convertor.

On test the frequency response was neither as flat or as extended as usual. Channel imbalance rose to a maximum of 1dB as the left and right hand traces diverged slightly at 2kHz. On the right channel a treble droop of 0.8dB was measured though I doubt whether, listening to the unit in isolation, any of this could be heard as such; only on critical A/B testing would it be noticeable, and even then not considered seriously. The output was almost to standard at 1.9V from a relatively low 220 ohms source impedance.

Channel separation was reasonable, the figures reducing to a modest but still acceptable 61dB at 20kHz. Interchannel phase difference was quite typical with up to 72° at 20kHz.

Total harmonic distortion was satisfactory at peak levels, with −93dB at 20Hz and increasing to −86dB at 1kHz, with −57dB at 20kHz. The latter looks poor but a good high frequency linearity was shown in the high frequency intermodulation results. Even at full level −91dB was measured while at the 10dB lower level, an amazing −100dB was recorded. This was rather better than an earlier sample I first reviewed. Some peak limiting was evident, but the fine results for distortion at lower levels indicated a good linearly and 15½ bit resolution was achieved. The de-emphasis was fine, while track access was comfortably quick at 4.6 seconds. Little compromise has been made as regards the error correcton capability; 800μm gaps and surface dots were handled well, almost to the full test limit.

Signal to noise ratios were fine, by normal standards, but in comparison with larger

machines were somewhat compromised. Without the help of de-emphasis, the player provided a satisfactory −86dB CCIR ARM (1kHz) weighted.

Spurious signals were well rejected, by 108dB — no skimping here. The headphone outlet worked very well, with an ample volume range for all but the least sensitive headphones. Source resistance here was a low 57 ohms.

Sound quality

Reaching an average score, the *D50* was felt to sound slightly soft in the bass and a touch imprecise in the treble. Some loss of stereo depth was also noted while transient definition was softened. Tonal balance was quite pleasant however. Conversely the player did offer all the basic CD virtues namely virtually inaudible distortion, no noise, no wow and flat frequeny respnses, with good stereo separation.

Conclusion

Almost standing up to a good basic mains machine, it is an amazing achievement that this micro deck sounded as good as it did. In any case, it is very realistically priced and is more than good enough for many audio fans. The quality is maintained on batteries. This delightful product proved a joy to use and enjoys a warm recommendation on these special grounds!

GENERAL DATA — Sony D50

Channel balance
At 20Hz 0.25dB
At 1kHz 0.35dB
At 20kHz 1dB

Stereo separation
At 20Hz 87dB
At 1kHz 84dB
At 20kHz 61dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 0°
At 20kHz ..... 72°

Total harmonic distortion at 0dB
At 20Hz ..... −93dB
At 1kHz ..... −86dB
At 20kHz ..... −57dB

Total harmonic distortion at −10dB
At 1kHz ..... −85dB

Total harmonic distortion at −60dB
At 1kHz ..... −49dB

Total harmonic distortion at −80dB
At 1kHz ..... −26dB

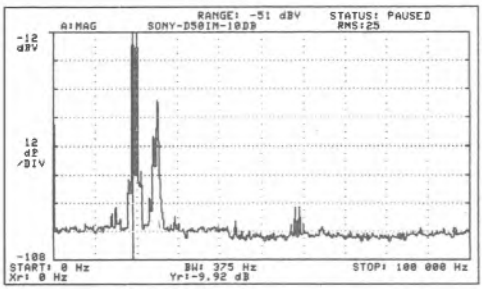
Intermodulation distortion
At 0dB, 19kHz/20kHz ..... −91dB
At −10dB, 19kHz/20kHz ..... −100dB

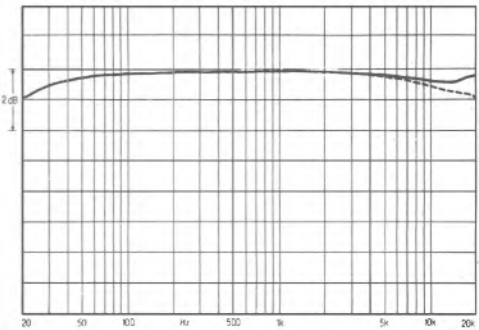
Frequency response
Left channel ..... +0, −0.4dB
Right channel ..... +0, −0.8dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted ..... −93dB
No emphasis, CCIR ARM, 1kHz ref ..... −86dB

Output level, 0dB
Left channel 1.9V
Right channel 1.9V

Output impedance 220ohms
De-emphasis ..... fine
Track access time ..... 4.6 secs
Error correction capability ..... 800µm gap, 800µm dot
Mechanical noise ..... low whine
Spuriae up to 100kHz ..... −108dB
Resolution at −90dB ..... +4.5dB
Headphone socket ..... yes
Dimensions (w × d × h) ..... 13 × 13 × 4cm
Estimated typical purchase price ..... £280, battery pack £50





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

Sony CD-P102

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

A more compact version of the *'302*, the *'102* is the replacement for the long-established *CDP101*. Like the *'101*, it is provided with a good infra red remote control, which includes the numeric keyboard that is missing from the machine itself. This adds index location but does not offer random track programming; I am uncertain how much importance to attach to the omission of this function since I cannot recall actually ever using it myself except for testing!

A fluorescent digital display shows track totals and track played, as well as index numbers and timings while via an auxiliary button, elapsed and remaining time may also be displayed. Repeat 'all' and 'A-B' functions are included. The usual precise Sony transport controls are located on a touch pad array, with a positive snap action feel.

This is a drawer loading machine and the finish is the usual satin grey-black. No headphone socket is provided, while the rear panel output is via fixed level nickel plated phonos. Additional connectors are provided for remote control, via a matching stack system and for a subcode data output. A spare switched AC outlet is also present.

The new high speed optical transport is fitted together with the 'unilinear' convertor. This is a twice oversampled circuit with low ripple 96th order digital filtering followed by a time shared 16 bit digital to analogue convertor plus LC analogue filtering.

Lab report

Frequency responses were extremely flat, devoid of emphasis or ripple. Channel balance was held to a very close tolerance, while channel separation measured well over the whole range, reaching a high 110dB at low frequencies; 91dB was still achieved at 20kHz. Interchannel phase difference was mild at a maximum of 37° 20kHz, amounting to 5μS or so, well below audible thresholds.

Noise and distortion were very low. Even at 20kHz full level, downband noise was a remarkable 0.0015%, with 0.001% at 1kHz. Good linearity results were maintained at – 80dB. The low distortion obtained at reducing modulation levels, together with the level error at – 90dB, indicated a resolution of a little better than 15½ bit, a good result.

For 19/20kHz intermodulatioin tones the results were particularly good at – 100dB and – 91dB for the two test levels of 0dB and – 10dB. The old *'101* recorded – 90dB for the peak level in the previous edition. The spectrum analysis for the – 10dB intermodulation was beautifully clear in the audible range, while the higher order components were satisfactorily rejected at – 63dB. On general tones, the upband rejection was typically around – 102dB.

Output was conveniently close to the standard 2V from a moderate source impedance of 430 ohms. Little deviation from the prescribed de-emphasis characteristic was

observed, and track access times were almost too quick to sensibly assess — estimated at 1.8 seconds. In fact on skipping to adjacent tracks, the deck is almost instantaneous.

A top-flight error correction ability was measured and mechanical noise levels were mild. Signal to noise ratios were well up to standard, eg: – 92.5dB CCIR ARM (1kHz) no emphasis. Few preamplifiers can even reach this specification.

Sound quality

Sony have achieved a logical progression of quality versus price in this new range. This the *'102* falls below the *'302* and yet it comfortably achieves a good standard. In addition to the almost taken-for-granted 'CD qualities', the *'102* offered better sound than the *'101* by virtue of its sweeter mid and a more transparent as well as detailed top end. Slightly 'laid back', it also provided good depth rendition.

Compared with the best, there was some overall softening of definition in the bass and mid register, with a touch of 'glass' also apparent in the treble.

Conclusion

Good value at £399 inclusive of a remote control, the *'102* is a solid performer from Sony's new range. Not quite Best Buy material in our view, it has nonetheless done well enough to secure a firm recommendation.

GENERAL DATA Sony CD-P102

Channel balance
At 20Hz....0.16dB
At 1kHz....0.16dB
At 20kHz....0.05dB

Stereo separation
At 20Hz.... – 110dB
At 1kHz.... – 92dB
At 20kHz.... – 91dB

Channel phase difference
At 20Hz....0°
At 1kHz....1°
At 20kHz....37°

Total harmonic distortion at 0dB
At 20Hz.... – 100dB
At 1kHz.... – 100dB
At 20kHz.... – 96dB*

Total harmonic distortion at – 10dB
At 1kHz.... – 88dB

Total harmonic distortion at – 60dB
At 1kHz.... – 52dB

Total harmonic distortion at – 80dB
At 1kHz.... – 24dB

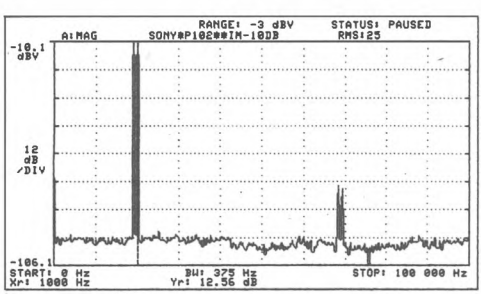
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 100dB
At – 10dB, 19kHz/20kHz.... – 91dB

Frequency response
Left channel.... + 0, – 0dB
Right channel.... + 0.15, – 0dB

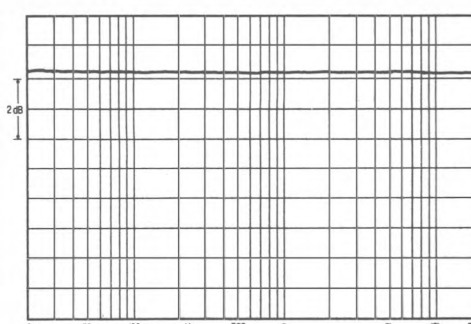
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 99.5dB
No emphasis, CCIR ARM, 1kHz ref.... – 92.5dB

Output level, 0dB
Left channel....1.934V
Right channel....1.975V

Output impedance....431ohms
De-emphasis....correct
Track access time....2.4 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....very low
Spuriae up to 100kHz.... – 102dB
Resolution at – 90dB.... + 1.88dB
Headphone socket....no
Dimensions (w × d × h)....33.5 × 33.5 × 8cm
Estimated typical purchase price....£400
** including noise*



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



Sony CD-P302ES

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Replacing the old *'501*, this large machine is similarly priced. Superficially it resembles the *'502*, but in practice it has a closer relationship with the *'102*.

As is customary with upmarket machines, this player is equipped with a comprehensive remote control as well as numerous facilities. It is slimmer than the *'502* but is still quite large. No numeric keypad is fitted, but track access is nonetheless rapid. Tracks can be programmed and indexed, while the large fluorescent display shows all the usual data-track numbers, overall and individual timings, plus elapsed and remaining time. The repeat modes allow repetition of a whole programme of of selected 'A-B' sections.

A headphone socket is provided, with an adjacent control but the main output, via gold plated phono sockets, is fixed.

Rear panel facilities include remote control via the matching stack system, plus a subcode output for future connection of computers and display units.

Inside, further improvements in chip integration have resulted in a relatively simple simple board construction with a tidy, accessible layout. Using the twice oversampled 'unilinear' convertor system, the player employs discrete LC output filters as well as selected audio quality signal components. Large Oki microprocessors handle the interfacing and display/control functions. The laser servo head employs the advanced linear motor drive system for faster access and lower noise.

Lab report

Showing a fine channel balance, the *'302* gave another of those ruler flat responses, +0, −0.06dB from 20Hz to 20kHz. Sony's digital filter has very low ripple as this player most clearly demonstrated. Channel separation was good but unexceptional, but was constant over the frequency range. Interchannel phase shift was moderate due to the twice oversampled but shared D/A convertor.

Total harmonic distortion was very low, with the 0dB error giving a resolution figure of 15¾ bits. The downband distortion products at 20kHz were particularly good, reading −100dB. Agreeing well, the high frequency two tone intermodulation test was superbly passed at full level with the difference tone at −106dB; with level reduced 10dB, the result was an excellent 95dB.

The fixed output level was close to the standard at 2.02V, sourced from a moderate 428 ohms. No problems were encountered with the de-emphasis response. Track access was very rapid, at approximately 2.2 seconds, while mechanically generated noise was low. A fine error correction performance was recorded, easily meeting the full test limits, even in the presence of significant vibration.

Signal to noise ratios were also on target. Peak values, unweighted, with pre-emphasis,

reached – 104dB while the usual worst case result, – 93dB for no emphasis at CCIR ARM (1kHz) weighted was fine. Overall spurious responses were 105dB down.

Sound quality

The *'302* did well in audition, and though scoring below the top Sony players, it held a high position overall, placed on the top five.

As with the more expensive Sony models, the *'302* offered a pleasantly civilised relaxed sound, yet it showed a good rendition of transient attack and detail, perhaps a surprising combination. Bass and treble registers were firm and clear, while stereo images were well focused with a good depth impression. Much musical detail was evident.

Conclusion

With this machine, build quality and finish are better than usual. Well equipped, it offered a high standard of sound quality and although its value rating is not really to Best Buy standard for those seeking a fine quality musical sounding player, this one is warmnly recommended.

GENERAL DATA Sony CDP 302

Channel balance
At 20Hz....0.2dB
At 1kHz....0.2dB
At 20kHz....0.2dB

Stereo separation
At 20Hz....89dB
At 1kHz....89dB
At 20kHz....88.4dB

Channel phase difference
At 20Hz....0°
At 1kHz....1.5°
At 20kHz....39°

Total harmonic distortion at 0dB
At 20Hz.... – 107dB
At 1kHz.... – 100dB
At 20kHz.... – 100dB

Total harmonic distortion at – 10dB
At 1kHz.... – 89dB

Total harmonic distortion at – 60dB
At 1kHz.... – 50dB

Total harmonic distortion at – 80dB
At 1kHz.... – 24dB

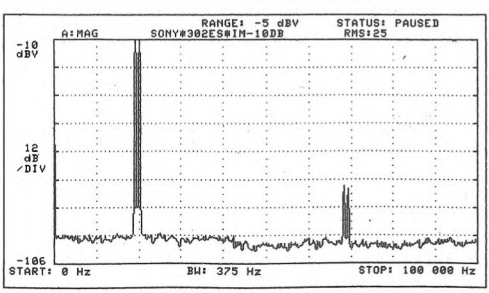
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 100dB
At – 10dB, 19kHz/20kHz.... – 95dB

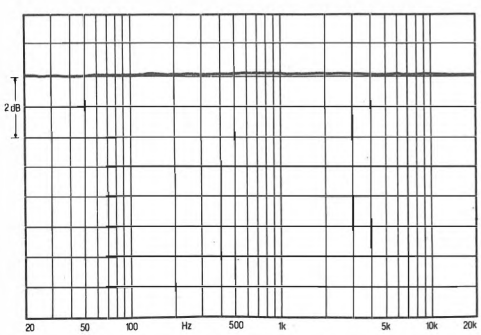
Frequency response
Left channel.... + 0, – 0.06dB
Right channel.... + 0, – 0.06dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 99.5dB
No emphasis, CCIR ARM, 1kHz ref.... – 93dB

Output level, 0dB
Left channel....2.023V
Right channel....2.068V

Output impedance....428ohms
De-emphasis....correct
Track access time....2.2 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 105dB
Resolution at – 90dB.... + 2.2dB
Headphone socket....yes (variable level)
Dimensions (w x d x h)....43 x 33.5 x 8cm
Estimated typical purchase price....£500





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

Sony CD-P502ES

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

This review of the Sony *'502* also stands for the player section of the *'552/'702* combination, which is really pretty similar in terms of facilities. The *'502* is a large machine finished in satin black and has a headphone socket with volume adjustment available under remote control.

A full 0-20 numeric keyboard is incorporated plus decades to 99. The infra red control is fully equipped and matches the front panel. Tracks can be accessed directly and programmed in random order for single play or the normal continuous mode. Repeat includes total and 'A-B' programme modes, while the start of tracks is automatically cued and index access is also provided. Fast audible music cueing is available, almost too fast with this deck, and an oddly randomised 'shuttle' play is possible.

The large fluorescent display gives full readout of all selected tracks plus the usualy track totals, timings, elapsed time and so on. Mechanical noise levels are low, and track access is particularly quick.

Internally, Sony use a 16 bit D/A convertor at a twice oversampled rate plus a 96th order digital noise shaping filter. Compromising somewhat on the full linear phase response, multi-pole analogue output filtering is employed here.

Lab report

At first the extremely flat frequency response was unbelieveable — I thought the recorder pen had stuck! It measured +0, −0.1dB from 20Hz to 20kHz, and the channel balance was excellent. Channel separation was modest, held at around 90dB, while a mild interchannel phase shift developed with increasing frequency, reaching 45° at 20kHz.

Total harmonic distortion was 0.001% at medium frequencies and this excellent result was maintained even to 20kHz. The error at 90dB modulation, with the overall linearity, indicated a resolution virtually at 16 bits.

The remarkable high frequency performance was also seen on the two tone intermodulation results, which were extraordinary. A −104dB difference tone was established at peak level, which held to −97dB at 10dB below peak. The matching system analysis confirmed the clean output with related spuriae present at −76dB or better. Overall the rejection lay at −110dB.

Output level was on target at 2.03V, both fixed and variable, the latter a discrete potentiometer with a motorised control. Source impedance was 429 ohms via the fixed output, and a rather weaker 330 ohms to 6 ohms via 'variable'.

De-emphasis equalisation was correct, while the track access times were very rapid — difficult to measure, but estimated at 1.9 seconds. No problems were encountered with error correction, and the *'502* easily met the full limits of the test disc.

Signal to noise ratios were fine; for example, −93dB for the non de-emphasis CCIR ARM

(1kHz) weighted result, the most pessimistic figure of the set. On all important aspects, the results for the *'502* matched or bettered the *'701* it replaces.

Sound quality

Would the *'502* also beat the *'701* as regards sound quality? The answer is a decisive yes, and in this issue, the *'502* ranked second only to the *'552*, although it must be admitted that this itself was some way from the full *'702* combination.

The *'502* offers an easy relaxed quality which made for extended, fatigue free listening. Nevertheless transients were reproduced with real definition and fine depth was also present in the well focused stereo images. The bass was pretty firm, with good articulation, while the treble was rather clearer than average. The midrange tonal quality was quite neutral, with a pleasing harmonic structure; in particular, its strength in stereo depth and treble accuracy could hardly pass unnoticed.

Conclusion

The *'502* is an expensive player, with a wealth of features and functions plus excellent build quality. The sound was to a very good standard but this was approached by a couple of rather less expensive models. In consequence the value rating is not particularly high; but in view of the high overall standard attained, it would be churlish not to recommend it.

GENERAL DATA Sony CDP 502es

Channel balance
At 20Hz....0.1dB
At 1kHz....0.1dB
At 20kHz....0.1dB

Stereo separation
At 20Hz.... – 90dB
At 1kHz.... – 90dB
At 20kHz.... – 89dB

Channel phase difference
At 20Hz....0°
At 1kHz....1.5°
At 20kHz....45°

Total harmonic distortion at 0dB
At 20Hz.... – 103dB
At 1kHz.... – 98dB
At 20kHz.... – 99dB

Total harmonic distortion at – 10dB
At 1kHz.... – 87dB

Total harmonic distortion at – 60dB
At 1kHz.... – 48dB

Total harmonic distortion at – 80dB
At 1kHz.... – 24.5dB

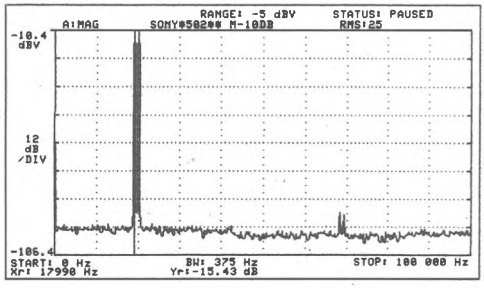
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 104dB
At – 10dB, 19kHz/20kHz.... – 97dB

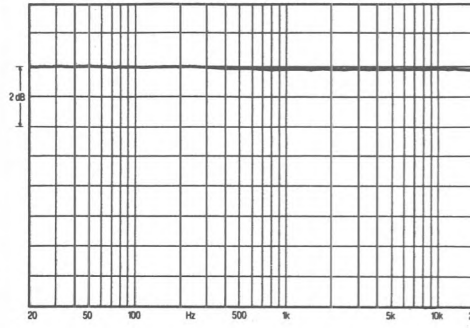
Frequency response
Left channel.... + 0, – 0.1dB
Right channel.... + 0, – 0.1dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 98dB
No emphasis, CCIR ARM, 1kHz ref.... – 93dB

Output level, 0dB
Left channel....2.03V (also variable)
Right channel....2.03V (also variable)

Output impedance....429ohms variable, 390ohm-6Kohm)
De-emphasis....correct
Track access time....1.9 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 110dB
Resolution at – 90dB....0.5dB
Headphone socket....yes variable level (remote)
Dimensions (w × d × h)....43 × 33.5 × 8cm
Estimated typical purchase price....£700





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

Sony CD-P552/DA-S702

Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Sony now have an impressive line-up of machines, entirely replacing their earlier models. The flagship of the range is the elaborately engineered *CD-P552es/DA-S702es* combination, expected to retail at around £1500.

The *CD-P552es* is a complete stand-alone player, basically similar to the *502es* 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 *'552es* is merely a transport, since full high-quality signal demodulation is carried out by the *DA-S702es* digital processor, a separate very high quality unit incorporating all of Sony's 'Esprit' knowhow. The *'702* does have a variable output and headphone socket, but maximum quality is obtained via its fixed-level output.

The *'702* uses an oversampling technique with a 96th order digital filter as well as separate high speed digital to analogue convertors of a new design. With a great emphasis on sound quality, some performance specifications for this decoder are actually poorer than, for example, the previous *CD-P 701es*. In other areas, such as high frequency linearity, the superiority of the new system was obvious.

In use, the *'552* is linked to the *'702* via a single cable, with the *'702* automatically registering the incoming sampling frequency (the *'702* will also operate on the 32kHz and 48kHz standards). All the normal facilities on the *'552* 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 on the *'552*.

Lab report

Though for the time being the units are not available as separate items, the lab testing included both the *'552* proper and the *'702*. The former showed an amazingly flat frequency response (not printed); almost ruler flat, it was +0.05dB −0.06dB, 20Hz to 20kHz. The *'702* 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* but the separate convertors of the *'702*, allowed it to reach 100dB of separation even at 20kHz. Its interchannel phase shift remained at zero degrees while for the *'552* a mild shift of up to 40° at 20kHz was measured. Downband noise and distortion were very good at 20kHz, reaching −90dB for all outputs but at lower frequencies the *'552* had the higher ultimate resolution. It achieved 0.001% while the *'702* stuck at a nonetheless very good 0.0015%. At lower modulation levels, the *'552* maintained its superiority though neither machine was exceptional here. The *'552* gave a −90dB signal error of 4.5dB while the *'702* was surprisingly poor at +9dB. These figures

suggest 15½ bit resolution for the *'552* and a poorer 15 bit for the *'702*. This was not a subjective problem as the listening results will indicate.

Both outputs demonstrated very good figures for high frequency intermodulation, the *'702* again slightly poorer than the *'552*. The latter's spectrogram showed the – 97dB 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 an amazing 120dB for the *'552* and 105dB for the *'702*.

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 *'702* could provide up to 5V via its variable output, possibly helpful in studio applications. For the *'702* the output impedance was low and constant at 104 ohms, while the *'552* offered 330 ohms on its fixed output, and useful variable impedance up to a high 5.8kohms 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 the two outputs, with the *'502* having the slight edge. The 92.5dB (CCIR ARM 1kHz) for the *'7* without pre-emphasis was fine nonetheless. The

continued on page 102

GENERAL DATA Sony CD-P552es

Channel balance
At 20Hz....0.13dB
At 1kHz....0.1dB
At 20kHz....0.13dB

Stereo separation
At 20Hz.... – 97dB
At 1kHz.... – 103dB
At 20kHz.... – 89dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....40°

Total harmonic distortion at 0dB
At 20Hz.... – 96dB
At 1kHz.... – 101dB
At 20kHz.... – 90dB

Total harmonic distortion at – 10dB
At 1kHz.... – 85dB

Total harmonic distortion at – 60dB
At 1kHz.... – 43dB

Total harmonic distortion at – 80dB
At 1kHz.... – 20dB

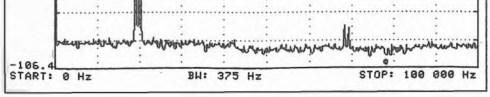
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 100dB
At – 10dB, 19kHz/20kHz.... – 97dB

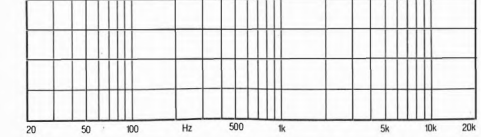
Frequency response
Left channel.... + 0.05, – 0.06dB
Right channel.... + 0.05, – 0.06dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 100dB
No emphasis, CCIR ARM, 1kHz ref.... – 94dB

Output level, 0dB
Left channel....2.00V (also variable)
Right channel....2.00V (also variable)

Output impedance....330ohms (variable, max 5.8Kohm)
De-emphasis....correct
Track access time....1.3 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....very low
Spuriae up to 100kHz.... – 120dB
Resolution at – 90dB.... + 4.5dB
Headphone socket....no
Dimensions (w x d x h)....43 x 35.5 x 8cm
Estimated typical purchase price....see text





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

Technics SL-P1

Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB
Tel (0753) 34522

Since the last issue, Technics have revamped their range, and now offer a handsomely styled and finished series in silver or alternatively the usual Technics dark metallic bronze. The *SLP1* is the simplest of these models.

A wide low profile unit, it uses a small fluorescent display which is rather deeply recessed in the panel — one's eyeline needs to be rather close to read it easily. Despite the moderate price, it does offer a numeric keypad for fast entry of desired tracks. Two-speed cueing is provided, with reduced-volume replay in the usual cued snatches. The improved laser transport exhibited a good vibration resistance with rapid access.

Internally, the construction was of good quality with an up-to-date level of circuit integration. A single 16 bit digital to analogue convertor is used, time shared between channels, and is followed by the usual 'brickwall' filtering. On the rear panel, an 8 pin socket offers subcode data for computer controlled ancilliaries.

Lab report

Almost perfectly balanced at low frequencies, the channel difference increased at high frequencies, reaching 0.6dB at 20kHz — not very serious. Fine channel separation was reached, 101dB at 1kHz, and still 92dB at 20kHz. A compensating circuit is incorporated for interchannel phase delay, this holding the maximum channel phase difference at 20kHz to less than 10°.

Output level was close to the 2V standard from an average source impedance of 607 ohms. The output has a fixed level. Total harmonic distortion at full level was about average, at – 97dB, 1kHz. At 20kHz, the in-band products were also reasonable, at – 85dB. The mid band distortion reduction at lower modulation levels was quite normal and in conjunction with the level error at – 90dB modulation, suggested 15¼ bit resolution.

High frequency intermodulation was – 95dB at full level, with a modest – 81dB at the 10dB lower setting.

The matching spectrogram shows mild downband noise, with the upband 24kHz component rejected at a typical 41dB. At higher frequencies, the output was clean enough, spurious signals being rejected to a good level of – 110dB. Test track access was speedy at 4 seconds while the mechanical noise was held to fairly low levels.

Technics' earlier models had shown some weakness with respect to error correction but I am glad to say that this is now a thing of the past. The *SLP1* easily met the requirements for the standard, and in fact exceeded the test limits on the disc.

Signal to noise ratios were quite normal, for example, – 92dB for the weighted CCIR ARM (1kHz) result, without emphasis. Unweighted it reached 103dB with the help of the pre-emphasis.

Sound quality

Referred to its predecessor the *SLP7*, the *SLP1* can be seen to offer an improvement to catch up with the latest Philips generation. Such has been the pace of progress that the *SLP1* actually scored below average in this issue. It was felt to be a trifle 'loud' and brash, with a 'forwardness' that detracted from the illusion of stereo depth. Some loss of detail and transient clarity were evident while both the bass and treble extremes could have been tidier.

Conclusion

In many ways, this is a nicely built, equipped and finished machine, but was let down by below-average sound quality. Whether all purchasers will find this important is open to doubt, but it must preclude recommendation here.

GENERAL DATA Technics SLP1

Channel balance
At 20Hz....0.07dB
At 1kHz....0.07dB
At 20kHz....0.6dB

Stereo separation
At 20Hz....–110dB
At 1kHz....–101dB
At 20kHz....–92dB

Channel phase difference
At 20Hz....0°
At 1kHz....0°
At 20kHz....9°

Total harmonic distortion at 0dB
At 20Hz....–97.5dB
At 1kHz....–97dB
At 20kHz....–85dB

Total harmonic distortion at –10dB
At 1kHz....–79dB

Total harmonic distortion at –60dB
At 1kHz....–36dB

Total harmonic distortion at –80dB
At 1kHz....–22.6dB

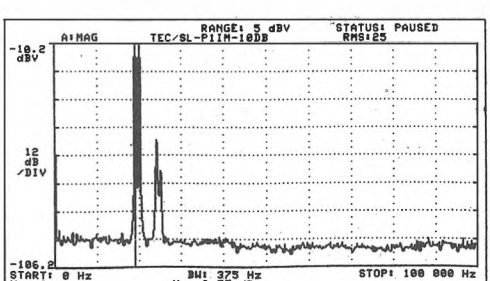
Intermodulation distortion
At 0dB, 19kHz/20kHz....–95dB
At –10dB, 19kHz/20kHz....–81dB

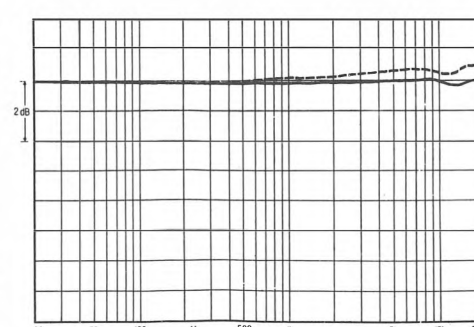
Frequency response
Left channel....+0.05, –0.15dB
Right channel....+0.55, –0dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–98dB
No emphasis, CCIR ARM, 1kHz ref....–92dB

Output level, 0dB
Left channel....1.973V
Right channel....1.957V

Output impedance....607ohms
De-emphasis....correct
Track access time....4.0 secs
Error correction capability....>900μm gap, >800μm dot
Mechanical noise....fairly low
Spuriae up to 100kHz....–110dB
Resolution at –90dB....+4.1dB
Headphone socket....no
Dimensions (w × d × h)....43 × 33 × 8cm
Estimated typical purchase price....£350

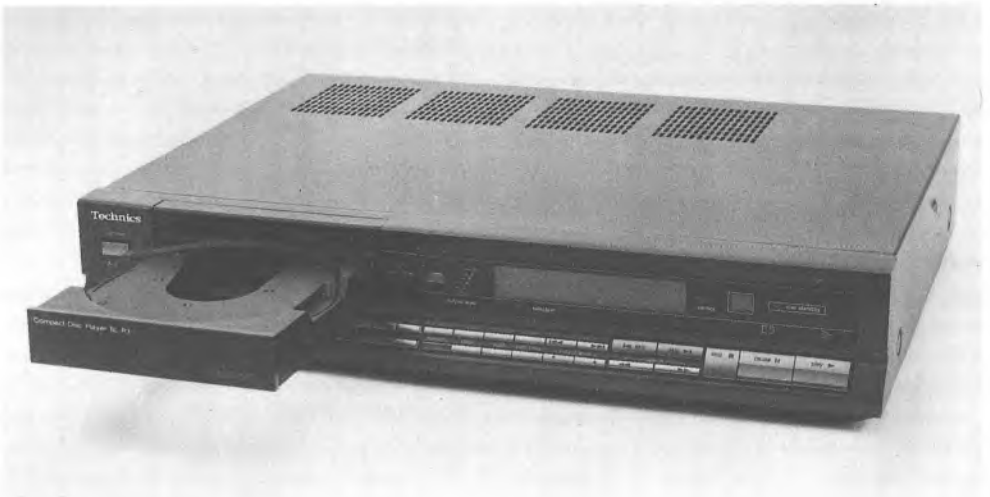




Spectrum analysis (above) with input of 19k and 20kHz tones, showing spuriae up to 100kHz, and (right) frequency response

Technics SL-P2 and SL-P3

Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB
Tel (0753) 34522



Two upmarket players from Technics, the *SLP2* and *SLP3*, are quite similar and so are covered together here.

Handsomely styled, both have extensive facilities including a full numeric keyboard for rapid entry of chosen tracks. Tracks may be programmed and index points accessed. Both carry rear terminals for a subcode output to take ancilliary equipment such as VDU displays. Both have headphone sockets with variable level control, with the reasonably sized fluorescent display showing the track position selected, plus overall and elapsed times.

Both models may be operated by comprehensive infra-red remote controls, these included in their price. Timer play is also possible, while the *'3* is distinguished by that rare facility of a power volume control, this under remote control and operating via a second pair of output sockets. Other facilities include rapid track skip, plus two speed audible music cueing.

A standard 16 bit digital to analogue convertor is used in real time, but time shared between the channels. A delay compensator on one channel realigns the output, reducing the interchannel delay to a negligible phase difference at high frequencies. A monolithic brickwall filter follows the convertor.

Lab report

Both machines gave a commendably uniform frequency response, free from treble emphasis and with very good channel balance. If anything, the *'2* was the better machine here while the *'3* showed a mild 0.2dB imbalance at 20kHz. Overall responses held within +0.1, −0.2dB.

Total harmonic distortion was near −100dB at mid frequencies, with a normal progression at lower modulation levels. The *'2* was again slightly better than the *'3*, but not significantly so, both settling at around 15¼ bit resolution.

Distortion was also checked via the variable output socket for the *'3*, and here distortion worsened to − 86dB at 1kHz full level, reducing the system's potential.

For both models, channel separation was fine while the delay compensator held the interchannel phase difference to a mild 10° at 20kHz.

On the high frequency two-tone intermodulation an average standard was attained, the *'2* still better than the *'3*. For the −10dB input level the downband audible range was clean, while a theoretically inaudible 24kHz component was a reasonable 42dB down. Spurious signals higher in the band were well rejected by typically 112dB.

Output level of all the phono terminals was very close to the standard at 2V, within a fraction of a dB, helpful for comparisons. The output impedances were consistent at 600 ohms, while de-emphasis correction was correct. Rapid in action, the transport accessed the test track 15 in around 4 seconds

and mechanical noise was held to a moderately low level. No problems were encountered with error correction, and the signal to noise ratios were to the usual standard, for example, – 91dB CCIR ARM (1kHz), no emphasis.

Sound quality

The *SLP2* and *'3* were rated similarly on audition, both unfortunately a little below average. The variable output on the *'3* was rated poorer still, and should only be used when strictly necessary. Judged fairly clear and detailed, with the overall CD quality certainly in evidence, the sound also exhibited that old-fashioned hardness and brashness, with a 'loud' effect. Stereo depth was curtailed and the sound did not appear relaxed, although superficially it remained very competent.

Conclusion

Although attractively presented, with the right line-up of features for the price, the *SLP2* and *'3* have not demonstrated a high enough sound quality to achieve a recommendation. Standards are so high now that attaining a basic CD performance is no longer good enough in the present lively and competitive market.

GENERAL DATA Technics SLP2

Channel balance
At 20Hz....0dB
At 1kHz....0dB
At 20kHz....0dB

Stereo separation
At 20Hz.... – 118dB
At 1kHz.... – 103dB
At 20kHz.... – 93dB

Channel phase difference
At 20Hz....0°
At 1kHz....0.5°
At 20kHz....4°

Total harmonic distortion at 0dB
At 20Hz.... – 100dB
At 1kHz.... – 100dB
At 20kHz.... – 93dB

Total harmonic distortion at – 10dB
At 1kHz.... – 79dB

Total harmonic distortion at – 60dB
At 1kHz.... – 38dB

Total harmonic distortion at – 80dB
At 1kHz.... – 23dB

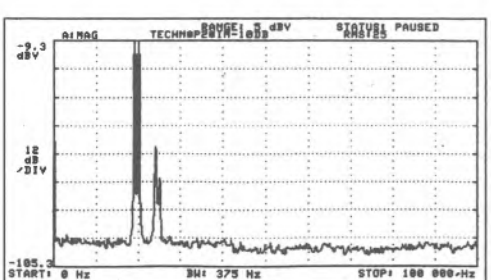
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 102dB
At – 10dB, 19kHz/20kHz.... – 92dB

Frequency response
Left channel.... + 0.1, – 0.2dB
Right channel.... + 0.1, – 0.2dB

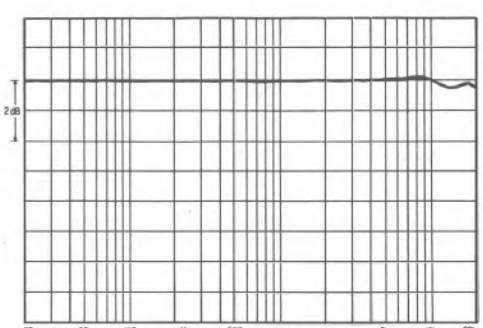
Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 98dB
No emphasis, CCIR ARM, 1kHz ref.... – 92dB

Output level, 0dB
Left channel....2.170V
Right channel....2.168V

Output impedance....590ohms
De-emphasis....correct
Track access time....3.8 secs
Error correction capability....>900µm gap, >800µm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 110dB
Resolution at – 90dB.... + 3.3dB
Headphone socket....yes (variable level)
Dimensions (w × d × h)....43 × 33 × 8cm
Estimated typical purchase price....£400



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



Toshiba XR-Z50 and XR-Z60

Toshiba (UK) Ltd, Toshiba House, Frimley Road, Camberley, Surrey
Tel (0276) 62222

Toshiba have a fair bit of experience in the CD field, and are now moving to wider markets, with volume of production of modestly priced machines. The *'50* and *'60* are both covered in this reviewed as they are fairly similar, (the *'70* has remote control), and further versions will soon be available, one with two disc drawers. Up to thirty tracks can be programmed from a pair of discs! But to return to the models under test, the *XR60* is a compact model finished in satin black, and has push-button controls with a nice action. The *'50* is a wider deck in a silver finish and with a membrane type touch control panel which worked well enough — both models lack the *'70*s full numeric keypad.

As a group, these decks are well equipped. For example, they have comprehensive fluorescent displays, showing remaining times, elapsed time, track number and index numbers when the machine is in index mode. Selections may be pre-programmed or repeated. Audible music cueing is available, plus headphone outlet with volume control.

Internally the construction is good, though not yet sufficiently integrated to allow one printed circuit board. Toshiba employ their own 16 bit convertor in a standard timeshared arrangement, while the output is filtered by the usual 9 pole monolithic filter modules.

Lab report

Both units were fully tested. The *'50* showed the most consistent frequency response, with a fine channel match. Both *'50* and *'60* showed a mild treble lift of 0.35dB, with the *'60* out of balance by almost 1dB.

Channel separation was best on the *'50* reaching 100dB in the mid band, while the *'60*, possibly due to its different wiring, was 8dB worse at 1kHz, though similar at 20kHz.

Some phase mismatch was seen in the interchannel phase difference which reached 76° for the *'60* and 92° for the *'50*. At present these are belived to be inaudible.

Again, the *'50* came out on top as regards total harmonic distortion with better than – 100dB on full-level input and a fine – 24dB at a – 80dB modulation level. A 15½ bit resolution was indicated, with a slightly worse figure for the *'60*. Level error at – 90dB was quite low for both machines. At 20kHz, 0dB, similarly average results for downband noise were recorded of around – 86dB. Differences were seen in the high frequency intermodulation test where the *'50* was superior at the – 10dB level scoring an excellent – 97dB. The matching spectrum analysis showed a notably clear output below 20kHz, with the dominant 24kHz component quite well suppressed at – 50dB.

Output levels were a little under the 2V industry standard, but only by a small margin. The source impedance was higher than usual at typically 780ohms, but both showed a good de-emphasis accuracy, and the laser transport operated with good speed. Around 3.5 seconds

is fast for the track 15 access on the YEDS 2 disc. Mechanical noise was fairly low. Both machines exhibited a fine tolerance of deliberate disc errors, and almost the entire error test section was successfully dealt with.

Signal to noise ratios were poorer than average. CCIR ARM (1kHz) weighted, without the benefit of de-emphasis, the *'60* measured – 86dB, while the *'50* gave – 88dB. Up to 105dB can be achieved here but the noise levels in this instance could not be considered a cause for concern. Spurious response rejection was also a little below average at 96dB for both decks.

Sound quality

Basically similar, on our listening tests these players were marked within 0.2 of a point, at just below average. The basic CD virtues were again apparent but the machines were not felt to sound very 'involving'. A glassiness, almost a grainy effect, was evident in the treble, while stereo focus was not to the usual standard; in particular, a loss of depth was noted. Bass was not very firm either.

Conclusion

A year ago, players of this standard and price would have been recommended but such has been the rate of progress in CD sound quality since, they are no longer strong enough for inclusion in this group. Perhaps some forthcoming lower cost models may re-establish the value basis for Toshiba.

GENERAL DATA Toshiba XRZ50

Channel balance
At 20Hz....0.12dB
At 1kHz....0.1dB
At 20kHz....0dB

Stereo separation
At 20Hz.... – 100dB
At 1kHz.... – 102dB
At 20kHz.... – 91dB

Channel phase difference
At 20Hz....0°
At 1kHz....6°
At 20kHz....92°

Total harmonic distortion at 0dB
At 20Hz.... – 96dB
At 1kHz.... – 102dB
At 20kHz.... – 85dB

Total harmonic distortion at – 10dB
At 1kHz.... – 86dB

Total harmonic distortion at – 60dB
At 1kHz.... – 49dB

Total harmonic distortion at – 80dB
At 1kHz.... – 24dB

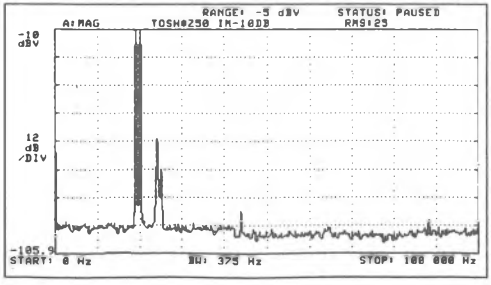
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 90dB
At – 10dB, 19kHz/20kHz.... – 97dB

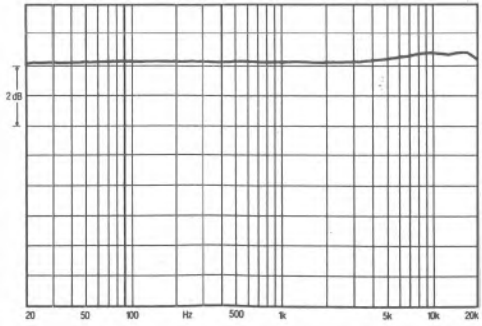
Frequency response
Left channel.... + 0.35, – 0.1dB
Right channel.... + 0.32, – 0.1dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 94dB
No emphasis, CCIR ARM, 1kHz ref.... – 88dB

Output level, 0dB
Left channel....1.90V
Right channel....1.93V

Output impedance....785ohms
De-emphasis....correct
Track access time....3.6 secs
Error correction capability....800µm gap, 800µm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 96dB
Resolution at – 90dB.... + 2.8dB
Headphone socket....yes
Dimensions (w × d × h)....42 × 31 × 9cm
Estimated typical purchase price....£350





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

Yamaha CD-X2

Natural Sound Systems, 7 Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 36740

Yamaha's *CD-X2* replaces the successful *'X1*, an established 'Best Buy' player. The *CD-X2* is a compact, tidy looking unit finished in the presently fashionable satin black. It comes equipped with a useful set of positive acting controls, including for example two-speed audible music cueing. Tracks may be programmed with memory and repeat.

A red 'led' type display shows track numbers and totals plus individual timing. Despite the absence of a numeric keyboard, the fast-acting transport and controls give rapid track access.

Yamaha have successfully integrated the design of their players and use a single printed circuit board with a surprisingly open layout. Accessibility is very good. The drawer loading mechanism is isolated on rubber posts though the machine's light overall weight means that its vibration resistance is not exceptional.

Yamaha multiprocessors control the logic and servo systems while the player continues to employ the two times oversampling system in conjunction with digital filtering and a time shared Burr Brown 16 bit digital to analogue convertor, with some additional analogue filtering to follow. Another 'extra' feature of the *'X2* is a headphone socket with level control, this despite a modest price reduction compared with the earlier model.

Lab report

While the *'X1* showed a slight loss in the extreme treble, the newer machine showed a slight lift, to a maximum of 0.65dB at 17kHz — almost inaudible. Channel balance was excellent up to 10kHz, deteriorating by just 0.2dB at 17kHz. Channel separation was quite good by CD standards at around 90dB mid band reducing to 82dB at 20kHz. The usual interchannel phase difference was measured at around 1° at 1kHz increasing to a moderate 37.5° at 20kHz. Total harmonic distortion was unexceptional; for example, +89dB at 1kHz, 0dB. At the −80dB modulation the result was a poorer than average −19dB. Up to −26dB is possible here. In addition the level error at −90dB was on the high side at +8dB (the less the better here), and for this sample the resolution was about 15¼ bits.

At high frequencies the distortion products in the audible range were about average at +85dB. Tested for high frequency intermodulation, the player surprised us with an excellent −105dB for the 1kHz product; however at the −10dB level it fell back to a typical −83dB. From the spectrogram one can see some downband noise, while at 24kHz the rejection was only 24dB. Several further spuriae were present showing only modest filtering of these products. Conversely on normal tones the rejection held at −70dB.

Output level was fractionally below the 2V standard, fed by a higher than usual source resistance of 1kohm. The de-emphasis curve was met correctly and a rapid track access was measured, 4 seconds for track 15. Mechanical

noise was comparatively low. Error correction was fairly good though not up with the best. The 800μm gap was well handled but surface dots greater than 400μm caused mild clicks. Signal to noise ratios were fine, indeed – 90dB CCIR ARM (1kHz) no emphasis, an improvement of 4dB over the *CD-X1*.

Sound quality

Scoring well in the auditioning at a 'good' standard, the *'X2* sounded clean and firm with good detail and transient definition. Both bass and treble extremes were a little better than before (*'X1*) while the presentation of stereo image and depth were to a good standard. If compared with the best the definition showed some softening at the frequency extremes while a trace of mid 'glare' and treble 'grain' could be detected.

Conclusion

Yamaha have maintained a high general quality and fine value for money with their latest budget player, which merits another 'Best Buy' rating.

GENERAL DATA Yamaha CDX2

Channel balance
At 20Hz....0.01dB
At 1kHz....0.01dB
At 20kHz....0.2dB

Stereo separation
At 20Hz.... – 90dB
At 1kHz.... – 91dB
At 20kHz.... – 82dB

Channel phase difference
At 20Hz....0°
At 1kHz....1°
At 20kHz....37.5°

Total harmonic distortion at 0dB
At 20Hz.... – 90dB
At 1kHz.... – 88dB
At 20kHz.... – 85dB

Total harmonic distortion at – 10dB
At 1kHz.... – 80dB

Total harmonic distortion at – 60dB
At 1kHz.... – 35dB

Total harmonic distortion at – 80dB
At 1kHz.... – 19dB

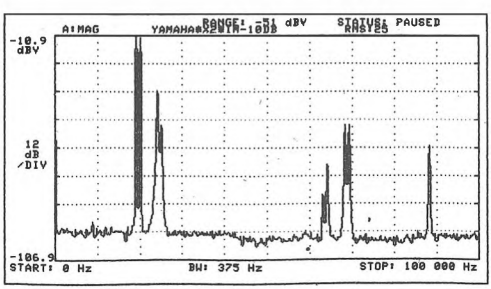
Intermodulation distortion
At 0dB, 19kHz/20kHz.... – 105dB
At – 10dB, 19kHz/20kHz.... – 83dB

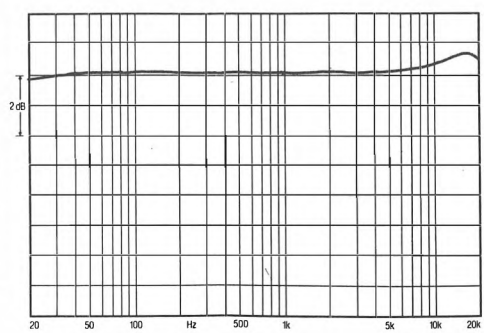
Frequency response
Left channel.... + 0.6, – 0.1dB
Right channel.... + 0.5, – 0.1dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted.... – 96dB
No emphasis, CCIR ARM, 1kHz ref.... – 90dB

Output level, 0dB
Left channel....1.907V
Right channel....1.902V

Output impedance....1.003kohm
De-emphasis....correct
Track access time....4.0 secs
Error correction capability....800μm gap, >400μm dot
Mechanical noise....low
Spuriae up to 100kHz.... – 70dB
Resolution at – 90dB.... + 8dB
Headphone socket....yes (variable level)
Dimensions (w x d x h)....34 x 28 x 12cm
Estimated typical purchase price....£330





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

Yamaha CD-3

Natural Sound Systems, 7 Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 36740

At present the Yamaha type numbers are a little confusing, since the *CD-3* is less expensive than the earlier *CD-2*. In some respects the *CD-3* could be regarded as a larger version of the *CD-X2*, with the addition of a simple infra-red remote control, the latter based on a slim little package. The *CD-2* has the numeric keyboard while the *CD-3* makes do without, but its price is competitive and it does include a headphone socket with variable level control.

The unit is finished in the usual satin black with a fast operating drawer load. Simple but clear, the single numbered led display can be made to show a variety of information via a selector button. Index numbers, total tracks, track timings and overall times may also be displayed. Tracks can be programmed in random order while the repeat mode can cover a whole selection or a pre-determined section. The usual two speed music cueing is also present. Output is at a fixed level.

As in other recent Yamaha players, the data stream here is twice oversampled, and with the single 16 bit digital to analogue convertor subjected to digital pre-filtering and noise shaping. Some discrete LC analogue filtering follows. No attempt has been made to linearise the phase response, a feature of the Philips, and now most of the new Sony players as well.

Lab report

While the frequency response was similar to that of the *CD-X2*, channel balance was rather tighter, at typically 0.05dB. A trace of treble lift was observed, a typical +0.5dB, with just a hint of low frequency rolloff of 0.2dB.

Channel separation beat the *CD-X2*, reaching 100dB midband and a still good 85dB at 20kHz. On interchannel phase difference the usual maximum of 39° at 20kHz was observed.

Total harmonic distortion was around average, and in view of the level error −90dB modulation, the overall resolution approached 15½ bits. The downband noise for a 20kHz full-level tone was unexceptional at −79dB but this was to some degree contradicted by the very fine results obtained with the 19/20kHz intermodulation tones. At peak level the 1kHz difference tone was an excellent 104dB down, while at the 10dB lower level, an equally fine −96dB was measured. The matching spectrum analysis is shown, and confirmed the clean audio band performance. Upband, the graph tells a different story, and the ultrasonic filtering of spuriae was not impressive. A 24kHz product was present at +24dB, with the rest not much better, and in general the rejection was at 64dB but could be improved.

The output is slightly under the 2V standard at 1.93V, from Yamaha's usual highish output impedance of 1kohm. Mechanical noise was low and track access rapid at 3.5 seconds. On error correction it was unbalanced; the 800μm gap result was good, but the 400μm surface dot was not fully covered. As with the *CD-X2*, this aspect could also be improved.

BEST BUY

Signal to noise ratios were fully to standard, for example, 99dB with emphasis and 92dB without, these CCIR ARM (1kHz) weighted.

Sound quality

By a small margin, the *CD-3* was the best of the Yamaha players to date. It reached a good quality level on absolute scores, appearing in the upper group. All the basic CD virtues were present, with this model offering additional refinement. Compared with the other Yamaha's a little more detail and definition was heard, plus a touch more transparency which helped in the impression of stereo depth.

Conclusion

Yamaha have continued their successful run — this nicely priced player is well equipped and finished, and generally operated well. The sound quality was competitive, and gained the *CD-3* a Best Buy rating.

GENERAL DATA Yamaha CD3

Channel balance
At 20Hz....0.03dB
At 1kHz....0.04dB
At 20kHz....0.22dB

Stereo separation
At 20Hz....101dB
At 1kHz....100dB
At 20kHz....85dB

Channel phase difference
At 20Hz....0°
At 1kHz....0.5°
At 20kHz....39°

Total harmonic distortion at 0dB
At 20Hz....–96dB
At 1kHz....–94dB
At 20kHz....–79dB*

Total harmonic distortion at –10dB
At 1kHz....–86dB

Total harmonic distortion at –60dB
At 1kHz....–40dB

Total harmonic distortion at –80dB
At 1kHz....–20.5dB

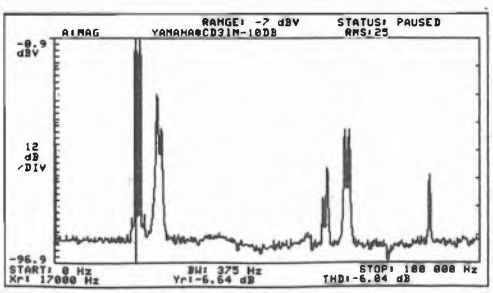
Intermodulation distortion
At 0dB, 19kHz/20kHz....–104dB
At –10dB, 19kHz/20kHz....–90dB

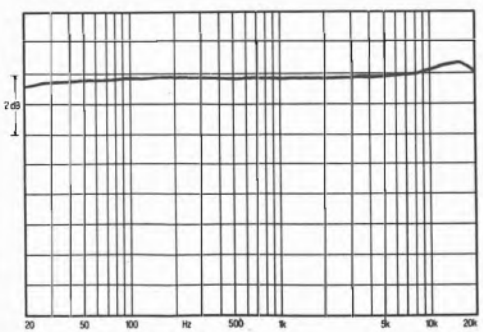
Frequency response
Left channel....+0.5, –0.2dB
Right channel....+0.4, –0.2dB

Signal to noise ratio
No emphasis, 20Hz-20kHz unweighted....–97dB
No emphasis, CCIR ARM, 1kHz ref....–92dB

Output level, 0dB
Left channel....1.93V
Right channel....1.93V

Output impedance....1Kohm
De-emphasis....correct
Track access time....3.5 secs
Error correction capability....800μm gap, >300μm dot
Mechanical noise....low
Spuriae up to 100kHz....–64dB
Resolution at –90dB....+6.7dB
Headphone socket....yes (variable level)
Dimensions (w x d x h)....34 x 28 x 12cm
Estimate typical purchase price....£400
** including noise*





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

COMPACT DISC PLAYERS SUMMARY REVIEWS

Models covered in these abbreviated reviews are for the time being still available, often at attractive prices, although they may be nominally discontinued.

Hitachi DA800
Hitachi's 1983 launch model *DA1000*, with its rather cumbersome vertical door-type disc loading, was quickly replaced by the second-generation *DA800*, a drawer-loader design resembling the Sony *'101*. It is well equipped, with numeric keypad for easy track access or programming of up to 15 tracks, audible music search, and headphone outlet with variable level. Compared with the best players it showed some loss of definition, some lack of stereo depth and a touch of hardness. At its original price of around £400 it represented only average value for money, though a competent, well constructed player.

Marantz CD63B
Just as the original Marantz player was effectively a Philips *CD100* in 'champagne gold' finish, the *CD63B* was a black-finished Marantz equivalent to the *CD101*. Still above average in subjective sound quality, the Philips players of this generation could no longer claim supremacy over the best Japanese players, close comparison now revealing mild stereo depth compression and a slight degree of upper-mid hardness in the Philips/Marantz models. Though now discontinued, the Marantz *'63B* is currently available at around £250, at which price it must still merit a recommendation while stocks last. Facilities are very basic, with no keypad, programming or music search facilities.

NAD 5200
Built for NAD by Toshiba, this model appeared to be a much simplified version of the then-current Toshiba *XRZ70*. In fact the simpler wiring and better grounding arrangements could have been responsible for the NAD's slightly better sound, but in our view the improvement was nothing like sufficient to justify the loss, compared with the Toshiba, of major facilities such as a headphone outlet, variable output and remote control, and the higher price of £400.

Philips CD101
Identical to the *CD63B* offered by their subsidiary, Marantz, Philips' own *CD101* is also apparently still available at around £250. Officially, it has now been replaced by the *'104*, given a full review in this edition. This means that the Meridian MCD (see full review) is now the only current machine based on the original Philips top-loading chassis.

Philips CD202 and CD303
A rack-width top loader, the *'202* offers some extra programming facilities, while the more sophisticated *'303* was a drawer-loader with time readout. But both still used a 'first generation' laser head which made track access rather slow (15-20 seconds to reach the test track 15) by modern standards.

Sony CD-P101
Sony were ready for the launch of CD, in early 1983, with a well thought-out remote control player, packed with facilities and beautifully styled. Easy and pleasant to use, the *'101* design stood the test of time (it has only just been replaced by the similar *'102* model) and its styling and ergonomics have been widely imitated by other manufacturers. Early *'101*s sounded a touch hardened and compressed, but changes during production improved sound quality to a level which stood comparison with the Philips players. Accordingly, the *'101* was recommended in the last edition. The final shipment of *'101*s went out to the trade for sale as part of the Sony's *Compact 66* system package.

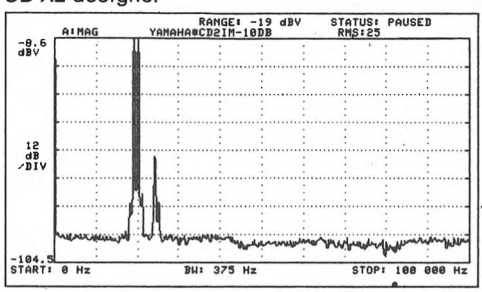
Sony CD-P701es
Largely based on the *CD-P101*, but with many engineering and electronic refinements, these reflected in the high price of around £900, the *'701* was intended as a 'state of the art' CD player to match Sony's prestige Esprit range. Separate D/A convertors are used for the two channels (the *'101* has a single time-shared convertor), while the analogue electronics are of advanced design, with special care taken over grounding, screening and the various power supplies. With superb build quality and excellent lab performance, the *'701* was at one time regarded as the best-sounding player on sale, giving a very precise, almost clinically clear soundstage with excellent focus and fine depth. The sound was highly detailed with particularly good definition in the bass and treble; but compared with the best recent designs, it now seems slightly lacking in the area of midband presentation, the sound here appearing slightly hardened and more 'forward', the overall effect being less relaxing.

Toshiba XR-Z70
Though rather bulky and expensive, Toshiba's original *XR-Z90* player did achieve good sound

quality and offered very rapid track access. The second generation *XR-Z70* matched the sound quality of the earlier model and showed improvements in some areas, such as error correction, but was in fact considered not much above the average standard set by second generation machines from other makers. When compared with the best, some mild loss of stereo depth was noted, with the bass a touch 'softer', treble lightly 'grainy', and the mid showing just a touch of 'hardness' and compression. These were considered minor criticisms, however, and the combination of competent sound quality with a useful array of features won the *XR-Z70* a recommendation in the last edition.

Yamaha CD2

Fully equipped, with numeric keyboard and infrared remote control, the *CD-2* appeared briefly as Yamaha's top-of-the line model, retailing at around £450. It had the Yamaha 2 × oversampling system with digital filtering, using a single time-shared 16 bit convertor. Apart from a small and probably inconsequential treble peak (+ 1.4dB at 19kHz), lab measurements were very good, and the *CD-2* performed well in listening tests. It showed a higher than usual standard of definition throughout the frequency range, with good mid focus and a pleasing degree of stereo depth. Tonally, the mid was neutral and did not sound 'forced'. If still available, the *CD-2* is warmly recommended; but we have been informed that no further stocks are being imported, and the *CD-2* is now effectively supplanted by the *CD-3*, a machine which (confusingly) is more closely related to the *CD-X1* and *CD-X2* designs.



Yamaha CD-2; spuriae to 100kHz (19/20kHz IM test)

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COMPACT DISC PLAYERS BEST BUYS

Here we list the models we have selected as 'Best Buys' and 'Recommended'. Note that this classification is only intended as a guide and may be affected by price fluctuations.

It is apparent that CD has settled down further during its second year of production both as regards the players and the discs, these providing an available and highly reliable music source. Essentially, error problems have been solved, and the quality standard is high — in fact must be considered competitive with analogue disc player alternatives for most users. Further gains in stereo depth and 'sweetness' are apparent with the most recent players, and this continuing process, in conjunction with improving standards of programme production and digital mastering, will provide further rewards.

The general characteristics of the CD medium have been covered fully in the *Technical Introduction*, which also deals with the comparison of CD with conventional analogue reproduction. While the differences between CD players may be regarded as small (relative to those that exist between analogue systems), they were clearly revealed in our tests and are certainly significant.

Compact Disc raises special problems with respect to the choice of 'Best Buy' and 'Recommended' players. A few relatively poor players do exist, which are easy to exclude from these listings, but a broad middle group predominates, which all attain a pretty decent standard. Prices here range from around £295 to £450 depending on the facilities offered such as headphone outputs and remote controls. With due respect for price, the finest of these have achieved Best Buy status.

Above £450, a selection of more costly models can be found, offering a superior performance. **These are beyond any sensible price limit for Best** Buy rating, but are eminently worthy of recommendation, again with an applied value element.

Below £450, there are a number of worthy Recommended examples, which could in fact deserve Best Buy status according to their selling prices at the time of purchase.

BEST BUYS

Offering basic facilities with no remote control we have the following:

Bang & Olufsen CD-X	£300
Sansui PC-V100	£330
Yamaha CDX-2	£330

With remote control and, except the Mission, with headphone socket, we have:

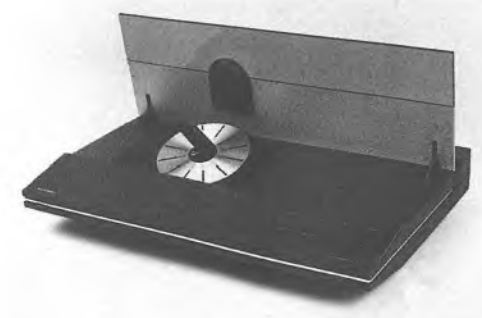
Akai CD-A7	£400
Akai CDM-88	£400
Mission DA 7000R	£450
Yamaha CD-3	£400

RECOMMENDED UP TO £450

Fisher AD840	£325
Marantz CD54	£290
Marantz CD74	£350
Marantz CD84	£400
Meridian MCD	£400
Philips CD104	£290
Sony D50	£285
Sony CDP102	£399
Yamaha CD2	£430

RECOMMENDED ABOVE £450

Sony CD-P302es	£499
Sony CD-P502es	£698
Sony CD-P552/DA-S 702	**approx £1500**



B&O CD-X; good looks but only basic facilities.

Sony 502; good sound, at a very high price!

Sony CD-P552/DA-S702

continued from page 87

transport also proved very resistant to shock, a mark of the fine servo design.

Sound quality

Listening tests were dominated by the *'702*, via its fixed output, although additional tests were made on the *'552* via its fixed and variable outputs as well. In rank order, the *'552*'s variable came last, its fixed output came second, but the *'702* was a handsome first. However, even via its worst output the *'552* led the field in this edition. Moving to the fixed output a 0.5 point improvement in score was heard, while the *'702* defeated our established 1-10 scale by scoring 11! Its performance was so convincing that our expectation as to what was possible from CD had to be revised.

The *'552* showed a fine level of bass precision and extension, and it produced well focused stereo images with fine 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.

Transferring to the *'702*, the improvement was striking, akin to moving from a good transistor to a good valve preamplifier. The tonal balance was rich and natural sounding, with an impression of weight and power. Stereo images were sufficiently solid to provide a near tactile quality, and depth planes were beautifully resolved. The bass was 'quick' and excellently articulate, mid transients were deceptively clear and the treble was both sweet and subtlely detailed. Its full qualities were not appreciated until it was partnered by a top quality amplifier system recommended in the *HFC: Amplifiers* issue, namely an Audio Research *D115 II* and *SP8 II*.

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 outstanding.

Favourably standing comparison with similarly-priced top line analogue turntables, the *CD-P552es/DA-S702es* gains a solid recommendation — price is no constraint here, if the product really delivers the goods, as this one so obviously does. The future of high-quality CD looks considerably more hopeful in the light of this product development.

GENERAL DATA	Sony DAS702es
Channel balance	
At 20Hz	0.07dB
At 1kHz	0.08dB
At 20kHz	0.09dB
Stereo separation	
At 20Hz	– 110dB
At 1kHz	– 104dB
At 20kHz	– 100dB
Channel phase difference	
At 20Hz	– 4°
At 1kHz	0°
At 20kHz	0°
Total harmonic distortion at 0dB	
At 20Hz	– 96dB
At 1kHz	– 98dB
At 20kHz	– 90dB
Total harmonic distortion at – 10dB	
At 1kHz	– 80dB
Total harmonic distortion at – 60dB	
At 1kHz	– 32dB
Total harmonic distortion at – 80dB	
At 1kHz	– 16.2dB
Intermodulation distortion	
At 0dB, 19kHz/20kHz	– 95dB
At – 10dB, 19kHz/20kHz	– 94dB
Frequency response	
Left channel	+ 0.24, – 0.09dB
Right channel	+ 0.24, – 0.09dB
Signal to noise ratio	
No emphasis, 20Hz-20kHz unweighted	– 100dB
No emphasis, CCIR ARM, 1kHz ref	– 92.5dB
Output level, 0dB	
Left channel	1.993V
Right channel	2.010V
Output impedance	104ohms
De-emphasis	fine
Track access time	1.3 secs
Error correction capability	>900μm gap, >800μm dot
Mechanical noise	very low
Spuriae up to 100kHz	– 104dB
Resolution at – 90dB	+ 9dB
Headphone socket	yes (variable level)
Dimensions (w x d x h)	43 x 35.5 x 8cm
Estimated typical purchase price	see text

COMPACT DISC PLAYERS COMPARISON CHART

	Output level and impedance (ohms)		Inter-modulation distortion at full level (dB)	Signal-to-noise ratio, CCIR ARM (dB)	Sampling	Resolution	Error correction	Head-phone outlet	Remote control
Aiwa 1200 *(m)*	2V	922	– 97	– 93	16 bit 2 ×	16 bit	v. good	yes	*(1)*
Akai CD-A7	2V	77	– 89	– 89	16 bit lin	15 bit	v. good	yes	yes
Akai CD-M88 *(m)*	2V	100	– 89.5	– 92	16 bit lin	15½ bit	v. good	yes	yes
Bang & Olufsen CD-X	2.1V	50	– 89	– 109	14 bit 4 ×	15½ bit	v. good	no	no
Ferguson CD01 *(m)*	2V	440	– 80	– 91	16 bit lin	15¾ bit	average –	no	no
Fisher AD840	2.25V	992	– 96	– 93.5	16 bit 2 ×	15¾ bit	v. good	no	no
Hitachi DA800*	2.45V	120	– 86	– 92	16 bit lin	15¼ bit	v. good	yes	no
Hitachi DA4000	2.42V	101	– 68	– 92.5	16 bit lin	15¼ bit	average –	no	no
JVC XL-V300	2V	999	– 67	– 94	16 bit 2 ×	16 bit	v. good	no	no
JVC XL-V2*(m)*	2.4V	430	– 95	– 101	14 bit 4 ×	15¼ bit	v. good	yes	no
Marantz CD54 *(m)*	2V	49	– 92	– 108.5	14 bit 4 ×	15¾ bit	v. good	no	no
Marantz CD74	1.9V	450	– 90.5	– 106	14 bit 4 ×	15½ bit	v. good	yes	*(1)*
Marantz CD84	1.9V	450	– 90.5	– 106	14 bit 4 ×	15½ bit	v. good	yes	yes
Meridian MCD *(m)*	2V	12.5	– 85	– 109	14 bit 4 ×	15¾ bit	v. good	no	no
Mission DAD7000R *(m)*	2V	308	– 87	– 104	14 bit 4 ×	15½ bit	v. good	no	yes
Mitsubishi DP105	2V	985	– 98	– 90	16 bit lin	15¼ bit	poor	yes	no
Philips CD101 *(m) (2)**	2V	40	– 85	– 105	14 bit 4 ×	15½ bit	v. good	no	no
Philips CD104 *(m)*	2V	33	– 89	– 105	14 bit 4 ×	15½ bit	v. good	no	no
Philips CD204	2V	600	– 88	– 105	14 bit 4 ×	15½ bit	v. good	yes	no
Philips CD304	2V	600	– 88	– 105	14 bit 4 ×	15½ bit	v. good	yes	yes
Pioneer PD-70	2.05V	200	– 85	– 92	16 bit lin	15¼ bit	v. good	yes	no
Pioneer PD-X700 *(m)*	2.05V	333	– 79	– 90	16 bit lin	15¾ bit	good	no	no
Revox B225	2V	350	– 100	– 100	14 bit 4 ×	15 bit	excellent	yes	yes
Sansui PC-V100 *(m)*	1.9V	1K	– 103	– 90.5	16 bit 4 ×	15½ bit	good	no	no
Sony CD-P30 *(3)*	2.1V	1K	– 81	– 88.5	16 bit lin	15½ bit	average +	no	no
Sony D-50 portable	1.9V	220	– 91	– 86	16 bit lin	15½ bit	good +	yes	no(!)
Sony CD-P102 *(m)*	1.95V	431	– 100	– 92.5	16 bit 2 ×	15½ bit	v. good	no	yes
Sony CD-P302ES	2V	428	– 100	– 93	16 bit 2 ×	15¾ bit	v. good	yes	yes
Sony CD-P502ES	2V	429	– 104	– 93	16 bit 2 ×	15 bit	excellent	yes	yes
Sony CD-P552	2V	330	– 100	– 94	16 bit 2 ×	15½ bit	excellent	yes	yes
Sony DA-S702 *(4)*	2V	104	– 95	– 92.5	16 bit 2 ×	15 bit	excellent	yes	*(4)*
Technics SL-P1	2V	607	– 95	– 92	16 bit lin	15¼ bit	v. good	no	no
Technics SL-P2	2.2V	590	– 102	– 92	16 bit lin	15¼ bit	v. good	yes	yes
Technics SL-P3	2.04V	600	– 90	– 91	16 bit lin	15¼ bit	v. good	yes	yes
Toshiba XR-Z50	1.9V	785	– 90	– 88	16 bit lin	15½ bit	good +	yes	no
Toshiba XR-Z60K	1.9V	785	– 90	– 88	16 bit lin	15½ bit	good +	yes	no
Yamaha CD-X2 *(m)*	1.9V	1K	– 105	– 90	16 bit 2 ×	15¼ bit	good	yes	no
Yamaha CD-2	2.1V	900	– 95	– 93.5	16 bit 2 ×	15½ bit	good +	no	yes
Yamaha CD-3	1.93V	1K	– 104	– 92	16 bit 2 ×	15½ bit	average +	yes	yes

Notes:
(m) = 'midi-sized' player, less than 35cm wide
**** = fully reviewed in issue No 35; see summary reviews***
(1) = remote control when used as part of same manufacturer's system
(2) = Marantz CD63B is identical
(3) = CD-P50 is similar, see review
(4) = digital processor only, tested using 552es as disc transport

COMPACT DISC PLAYERS COMPARISON CHART

Stereo qualities		*Midband tonal balance*	*Musical detail*	*Bass precision*	*Treble quality*	*General sound quality*	*Typical price/ rating*		
stereo depth and ambience quality	*stereo focus and precision*								
average	average	sl. forward	good	average –	average	average	£380		**Aiwa 1200**
good +	v. good	good	v. good	average +	sl. bright	good +	£400	B	**Akai CD-A7**
v. good	v. good	good	v. good	average +	sl. bright	v. good	£430	B	**Akai CD-M88**
average +	good	good	good	good	good	good	£350	R	**Bang & Olufsen CD-X**
average –	average +	sl.forward	good	average	average –	average –	£300		**Ferguson CD01**
good	good	good	good	sl. soft	sl. grain	good	£325	R	**Fisher AD840**
average	average +	sl. hard	good	average	sl. bright	average	£450 *(5)*		**Hitachi DA800***
average –	average	forward	average	average –	brash	average –	£450		**Hitachi DA4000**
average –	average –	hard	average	average –	sibilant	average –	£440		**JVC XL-V300**
average	good	sl.forward	good	good	sl. bright	average	£550		**JVC XL-V2**
good	good	sl. thin	good	average +	good	good	£290	B	**Marantz CD54**
good +	v. good	good	v. good	good	sl. brash	good +	£350	R	**Marantz CD74**
good +	v. good	good	v. good	good	sl. brash	good +	£400	R	**Marantz CD84**
good +	v. good	v. good	good +	v. good	-average +	v. good	£400	R	**Meridian MCD**
v. good	v. good	sl. thin	v. good	v. good	v. good	v. good +	£450	R	**Mission DAD7000R**
average –	average	sl. forced	average	average	average	average	£330		**Mitsubishi DP105**
average +	good	sl. thin	good	good	average +	average +	£250*(5)*	R	**Philips CD101***
good	good	sl.forward	good	good	good	good	£300	R	**Philips CD104**
good	good	sl.forward	good	good	good	good	£350		**Philips CD204**
good	good	sl. glare	good	good	good	good	£400		Philips CD304
average +	average	good	average +	good	average +	average +	£400		**Pioneer PD-70**
average	average	good	average +	good	average +	average	£300		**Pioneer PD-X700**
good	average +	good	average	average +	good	average +	£780		**Revox B225**
good +	good	good	good	good	good	good +	£300	B	**Sansui PC-V100**
average	average +	sl.forward	good	average +	average	average	£300*(6)*		**Sony CD-P30**
average	average +	good	average +	average	average	average	£285		**Sony D-50**
good +	v. good	good	good +	average +	good	good +	£400	R	**Sony CD-P102**
v. good	v. good	good +	good +	good	good	v. good	£500	R	**Sony CD-P302ES**
v. good +	v. good +	v. good	v. good	good +	good +	v. good +	£700	R	**Sony CD-P502ES**
v. good +	v. good +	v. good	v. good	v. good	v. good	v. good +	*(7)*	R	**Sony CD-P552**
excellent	excellent	v. good	excellent	v. good +	excellent	excellent	*(7)*	R	**Sony DA-5702**
average –	average +	forward	average	average	average	average –	£350		**Technics SL-P1**
average +	good	sl. hard	good	average +	average –	average	£400		**Technics SL-P2**
average +	good	sl. hard	good	average +	average –	average	£450		**Technics SL-P3**
average +	good	sl. hard	average +	average	sl. glassy	average	£350		**XR-Z50**
average +	good	sl. hard	average +	average	sl. glassy	average	£350		**Toshiba XR-Z60K**
v. good	v. good	v. good	good +	good +	good	good +	£330	B	**Yamaha CD-X2**
v. good	v. good	v. good	good +	good +	average +	good +	£390	R	**Yamaha CD-2**
v. good	v. good	v. good	good +	good +	good	v. good	£400	B	**Yamaha CD-3**

Notes:
(5) = model discontinued but stocks still available
(6) = effectively £250 if purchased as part of a system from the same manufacturer
(7) = CD-P552es, DA-S702 not available separately in UK. Price of combination estimated at £1500-£2000, expected to be available Autumn 1985
Ratings (B = 'Best Buy', R = Recommended) are based on the prices quoted and only apply while these prices are in force.

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TURNTABLES AND TONEARMS INTRODUCTION

From the most esoteric separate components down to a selection of quite basic integrated players, this edition gives the fullest possible coverage of current turntables and tonearms.

Very often the immediate question about choosing a turntable is whether to go for an integrated player — a turntable supplied complete with arm, and often with a cartridge ready fitted as well — or to buy the turntable (or motor unit) and tonearm separately. The turntable, arm and cartridge have to work together of course, so in theory it would seem that an integrated player, where a single manufacturer has designed all the parts, might be the best bet. In practice, many integrated players have been designed more with styling, features and 'perceived value' in mind than sound quality.

On the other hand, the 'specialist' manufacturers almost invariably produce separate motor units which attempt to offer optimium sound quality when partnered with a suitable arm. Many of these manufacturers now offer their turntables 'factory fitted' with arm, making them as easy to set up and use as integrated players.

It has often been assumed, quite wrongly, that provided the turntable goes round at the right speed and doesn't produce extraneous noises, it will have no influence of its own on the sound of a disc-playing system. The construction and design of the turntable are crucial to good sound. While the arm and cartridge appear to be most directly responsible for tracing the tiny undulations of the groove, the turntable is inescapably part of the same mechanical system, and must also isolate cartridge and disc from outside disturbance such as acoustic feedback. This is dealt with fully in the *Technical Introduction*.

These factors explain why lightweight plastic plinths, light platters and flimsy plastic arms generally produce poor sound, and consequently the turntables supplied with rack or midi-systems are typically poor in sound quality. It inevitably costs more to produce a solidly-built turntable, and so sound quality can be expected to improve directly with price, provided the extra money is not simply paying for more gimmicky automatic facilities, 'linear tracking' and so forth. On decks with conventional pivoted arms, it is still generally true that the inclusion of automatic facilities tends to compromise performance, due to interference with the free movement of the arm by the auto trip mechanism.

With some 'direct drive' manufacturers now reverting to belt systems, the controversy over which drive method is best has fizzled out, as it seems to be generally accepted that the apparently crude expedient of belt drive is the best available compromise. Virtually all the respected 'high end' turntables are belt-drive designs using a suspended subchassis, an idea originally introduced some decades ago by Acoustic Research and subsequently popularised by Thorens. The benefits of this system seem well proven although the detail design may be the subject of fierce controversy.

At the lower end of the price spectrum, specialist manufacturers fall into two camps. Some, primarily inspired by Rega, use a non-suspended design but hope to get good sound by 'fine tuning' the design in terms of materials, isolating feet, arm termination and so on; others, notably Ariston, Systemdek and Walker, have found ways of retaining the subchassis even in a low-cost product.

Arm manufacturers again adopt different solutions in detail design, but tend to agree on the basic requirements of rigidity and mechanical integrity. Here some relatively inexpensive models now beat the 'super arms' of a couple of years ago, and a gradual settling towards arms of medium mass and cartridges of medium compliance has made cartridge compatibility problems the exception rather than the rule. If available factory-fitted or set up by a good dealer, the choice of separate tonearm should present no problems to even the least technically-minded buyer.

The continuing development of the analogue turntable now seems very firmly in the hands of the specialist manufacturers, and indeed some of the major Japanese companies now make absolutely no attempt to improve or maintain turntable sound quality, and supply only very poor-sounding record players to complete their rack or midi stack systems. This is a very great pity as it means that many purchasers of such systems are doomed to disappointment, and the musically unsatisfying results will probably lead them to believe that analogue discs are not worth bothering with. We would earnestly beseech those who have been disillusioned in this way to audition some better (not necessarily very expensive) equipment, when they will probably be surprised at just how good black vinyl discs can sound, and perhaps rediscover their record collection. Whatever other recorded media may offer, a good conventional record playing system can still offer an unlimited amount of enduring musical pleasure.

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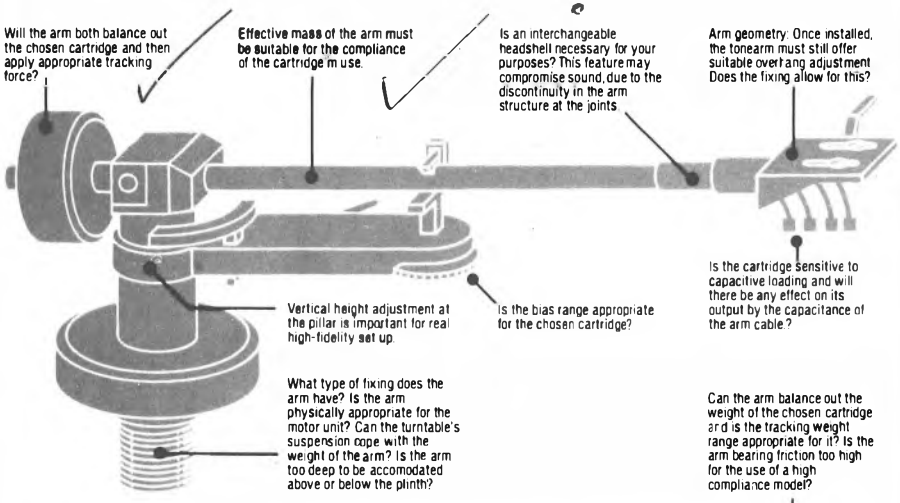
TURNTABLE & TONEARM BUYER'S CHECKLIST



Will the arm both balance out the chosen cartridge and then apply appropriate tracking force?

Effective mass of the arm must be suitable for the compliance of the cartridge in use.

Is an interchangeable headshell necessary for your purposes? This feature may compromise sound, due to the discontinuity in the arm structure at the joints.

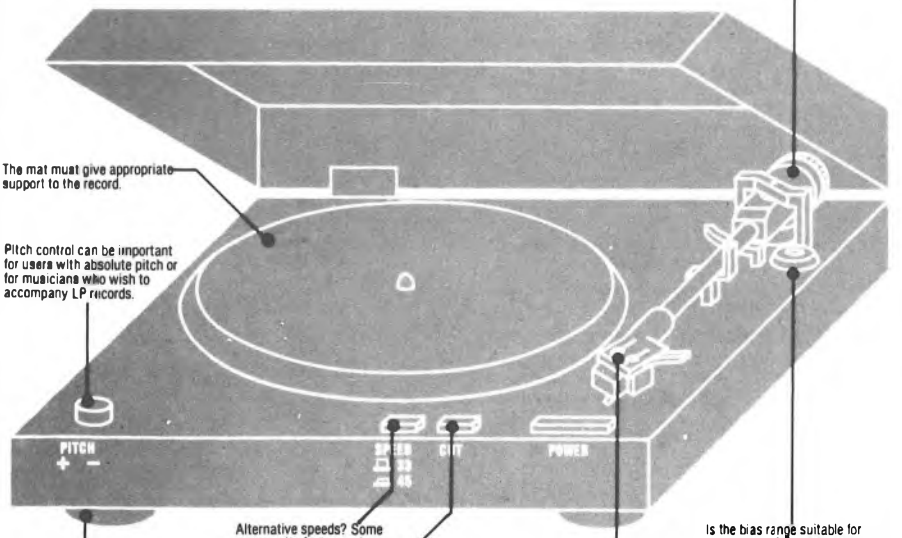
Arm geometry: Once installed, the tonearm must still offer suitable overhang adjustment. Does the fixing allow for this?

Is the cartridge sensitive to capacitive loading and will there be any effect on its output by the capacitance of the arm cable?

Vertical height adjustment at the pillar is important for real high-fidelity set up.

Is the bias range appropriate for the chosen cartridge?

What type of fixing does the arm have? Is the arm physically appropriate for the motor unit? Can the turntable's suspension cope with the weight of the arm? Is the arm too deep to be accomodated above or below the plinth?



Can the arm balance out the weight of the chosen cartridge and is the tracking weight range appropriate for it? Is the arm bearing friction too high for the use of a high compliance model?

The mat must give appropriate support to the record.

Pitch control can be important for users with absolute pitch or for musicians who wish to accompany LP records.

Alternative speeds? Some motor units feature only 33⅓rpm.

Suspension should be adequate for the environment in which the turntable will be used. A model which relies on sprung feet will not be suited for use on a sideboard, for instance. Correct mounting and location for feedback free results is essential.

Semi automatic decks may just lift off at the end of side or may return the arm to its rest. Fully automatic turntables will play without any manual cueing.

The cartridge for an integrated player must be mechanically compatible. Its weight and compliance must be matched to the tonearm's effective mass to produce a mechanically stable combination. If there is no height adjustment in the integrated arm, is the cartridge body too deep or too shallow without packing for correct vertical tracking?

Is the bias range suitable for the cartridge? The bias dial sets a small force to counteract the arm's tendency to pull inwards when the stylus is placed on a moving record (this is due to arm geometry and does not occur with radial tracking). Bias is necessary to centralise the moving parts of the cartridge — if bias is inappropriately set, the effects will be heard as vague stereo imaging and poor tracking.

Acoustic Research EB101

Acoustic Research Ltd, High Street, Houghton Regis, Bedfordshire LU5 5QJ
Tel (0582) 603151

Following the successful relaunch of the classic AR turntable design, Acoustic Research UK have developed this further model. The *EB-101* has a vinyl 'black ash' finish and, inside, a steel girder subchassis substituting for the aluminium original. A new arm has also been commissioned from Japan, and this is factory fitted to provide a complete integrated player. For the review, a modest cartridge was also included, the whole expected to sell for around £170. This offers a considerable saving over the original model, equivalent to throwing in the arm and cartridge free.

This deck has rather a dark appearance, and comes with a low resonance tinted pvc cover on sprung hinges. The two piece alloy platter has been retained while on the bearing, as well as in other areas, tolerances have been improved. The arm is a robust example, with a firmly clamped headshell using a locking sleeve. Its bearings proved free from play, an important aspect.

Fully suspended, the chassis moved very freely and promised good acoustic and vibration isolation.

Lab report

The total platter mass was close to 2kg, healthy for the price category, with the two part construction offering good damping. Tested for disc impulse, the initial transient was quick with a fast decay and no low frequency hangover.

Speed change is manual, on lifting the outer platter. At 33⅓ the deck ran nearly 0.5% fast, which was satisfactory, and slowing under load held to a fine 0.25%. Long term drift was negligible with the synchronous motor employed. DIN peak weighted, the overall wow and flutter was fine at 0.09% with similarly low individual contributions from the wow and flutter components. Start up was fairly rapid at 3.5 seconds, and the player clearly had a healthy torque.

DIN B rumble measured very well, at −77dB. Little breakthrough was evident since the electrical and mechanical spectra matched well; just a hint of motor vibration was evident at 200Hz.

The high quality suspension was demonstrated by the excellent breakthrough responses for both acoustic and vibration excitation; here the unit was clearly up with the best modern examples.

Turning to the arm, here the robust headshell was nominally detachable but did not come with a plug and socket. Rotational adjustment is allowed, as well as overhang and lateral tracking angle. Effective mass was in the medium to high range at 13.5g including hardware, this suited to fairly low compliance cartridges.

Charted for arm resonances with the supplied Shure moving magnet cartridge the first break appeared around 700Hz, with the overall behaviour looking quite tidy, particularly at higher frequencies. Bearing friction was quite low, at 40mg lateral and 20mg vertical, while sensible bias levels were also established. Downforce calibration was accurate while the arm cue device operated well.

Sound quality

There was no doubt concerning the high subjective merit of this player. The sound was notably well focused, with good stereo stage width and depth. Transients were reproduced with good speed and attack, while the overall effect was lively, with well differentiated dynamics. The bass was quite good, articulate as well as extended, with considerable detail apparent. Overall the tonal balance seemed well proportioned while the supplied cartridge was quite tidy itself and did not let the deck down; a sort of 'AR *Basik*', I suppose!

Conclusion

This new turntable offers a remarkable package. A genuine high fidelity product, it had no significant subjective or lab tested weaknesses. Its rigid arm, good platter and drive, with a fine, effective subchassis, are comple-

mented by a workable cartridge, which will happily benefit from upgrading at some future date, if so desired. Pricing is also very competitive, and a Best Buy rating is the logical outcome.

GENERAL DATA Integrated player

Motor section

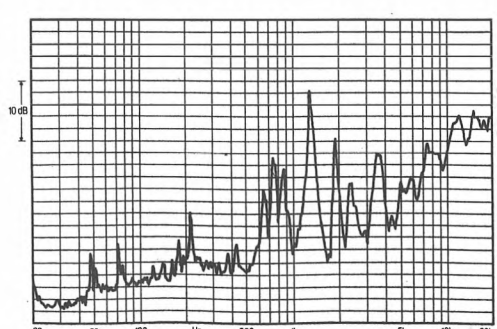
Type.....belt-drive, subchassis
Platter mass/damping.....2.0kg/good
Finish and engineering.....very good, very good
Type of mains lead/connecting lead...3 core, phonos plus earth
Speed options.....manual change, 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.4%
Wow and flutter (Iin peak wtd 0.2-6Hz/6-300Hz).....0.1%/0.07%
Absolute speed error..... +0.45%
Speed drift, 1 hour/load variation.....negligible/ – 0.25%
Start-up time to audible stabilisation.....3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 77dB

Arm section

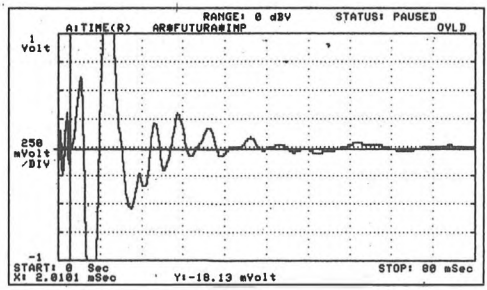
Approximate effective mass, inc screws, excl cartridge....13.5g
Type/mass of headshell.....special/9.8g
Geometric accuracy.....very good
Adjustments provided.....tilt/overhang/offset
Finish and engineering.....very good, very good
Ease of assembly/setting-up/use.....very good/very good
Friction, typical lateral/vertical.....40mg/20mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....225mg/275mg
Downforce calibration error, 1g/2g..... – 0.05g/ – 0.1g
Cue drift, 8mm ascent/descent.....negligible, 1.0secs/2.5secs
Arm resonances.....fairly good
Subjective sound quality.....see system result
Arm damping.....decoupled counterweight

System as a whole

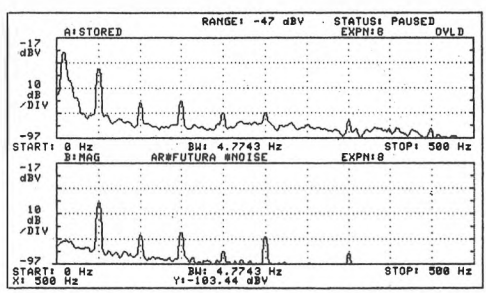
Size (w x d x h)/clearance for lid rear.....44 x 38.5 x 16cm/7cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....very good
Subjective sound quality of complete system.....very good
Hum level/acoustic feedback.....low/very good
Vibration sensitivity/shock resistance.....excellent/fairly good
Estimated typical purchase price.....£170 inc cartridge



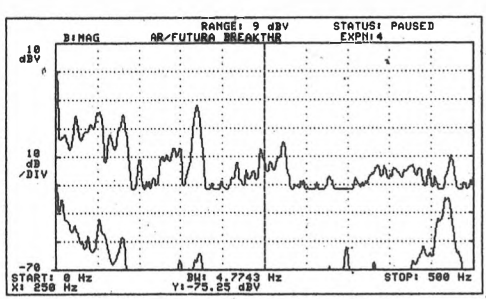
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Akai AP-X1

Akai (UK) Ltd, Unit 12, Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388

This modestly priced player is available as a separate component, but will generally complete an Akai rack or stack system. Of lightweight plastic construction, it is fully integrated with its tonearm, which has a T4P style mounting, and an Akai *PC35* cartridge, a moving magnet type built by Audio Technica.

Belt driven, the platter is rather a thin alloy casting weighing just 0.6kg, with mat. Belt loading is accomplished via large access holes in the platter, and the mat sags a little over these apertures. Semi-automatic, the arm returns at the end of side. The player is quite compact and is enhanced by the design of the lid, which does not require any additional rear clearance when hinged up.

Lab report

The disc impulse trace said much about the mechanical integrity of the platter, and chassis. These were clearly rather weak with little damping, and the prolonged low frequency energy was considerable.

Wow and flutter was low at 0.08%, DIN weighted. Wow dominated this reading, at 0.13% unweighted. Absolute speed error was low, within 0.15%, though drift of up to 0.35% was observed over the first hour. Slowing under load was moderate, at 0.25%. Start up was very rapid at 1.3 seconds, virtually as the arm was moved into the play position.

Rumble was disappointing and on quiet musical passages an audible 'drone' could be **heard from the motor. The DIN B weighted** reading was −64dB, not low enough to ensure inaudibility, while the rumble spectogram showed the presence of a range of motor related rumble components over a wide span.

Low overall mass and damping meant that the acoustic isolation was weak, with the graph showing a result 10-20dB poorer than that for an optimum design. Vibration was also poorly isolated at both low and high frequency extremes.

With a low effective mass of around 8g, the integral arm was charted for resonances, using the fixed, supplied cartridge. Above 2kHz the behaviour was very good, but the 300Hz to 1.5kHz range contained some fairly severe resonance modes, with the first headshell bending mode occurring at 300Hz which is rather a low figure.

Arm friction was moderate in both planes, while downforce was fixed at a low 1.4g, with bias also set at a fixed value. Cue operation was rapid and free from drift.

Sound quality

Auditioned with the attached cartridge, the sound quality was rated below average, but not disastrously so in view of the modest pricing. Overall the tonal balance was nicely judged, with cleaner treble than usual, while the stereo presentation was also promising, with quite good stage width, fair focus and modest depth. The bass was found below average but not too

uneven. Mild mid coloration was also evident and programme dynamics were compressed.

Conclusion

A tidy well finished player, the *AP-X1* offered a well balanced sound offering reliable installation and operation. Care should be taken with siting since its feedback and isolation properties were none too good. It misses recommendation despite its modest price, but is worth considering for budget systems.

GENERAL DATA Integrated player with cartridge

Motor section

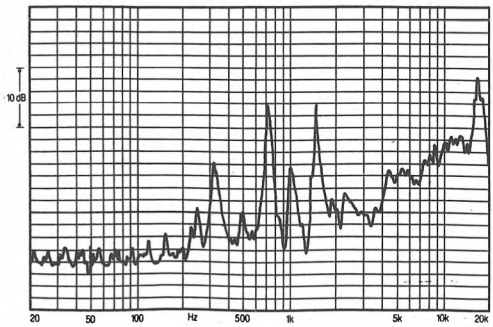
Type.....electronic belt drive auto return
Platter mass/damping.....0.59kg/fair
Finish and engineering.....very good, fairly good
Type of mains connecting lead.....2 core/phonos plus earth
Speed options.....33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.13%/0.1%
Absolute speed error..... – 0.15%
Speed drift, 1 hour/load variation.....0.35%/ – 0.25%
Start-up time to audible stabilisation.....1.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 64dB

Arm section

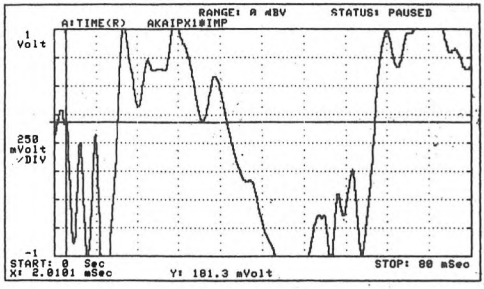
Approximate effective mass, inc screws, excl cartridge.....8g
Type/mass of headshell.....fixed, T4P
Geometric accuracy.....good
Adjustments provided.....none
Finish and engineering.....good, fairly good
Ease of assembly/setting-up/use..excellent/excellent/excellent
Friction, typical lateral/vertical.....<50mg/<50mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....not measured
Downforce calibration error, 1g/2g.....fixed at 1.4g
Cue drift, 8mm ascent/descent.....negligible, 0.5secs/1.0secs
Arm resonances.....see graph
Subjective sound quality.....see system result
Arm damping.....N/A

System as a whole

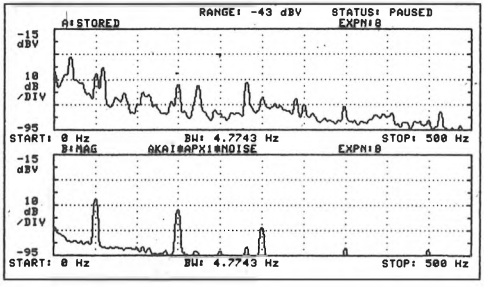
Size (w × d × h)/clearance for lid rear.....43 × 34.5 × 10.5cm/none
Ease of use.....very good
Typical acoustic breakthrough and resonances.....poor
Subjective sound quality of complete system.....average
Hum level/acoustic feedback.....fairly good/poor
Vibration sensitivity/shock resistance.....average/average
Estimated typical purchase price.....£60



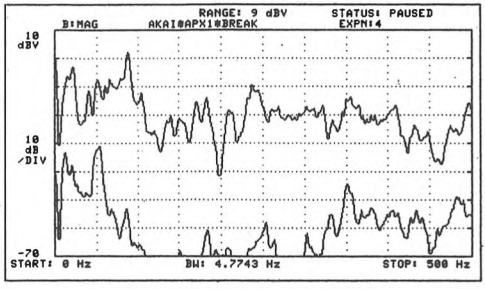
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



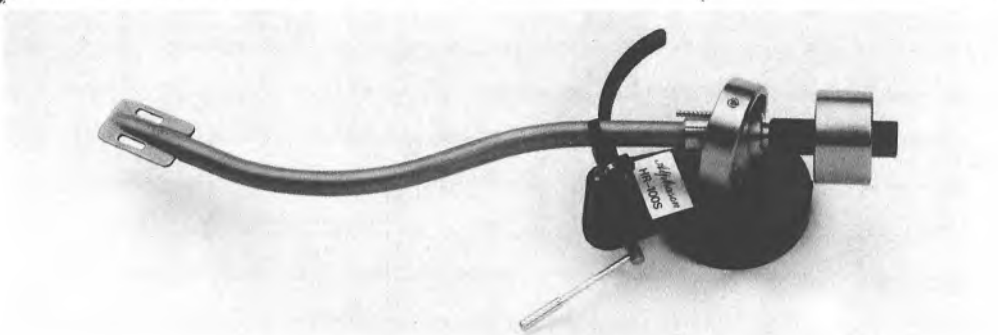
Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

RECOMMENDED

Alphason HR100S

Alphason, 31 Shawbrook Close, Euxton, near Chorley, Lancs PR7 6JY
Tel (02572) 76626



Since I was first asked to report privately on an early prototype of this UK-designed arm three years ago, production models have undergone significant further development.

A medium mass arm possessing high rigidity, the Alphason's main feature is the use of a substantial titanium beam tube with classic 'S' shape geometry. This has allowed a straight join to the headshell, itself ingeniously formed from the front end of the tube; a transition accomplished with minimal impairment to good interfacing of cartridge and arm. A considerable proportion of the beam upper surface continues down to the 'shell' or cartridge mounting platform.

The concentric gimbal bearings are built of hardened tool steel for maximum strength and the pivots are pre-loaded high precision ball races. During the course of the review the bearing surfaces were updated using ultra-hard carbide inserts — pre-loading could then be dispensed with, offering much higher rigidity with reduced friction levels.

Considerable care has been taken to maximise rigidity as well as to minimise resonances in the design by suitable choice of materials and structure, the resulting performance reflecting the mechanical engineering expertise of the designer. Appearance and finish are undoubtedly to a good standard, but nonetheless this arm exhibits a 'craftsman' approach rather than the superlative feel and finish of the Japanese manufactured designs, for example.

At present the arm is supplied with a pillar base specified as Linn *Ittok/Basik* compatible, but we did not find this to actually be the case. 6mm rather than the required 4mm bolts are used, and the tracking geometry is optimised for a 58mm radius zero tracking-error point, **rather than the accepted 64-65mm. The arm is** also slightly longer than the *Ittok* by about 2mm. However we understand that these discrepancies will soon be overcome in production to make the arm fully compatible. The long slotted headplate of the Alphason of course allows any desired overhang/offset angle to be obtained, and in this sense the geometry is already compatible.

The Alphason's fixed arm leads are reasonably compliant, aiding subchassis cable dressing, and are fitted with gold-plated plugs of good quality. Cable capacitance was low at 95pF. It is likley that two counterweights will be provided, these sliding on a hard nylon insert with a locking socket-head screw, while the weight carrier is stiffly engaged on a threaded section allowing fine adjustment of downforce — 0.4g per revolution for the heavier weight, which is suited to the Koetsu.

Lab report

Effective mass was in the low to medium range at 10g inclusive of steel fixing bolts, and the structure was highly 'dead' as well as most rigid, with zero bearing play. The geometry (optimised) was excellent with very good finish and fine engineering. With the larger bias weight on the centre notch the compensation was fine for a 2g downforce as well as being in the right ratio, while friction was very low particularly on the 'carbide' version now standard. The cue worked well though the arm lock was rather stiff — I would prefer a separate pillar rest. Resonance graphs were plotted for the first sample which has steel bearings and a small counterweight, and also for the second sample with 'carbide' bearings and larger stiffened counterweight assembly. The latter showed improved rigidity, noticeable

in the 'sharper' nature of the resonances but in both cases behaviour was very good, indicative of a very low-coloration design. Below the 'carbide' graph, the excitation on the Linn arm board is shown as a dotted line, demonstrating the substantial pillar coupling and clear interactive relationship between arm and mounting.

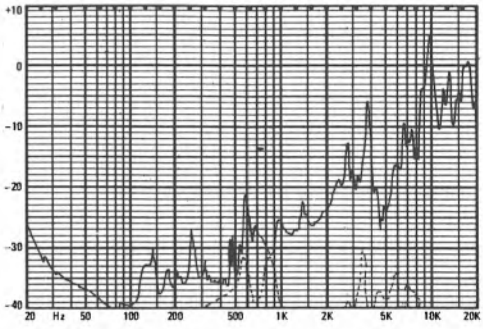
Sound quality

The *HR100* impressed us strongly by its neutral and tonally balanced performance. Treble was detailed and precisely located and yet free of 'edge' or 'grain'. The mid-range gave excellent rendition of vocal lines while bass was firm, extended and detailed. Stereo was exceptional with precise positioning and fine depth and ambience, and despite an apparent 'smoothness', transients were nevertheless reproduced with fine 'attack'.

Conclusion

The current *HR100S* shows improvements in respect of finish and tube damping, and in addition a version is available wired throughout with LC cable. Re-auditioned, the standard arm showed improvements in high frequency control, while the LC version gave worthwhile gains in clarity and definition throughout the range. Both versions can be recommended.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	10g
Type/mass of headshell	non-detachable
Geometric accuracy	N/A
Adjustments provided	overhang/offset/height
Finish and engineering	good/excellent
Ease of assembly/setting-up/use	very good/good/good
Friction, typical lateral/vertical	10mg/20mg
Bias compensation method	thread, pulley and weight
Bias force, rim/centre (set to 1.5g elliptical)	180mg/150mg
Downforce calibration error, 1g/2g	– 0.1g/ – 0.1g
Cue drift, 8mm ascent/descent	negligible, 0.5 sec/1.0 sec
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	95pF/none
Estimated typical purchase price	£335



Structural arm resonances, audio band

Ariston RD20

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD
Tel (0292) 76933

Since the withdrawal, several years ago, of Garrard and BSR from the budget turntable market, Dual have dominated the field with their *505*. However, Ariston have now laid down a new challenge in the shape of their *RD20*, priced at just under £100. A compact integrated player, it includes a matched cartridge, either a Goldring *Astron* or an Ortofon *OM10*.

The plinth and chassis work is constructed from rather flimsy plastic moulding and is not impressive. In Dual style, the chassis is suspended on four coil springs which are foam damped. This frail chassis contrasts with the surprisingly massive, machined alloy platter which weighs in at 1.37kg, complete with the Ariston concave centre clamp system. The arm is of promising construction with a rigid form and fixed headshell, and although no bias is provided, there is some internal means of applying some fixed bias, judging by the measurements.

The platter is belt driven, powered by a small dc servo motor, while the speed switching is by a convenient lever near the front. To fit within the small overall dimensions, the tonearm has been made shorter than usual, measuring 185mm as opposed to the usual 225mm, and as a result, tracking error is greater than usual.

Lab report

The substantial platter and clamp mat combination provided quite good damping of the disc impulse, but the graph showed a massive low frequency platter rocking mode due to the flimsy mounting of the main bearing in the chassis. Significant slack was also noted in this area.

Wow and flutter was satisfactory at 0.14% DIN peak weighted, with a fair balance of the separate wow and flutter components. Speed accuracy was good, within 0.1% on start-up, but this was invalidated by the significant speed drift, rising by 0.5% maximum in the first hour. Slowing under load was fine at around 0.1%, with the start-up time average at 3 seconds, and good control was shown on speed overshoot.

DIN B-weighted rumble was very satisfactory, at −71dB, in theory low enough to be inaudbile. From the rumble spectrogram analysis it could be seen that some motor vibration harmonics do break through.

Vibration isolation was fairly good, though with some loss at near 50Hz and with further breakthrough at 400Hz. The acoustic isolation was uneven, especially at low frequencies, but improved in the midband, 250-400Hz. Shock resistance was just average, while feedback could be induced if placed too near the loudspeakers at high gain settings.

Effective mass of the arm was in the region of 9g, while the headshell was fixed. On geometric accuracy it was only fair, and due to the high level of bias the friction levels quoted are only an estimate, at typically 50mg, and reasonable for the price. At the rim, the bias level was appropriate for a modest 2g downforce cartridge, but rose to 700mg at the centre, rather too much for optimum tracking. Given the short arm length, 375mg would have been appropriate. Downforce calibration error was low but the cue drift was serious, mainly due to the excessive bias. Cue descent and ascent were also satisfactory. Tested with an Ortofon *OM10* cartridge, the main resonance mode was fairly high in frequency at 500Hz, while the high frequency control was also better than average.

Sound quality

The sound quality was not rated well. Tonally it sounded uneven with a 'loud', muddled character apparent at times. The treble register was untidy, the bass lumpy and lacking definition or extension. A kind of hollow coloration was heard in the midrange, with the light upper chassis the main suspect here. Musical dynamics were supressed and the result lacked interest.

Conclusion

While some good aspects were incorporated into this budget deck, the design was

sufficiently unbalanced to make the resulting sound quality rather below average, and as such, no recommendation is possible.

(Note: As we went to press, the distributors informed us that they had been dissatisfied with the RD20 *and had recommended several modifications to improve the sound. Only time will tell how successful these are.)*

GENERAL DATA Integrated player

Motor section

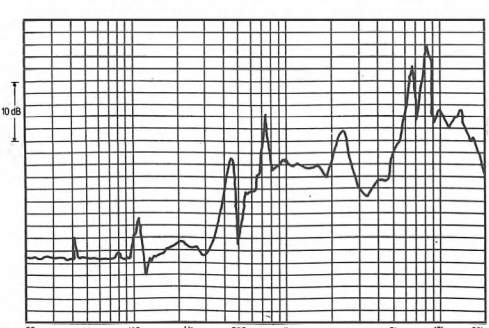
Type.....electronic belt-drive auto-return
Platter mass/damping.....1.37kg/good
Finish and engineering.....fairly good, fairly good
Type of mains connecting lead.....2 core, phonos plus earth
Speed options.....33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.14%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)...0.13%/0.12%
Absolute speed error.....+0.1%
Speed drift, 1 hour/load variation.....approx 0.5%/–0.1%
Start-up time to audible stabilisation.....3.0 secs
Rumble, DIN B wtd, L/R average (see spectrum).....–71dB

Arm section

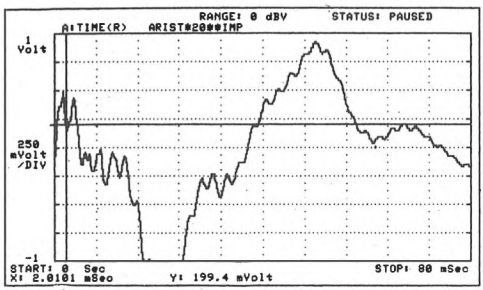
Approximate effective mass, inc screws, excl cartridge.....9g
Type/mass of headshell.....fixed
Geometric accuracy.....fair
Adjustments provided.....overhang/offset
Finish and engineering.....fairly good
Ease of assembly/setting-up/use.....good/good/fairly good
Friction, typical lateral/vertical.....approx 50mg/30mg
Bias compensation method.....internal, fixed
Bias force, rim/centre (set to 1.5g elliptical).....330mg/700mg
Downforce calibration error, 1g/2g.....–0.03g/0.04g
Cue drift, 8mm ascent/descent.....serious, 1.2secs/0.7secs
Arm resonances.....fairly good
Subjective sound quality.....see system result
Arm damping.....decoupled counterweight

System as a whole

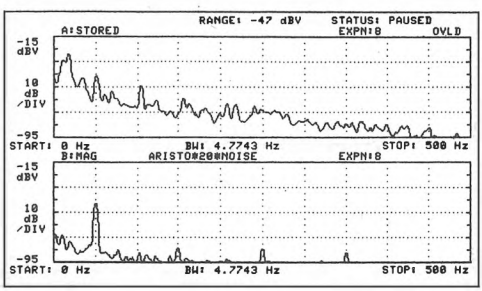
Size (w x d x h)/clearance for lid rear.....42 x 34 x 13cm/6.5cm
Ease of use.....fairly good
Typical acoustic breakthrough and resonances.....average +
Subjective sound quality of complete system....disappointing
Hum level/acoustic feedback.....good/average
Vibration sensitivity/shock resistance.....average + /average
Estimated typical purchase price.....£100



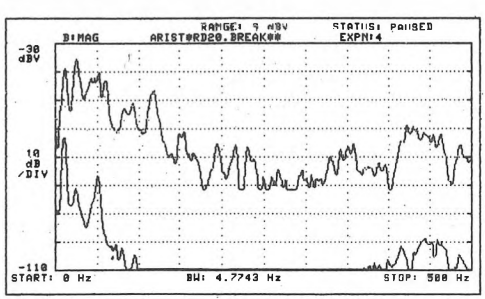
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is –80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Ariston RD40AC and RD40E

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD
Tel (0292) 76933

Conceived as a complete range of turntables available with and without Ariston tonearms, the *RD40* series starts with the basic *RD40AC*, a two speed ac synchronous motor powered deck. Speed changeover is by hand, via access holes in the platter.

The design is founded on a circular subchassis in a cast aluminium alloy, this suspended from three sprung towers at the periphery. These are fixed to the baseplate, which itself follows the form of the open, skeletal style subchassis. The arm is mounted on an accessible outrigger platform, while a skeletal perspex awning may be fitted to the rear to help keep the dust off; this is the 'pop on' cover.

Drive is via a square section belt from the inboard mounted motor. In the case of the electronic *'E* version, a dc motor is substituted, this provided with front panel speed change and independent variable controls. An outboard power supply is also used with an extended low voltage cable allowing its convenient remote location. These models all have a striking 'engineered' look reminiscent of the large Oracle, and currently Ariston's finish is very good.

Two platter mass options are available, while all versions are equipped with a concave, acoustically absorbent mat working in conjunction with a threaded centre spindle and Ariston's screw-down record clamp. Good record/mat contact is thereby assured. An **internal hub is integral with the platter, this** forming the drive belt hub, with the belt **loaded** via one of the access holes.

Easily adjusted from above, the suspension springs are foam damped to improve the shock resistance, this an intentional compromise with respect to ultimate vibration isolation.

Lab results

Slight play and some noise were noted from the main bearing; the latter improved on running in. Rumble levels were fairly good at typically −72dB. But combined wow and flutter for the *'AC* was poorer than average at 0.19%, this mainly wow, but proves not to be too serious subjectively.

The *'E* version gave slightly better rumble results and noticeably better wow and flutter down to an excellent 0.04%. However the *'E* was well off speed as delivered, and was also difficult to set owing to the excessive range of variable speed control, this ±15%, with no 'correct speed' detent. A stroboscope card is included to help reset the speed — an awkward procedure involving a mains powered lamp.

While the *'AC* version was good with respect to load tolerance, the *'E* proved rather disappointing, slowing 0.7% on test which is likely to produce audible pitch instability.

The platter clamp system provided very good control of the initial leading edge impulse with only moderate platter ringing observed thereafter. From the graphs, the acoustic isolation

can be seen to be pretty good, and vibration was quite well rejected, but was compromised at low frequencies by the fairly solid foam cores to the springs. In compensation, the player resisted shock better than the usual subchassis type.

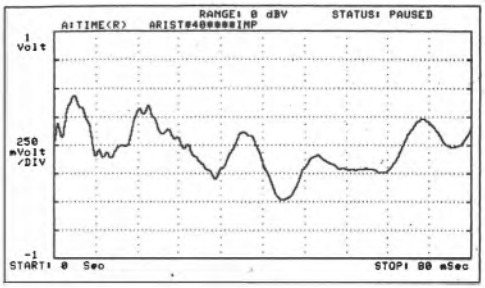
Sound quality

The *'E* came fitted with a *BX-150E* cartridge which was rather unsatisfactory and was replaced by an alternative. On audition, the general character was considered pretty good, with firm bass, good stereo and pleasing depth, these the hallmarks of a subchassis design. It sounded clear and open, but was not particularly 'tuneful' and doubts were expressed concerning the pitch stability (the listening was done prior to the lab tests).

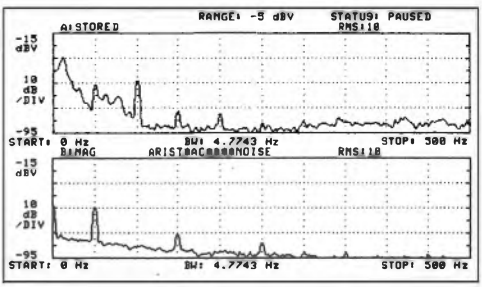
Turning to the *'AC* verison, the good points were maintained, and the pitch query resolved with notably better timing and tunefulness. Wow and rumble proved inaudible, and good feedback margins were also demonstrated.

Conclusion

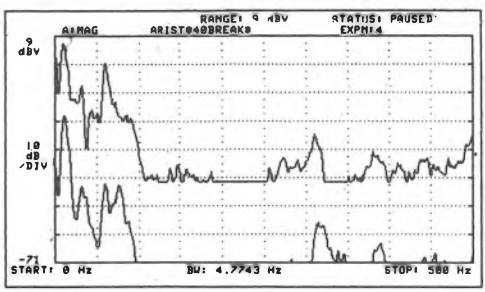
The *'E* version, despite a higher specification, cannot be recommended at present. The poor torque and crude variable speed setting were weak points. However, the standard *'AC* synchronous motor version performed well, and is attractively priced in view of its high engineering content this including the effective record clamp system. Purchasers should remember to account for the options such as the add-on cover, but in basic form the *RD40AC* is a recommended model.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

GENERAL DATA RD40AC Motor Unit*

Motor section

Type	belt drive, subchassis
Platter mass/damping	1.8kg/very good
Finish and engineering	very good, very good
Type of mains lead/connecting lead	2 core
Speed options	manual change, 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2)	0.19%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.09%
Absolute speed error	<0.1%
Speed drift, 1 hour/load variation	negligible/ – 0.1%
Start-up time to audible stabilisation	2.2 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 72dB

System as a whole

Size (w x d x h)/clearance for lid rear	45 x 38 x 17cm/4cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	from £160*

** arm and other options available*

RECOMMENDED

Ariston RD80SL

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD
Tel (0292) 76933

Favourably reviewed in the last issue, the Ariston *RD80* has undergone some changes over the intervening 18 months — hence the current designation *RD80SL*. As outlined by the manufacturer, changes comprise improvements to the electrical insulation to meet Semco-Demco standards, while the platter is now machined to a slightly concave upper surface. Using the screw-down record clamp, standard with the unit, this allows reduction of most record warps as well as improved record-to-mat contact. Fine adjustment of the motor/pulley/belt angle is now possible by a tilt frame and a nut-runner is supplied for this purpose and for subchassis suspension levelling. Access is now provided underneath the tonearm without removing the base plate and in addition a new absorptive composition mat is included.

Of slightly plain finish and appearance, the *'80SL* employs a weighty 2.5kg platter. The subchassis has a well-balanced three-point spring suspension, and plinth and cover being substantial non-resonant items.

Lab report

Though apparently undamaged externally our review sample suffered motor disintegration in transit, but fortunately survived a rebuild. The supplied *LVX* arm fared less well as the counterweight had been left in position; the result was 'notchy' bearings.

Lab performance of the version was much the same as for the earlier model, both being to a respectable standard. Speed, wow and flutter and rumble figures were all good, if marginally poorer than before on our sample, and some mains-related rumble was evident on the drive, though the bearing showed signs of improvement with continued use — Ariston do state that there is a 'running-in' period.

Platter damping was fine, with a clean initial transient but some subchassis/platter flutter in the 'after-shock' (see impulse plots). Vibration isolation proved very good, as did resistance to acoustic breakthrough, with tolerable shock resistance and very good feedback immunity. Some rotational whippiness around 9Hz was observed with the subchassis, the main resonance being at 6Hz — while belt loading with the ridged two-speed pulley could be troublesome if adequate talc dressing had not been previously applied.

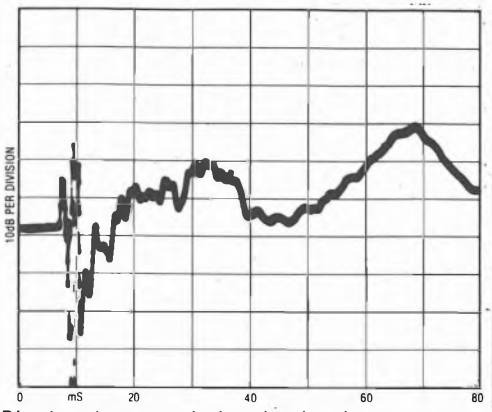
Sound quality

Maintaining the standard set previously on sound quality grounds, the *80SL* provided a substantial proportion of the required performance parameters on a number of basic counts. The stereo soundfield seemed well focused, stable and precise, while the overall balance was generally neutral and the sound fairly transparent. The bass showed good depth and evenness, and pitch stability was also pretty good.

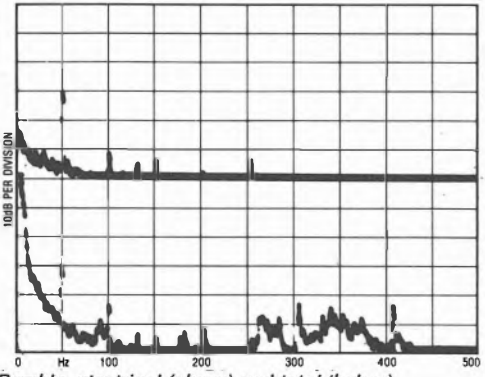
Conclusion

Revised for this edition, the *RD80* maintains a competitive standard and is probably Ariston's most successful product. A solid recommendation is continued.

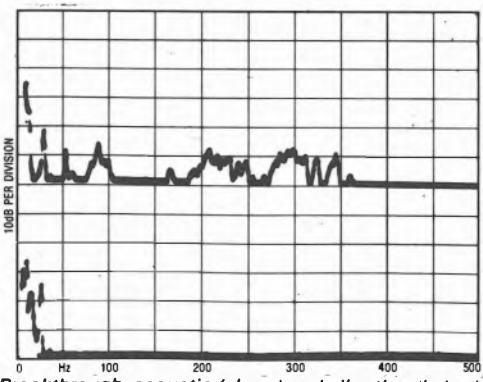
GENERAL DATA	Motor Unit
Type	manual belt drive, synchronous motor, subchassis
Platter mass/damping	2.6kg/very good
Finish and engineering	good/very good
Type of mains	2-core
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.07%
Absolute speed error	+0.08%
Speed drift, 1 hour/load variation	synchronous/ – 0.25%
Start-up time to audible stabilisation	4.0 sec
Rumble, DIN B wtd L/R average (see Spectrum)	– 75 dB
Size/clearance for lid rear	44.5(w) x 36(d) x 17(h)/4.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	very good/fairly good
Estimated typical purchase price	£180



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

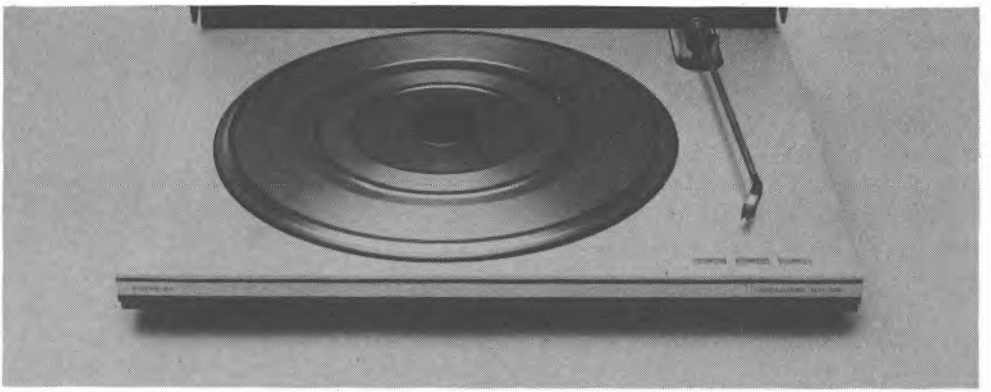


Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Bang & Olufsen Beogram RX-2

Bang & Olufsen UK Ltd, Eastbrook Road, Gloucester GL4 7DE
Tel (0452) 21591



Initially supplied for review as a *Beogram 1800* model, this deck has been re-introduced in alternative RX-2 form, this version having phono-plug signal wiring and some cosmetic changes.

The *1800* was a development of the *1700* (reviewed in a previous *Turntables* issue) and retains B&O's extremely effective suspended subchassis with cantilevered leaf springs.

Demonstrating modern, unfussy styling, the *RX-2* is excellently finished and offers fully automatic operation. An ultra-low mass tonearm is fitted, this excluding a matching B&O cartridge.

In two areas the construction is rather lightweight, namely the thin aluminium platter and the tonearm bearing/pillar assembly; the latter clearly does not follow the current fashion for rigidity with bearings free from slackness.

Lab report

Under test, the motor section performed well. DIN peak-weighted wow and flutter was fine at 0.09%, with good figures also obtained for the separate flutter and wow component. Absolute speed error was low while good torque was shown by the mild 0.22% slowing under load. Some mild speed overshoot was however present on recovery after load removal. Start-up was satisfactory and, more important, the deck's automatic cycles were free from the frustrating dithering and delays so often experienced with other 'auto' players.

Rumble was excellently low for the price, measuring −80dB, while the spectrum analysis of mechanical noise revealed nothing of significance, with both motor and hum vibration very well suppressed.

Acoustic breakthrough was particularly well-handled by this deck, while the vibration isolation was also good considering the low subchassis mass. The suspension was also well behaved, placing all modes clearly in the 3-5Hz region, well clear of the arm/cartridge resonance frequency.

The arm performed fairly well on measurement, though tests were complicated by the unique cartridge and fixing, and the automatic facilities. For example, arm structural resonances were measured using the supplied cartridge and consequently are not directly comparable with those for the other arms. A lack of rigidity was denoted with modes at 300Hz and 600Hz, which are however satisfactory in this price context, and arm friction was low. Bias levels were on the high side by about 30%, but this again is not too serious.

The cartridge proved to be an able performer, with good channel separation plus a decent frequency response of 30Hz to 20kHz, ±2dB. Overall it is rather better than most cartridges fitted to players at this price level. Close inspection of the graph does again show evidence of the 300 and 700Hz arm modes.

Turning to the disc impulse response, the platter did not appear to offer very good record termination and is no better than average here.

Sound quality

Performing well in its category, the B&O was an eminently civilized and well mannered product. In terms of frequency balance it was fairly neutral, with a sweet, restrained treble register — but overall it lacked some 'bite' and 'attack'.

The bass could also have been firmer, and while the stereo effect was pretty good, more transparency would not have gone amiss. None-

theless, the overall impression was good, and furthermore, both shock and acoustic feedback were well handled.

Conclusion

Originally cost around £100, inclusive of cartridge, the present version of this deck will set you back around £135, with optional cartridge. The overall performance is satisfactory but has remained static while other comparable decks have continued to improve over the same period. These factors have served to relegate this B&O deck from the Recommended to the Worth Considering category.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

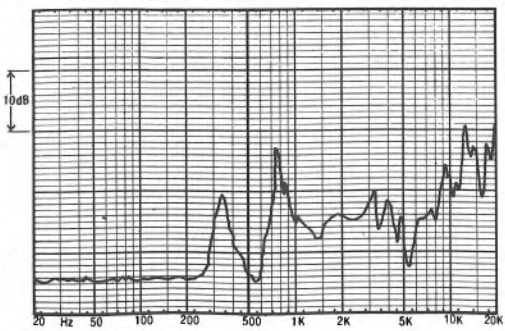
Type.....auto belt-drive, subchassis
Platter mass/damping.....0.6kg/fairly good
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/DIN
Speed options.....auto, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.09%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.11%/0.14%
Absolute speed error..... – 0.15%
Speed drift, 1 hour/load variation..... + 0.08%/ – 0.22%
Start-up time to audible stabilisation.....approx. 3 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 80dB

Arm section

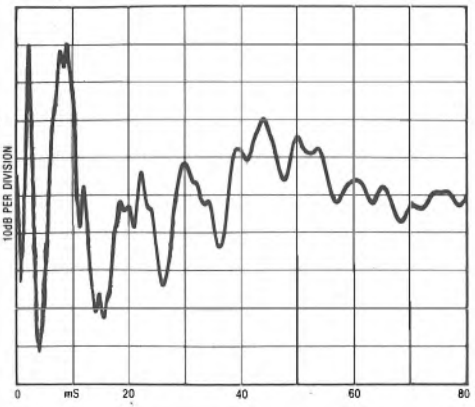
Approximate effective mass, inc screws and cartridge.....6.0g
Type/mass of headshell.....integrated cartridge
Geometric accuracy.....very good
Adjustments provided.....downforce
Finish and engineering.....very good, good
Ease of assembly/set-up/use.....very good/very good/excellent
Friction, typical lateral/vertical.....35mg/20mg
Bias compensation method.....internal fixed spring
Bias force, rim/centre (set to 1.5g elliptical).....400mg/420mg
Downforce calibration error, 1g/2g.....±0.06g/±0.06g
Cue drift, 8mm ascent/descent.....low, 1.2 secs/0.8 secs
Arm resonances.....see graph
Subjective sound quality.....—
Arm damping.....none

System as a whole

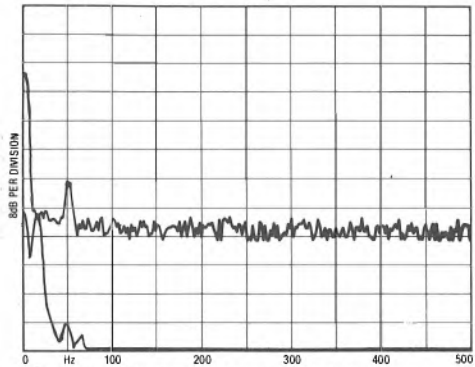
Size (w x d x h)/clearance for lid rear.....44 x 33 x 9.5cm/none
Ease of use.....excellent
Typical acoustic breakthrough and resonances.....very good
Subjective sound quality of complete system.....average +
Hum level/acoustic feedback.....very good/very good
Vibration sensitivity/shock resistance.....very good/very good
Estimated typical purchase price.....£135



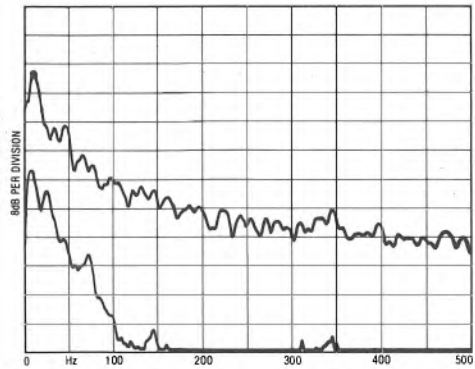
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

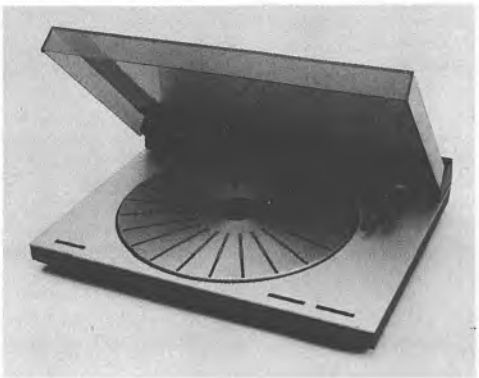


Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Bang & Olufsen TX4

Bang & Olufsen (UK) Ltd, Eastbrook Road, Gloucester GL4 7DE
Tel (0452) 21591



B&O's reputation for excellent style and finish well maintained with this modern linear- or parallel-tracking turntable. Sold separately under the model designation *TX4*, the player is also supplied as part of the B&O *5000* series system, where it is subject to the system's remote control facilities.

A fully automatic deck, the *TX4* came equipped with an optional *MMC4* cartridge, fitted directly into the low mass 'system' tonearm. As with the other long established series of B&O players, this model is founded on a leaf-spring, cantilevered suspension subchassis, and is belt driven by a dc servo motor installed in the plinth and mechanically isolated from the platter.

The platter is a rather light pressed sheet of aluminium alloy with a vestigial printed nextel pattern 'mat'. Good disc contact is afforded, the idea being that mutual damping is established between the record and the platter, the two being of similar mass and mechanical impedance.

This slim deck is operated by touch button controls, with the main 'Play' control discreetly accessible from the front. A speed switch override is provided for playing large 45rpm discs.

Lab report

The limited access allowed by the parallel tracking made some measurements difficult; in particular the old method for rumble analysis had to be used, with a blank acetate disc rather than the higher precision rumble coupler. In consequence the DIN B figure quoted is simply 'better than – 73dB'. The rumble spectrogram was masked by disc noise, but implied that no motor breakthrough was present at the measurement limit. An ideal 10Hz arm cartridge resonance was noted.

From the remaining graphs the vibration and isolation could be seen to be excellent, as was the acoustic breakthrough, this taken with the lid down. The turntable also showed a good stability with respect to impact shock.

Graphed for disc impulse, high frequency modes are well damped but the platter and its support suffered from a lack of rigidity, clearly seen in the low frequency oscillation. The platter weighs around 0.7kg, this estimate including the non-detachable inner hub. The motor section is beautifully finished and well engineered, with the platter using a shallow self centring bearing of small diameter and high finish.

Combined DIN-weighted wow and flutter was held at 0.09%, which was a good result, while on a linear measurement the flutter was rather better than the wow. The speed was satisfactory at 0.6% fast, and showed negligible drift. Slowing under load was fine at 0.2%, while start up was a near instantaneous 1.5 seconds, the player showing ample torque.

The arm effective mass was very low, estimated at 3.5g, excluding cartridge. Geometry was understandably excellent, and of course no bias compensation was required. The cue operated rapidly and effectively, minimising record damage.

Charted for arm resonances, with (of necessity) the B&O cartridge, it was rated poorer than average, the 600Hz break being severe with additional modes present in the region of 1.5kHz.

Sound quality

While resting firmly on its fine subchassis, this player did however show subjective weaknesses in other directions, and these let the side down. Musical dynamics showed some compression, the mid band was muddled, vital detail as well as transient attack were suppressed, and some upper mid coloration was also evident. The bass was reasonable, but lacking in weight and impact, while stereo depth was disappointing.

Tonally, it sounded sweet and well balanced especially in the treble, where it was well above average.

Conclusion

We were not very impressed by this new B&O player. The fine subchassis design appeared to

be constrained by the quality of the platter and arm, which adversely affects the subjective performance. No recommendation is possible, though as a superbly finished automatic it is certainly worth considering.

GENERAL DATA Integrated player with cartridge

Motor section

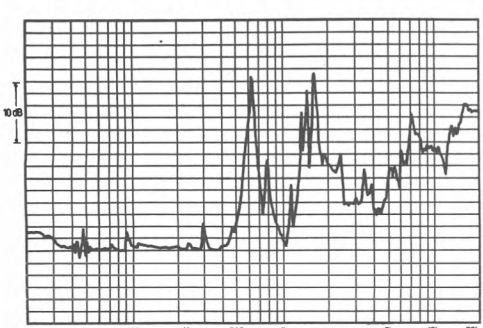
Type.....belt drive, subchassis, automatic
Platter mass/damping.....approx 0.7kg/fairly good
Finish and engineering.....excellent/good
Type of mains lead/connecting lead....2 core/phonos plus earth
Speed options.....auto, 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.09%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)....0.13%/0.065%
Absolute speed error..... + 0.5%
Speed drift, 1 hour/load variation.....<0.1%/ – 0.2%
Start-up time to audible stabilisation.....approx 1.5 secs
Rumble, DIN B wtd, L/R average.....better than – 73dB

Arm section

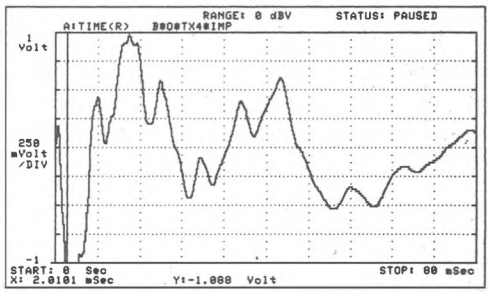
Approximate effective mass, inc screws, excl cartridge.....3.5g
Type/mass of headshell.....none
Geometric accuracy.....excellent
Adjustments provided.....none
Finish and engineering.....very good
Ease of assembly/setting-up/use..excellent/excellent/excellent
Friction, typical lateral/vertical.....<50mg/<30mg
Bias compensation method.....not required
Bias force, rim/centre (set to 1.5g elliptical).....none
Downforce calibration error, 1g/2g.....N/A
Cue drift, 8mm ascent/descent.....negligible, 0.5secs/0.5secs
Arm resonances.....average –
Subjective sound quality.....see system result
Arm damping.....none

System as a whole

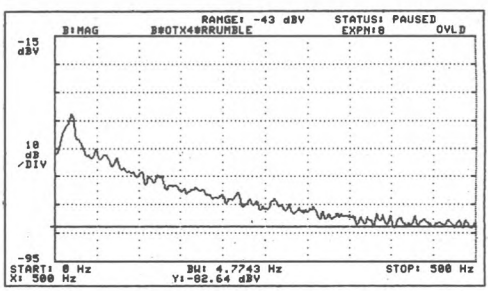
Size (w × d × h)/clearance for lid rear.....42 × 32.5 × 7.5cm/none
Ease of use.....excellent
Typical acoustic breakthrough and resonances.....excellent
Subjective sound quality of complete system.....average
Hum level/acoustic feedback.....low/very good
Vibration sensitivity/shock resistance.....excellent/very good
Estimated typical purchase price.....£250



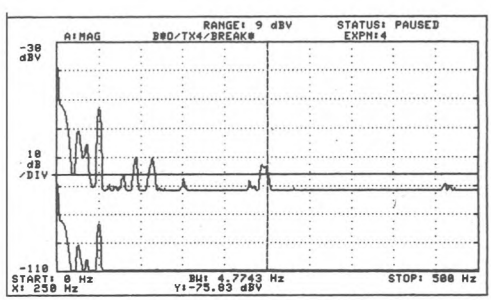
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

BEST BUY

Dual CS505-2 and CS505S

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks
Tel (0753) 888447

In production now for a number of years, the *505* design has undergone a continuing series of cumulative minor improvements which have helped maintain its competitive position. Price has also been kept in check.

The player is based on an old-style steel deck plate, supported on four foam-damped coil springs. This deck plate is heavily flanged to increase rigidity, and the modest platter is equipped with a fairly heavy rubber mat.

Belt driven by a 16-pole synchronous motor, the *505* is fitted with a unique variable pitch control, achieved by the use of a multi-lobed expansible motor pulley. Correct speed setting is achieved via stroboscope markings on the platter rim, though these were found none too easy to use.

For the latest *505-2* version the tonearm has been revised and is now fitted with a special detachable headshell with quite a firm fixing. The *505S* has a better appearance and a lower resonance construction, this imparted by a substantial wooden plinth finished in 'black ash' vinyl. Both versions come complete with a compatible good-value Ortofon cartridge.

Lab report

A notable feature of this new version is the significant reduction in rumble, which has improved from a satisfactory figure of 67dB to a new average of 73dB. Spectrum analysis showed the usual contribution of motor vibration components, but these were not considered to be very serious. Speed characteristics were much as before with good wow and flutter, while good torque was also demonstrated, the mild 0.2% slowing under load being up with some of the best examples, and helping to offset the low inertia of the platter. Vibration and acoustic isolation factors remain unchanged, at a good level, and well above average for the price.

The new arm possessed a moderate effective mass, measured at 10g, this including mounting hardware. The headshell itself weighed a modest 4g. The arm was well aligned and the pivots were reasonable, proving moderate in friction but subject to a rather small pre-load; more than a gentle twist to the arm resulted in audible bearing 'clicking'. Biasing was accurate and downforce calibration acceptable. Arm structural resonances were chartered with the cartridge supplied; as can be seen on the graph, the first weakness appeared at 90Hz, while the main problems occurred at 220 and 400Hz, this result apparently not a great improvement on the previous design. Above 600Hz, however, the resonances were pretty well behaved.

Sound quality

The *505's* sound was tuneful, lively, punchy and somewhat 'forward' in presentation. Pitch and

timing were also good, while the bass was fairly good and the stereo image had quite a respectable depth as well as above-average focus. It could sound a little muddled in the mid and treble but not seriously so, and the cartridge suited it well — we would not change it. The 'S' version showed a small improvement in clarity and definition, attributable to the improved plinth.

Conclusion

The *505* has managed to maintain its competitive position and provides a competent hi fi sound. In our view it is the clear £100 group leader, so much so that the less expensive players, including Dual's own *514*, do not really stand much of a chance. Strongly recommended as a complete package with the *OM10* cartridge, the *505-2* wins Best Buy status; the *505S* is Recommended.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

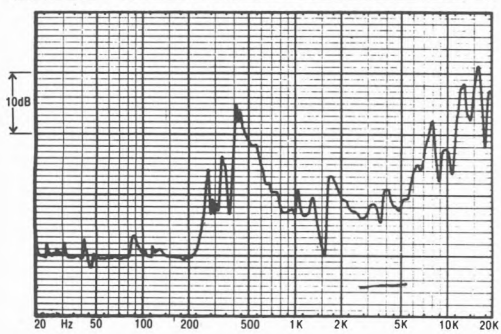
Type	semi-auto, belt drive, subchassis
Platter mass/damping	0.85kg/good
Finish and engineering	very good/good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.075%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.95%/0.08%
Absolute speed error	– 0.1%
Speed drift, 1 hour/load variation	+ 0.065%/ – 0.2%
Start-up time to audible stabilisation	2.4 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 72/ – 74dB

Arm section

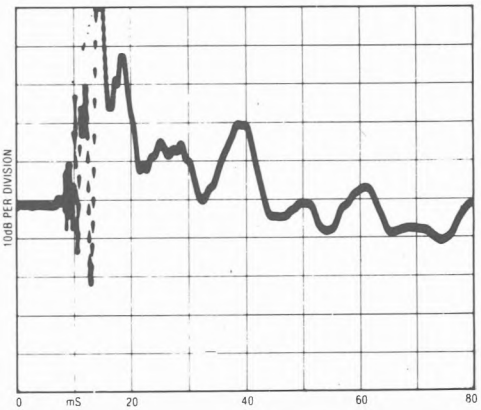
Approximate effective mass, inc screws, excl cartridge	10g
Type/mass of headshell	special detachable/40g
Geometric accuracy	good
Adjustments provided	overhang/offset
Finish and engineering	very good/good
Ease of assembly/set-up/use	very good/very good/very good
Friction, typical lateral/vertical	40mg/20mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	225mg/225mg
Downforce calibration error, 1g/2g	– 0.12g/ – 0.2g
Cue drift, 8mm ascent/descent	very slight, 3.5 secs/3.0 secs
Arm resonances	average +
Subjective sound quality	average +
Arm damping	decoupled counterweight

System as a whole

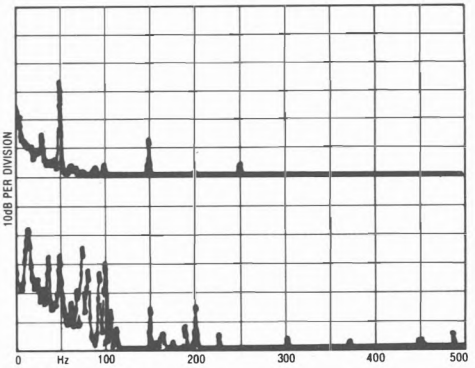
Size (w x d x h)/clearance for lid rear	43.5 x 37 x 14cm/7cm
Ease of use	good
Typical acoustic breakthrough and resonances	average +
Subjective sound quality of complete system	good
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£109



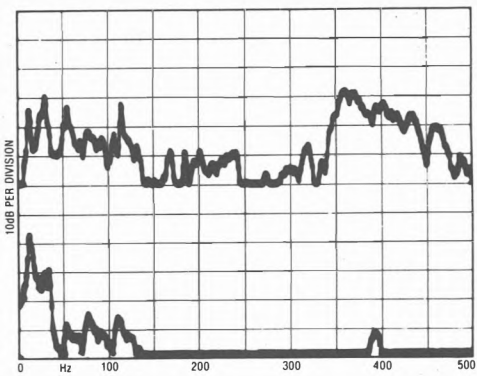
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

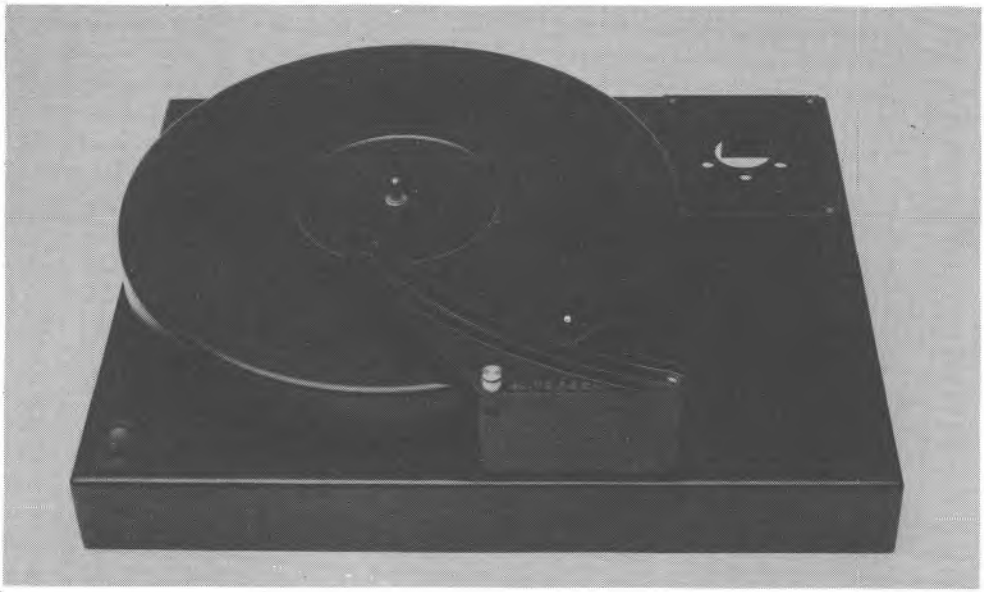


Breakthrough, acoustic (above) and vibration (below)

RECOMMENDED

Elite Townshend Rock II

Elite Townshend Ltd, Unit 2, North Weylands Ind Est, Molesey Road, Hersham, Walton-on-Thames, Surrey Tel (0932) 246850



This new Elite turntable is designated *Rock II* to distinguish it from the original master design developed at Cranfield Institute of Tecnology. This was in fact only built in very small and highly expensive quantities. Lessons learned from its development have subsequently been applied to this new model, which sells typically at £280, plus £65 for the cover and platform if required.

The original *Rock* made much use of a mineral-filled resin for mass and damping, but with the new model gypsum is employed to the same end, for example in the solid platter and the weight plinth/chassis. Both these components use a fabricated metal skin to contain their mineral castings.

The *Rock II* is a solid-plinth model with a synchronous motor firmly bolted in place, a rubber cord drive belt linking the motor to the inner hub of the two piece platter. The unit achieves a substantial degree of environmental isolation through the use of a suspension consisting of three air filled rubber balls (squash balls, I believe). The lid is not attached to the plinth but to the base plate and hence remains isolated. Speed change is done by hand.

One special feature is the incorporation of a large silicone fluid damper mounted on the plinth which operates at the headshell end of the chosen arm. This is designed to help control both the audio band structural resonances in the tonearm, as well as the cartridge subsonic resonances, without imposing excessive forces on the cantilever in the record warp frequency range. Shock resistance and record 'rumble' are said to be improved in this manner.

No set up or alignment is required and, apart from the necessarily limited cartridge access, the turntable was easy to use, with arm lead dressing proving to be uncritical.

Lab report

The loaded platter weighed a notable 2.9kg, with its plastic enamelled surface forming the disc support. As such it showed good damping in respect of the disc impulse, which showed an even characteristic. Tonally, the platter should sound neutral. No platter ringing was observed.

No problems were experienced in the speed department. DIN peak wow and flutter was fine at 0.1% weighted with the individual contribution of wow at 0.21% — satisfactory — while flutter at less than 0.05% looked very good.

Absolute speed accuracy was fine and within 0.1%, while torque was more than

satisfactory, this confirmed by the modest 0.25% slowing under the test load. No overshoot was observed. Start-up time with our sample was a little slow at 6.8 seconds, but this improved to 4.8 seconds with a new pulley. The DIN B rumble figures were fine at – 77/ – 77dB, given the unpromising motor location; spectral analysis did show the presence of some mild motor vibration breakthrough, though at a pretty inaudible level.

The simple design proved to be remarkably effective in supressing airborne acoustic feedback and vibration — it performed well albeit not superbly on these counts. It also proved well above average in its handling of shock when using the damper, and was also uncritical of location.

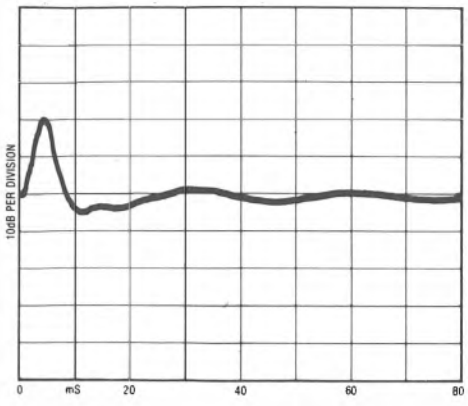
Sound quality

The *Rock II* did well on audition, demonstrating a good stability of pitch, with a neutral, even-handed tonal balance. It performed competently throughout the frequency range with firm clean bass, good perspectives in the mid-range, and an unexaggerated treble. In fact, the treble seemed 'cooler' and less exuberant than usual when the deck was used with an *Ittok* arm. Stereo focus was good, and cartridges tracked well with reduced low frequency noise. A pleasing level of stereo depth was available.

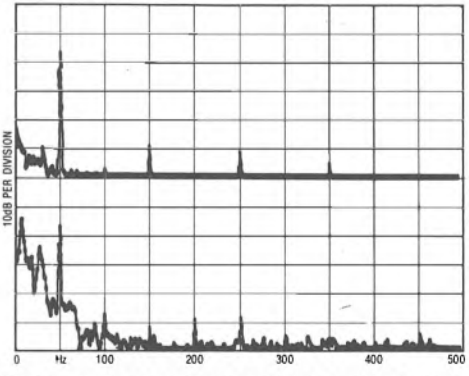
Conclusion

I would hesitate to place this model in the highest sonic category, but it nonetheless has a lot going for it. The damper does the job it is claimed to do, particularly with good cartridge combinations, and the deck needs no setting up — a plus point for many purchasers. It offers a performance near to that available from a true subchassis turntable, doing so with a high level of neutrality, or if you like, a low level of coloration. As such it represents an interesting proposition and the standard attained merits recommendation.

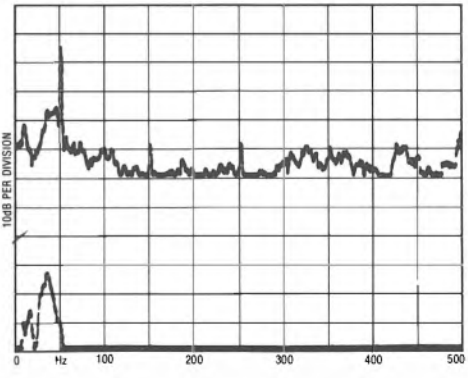
GENERAL DATA	Motor unit (with arm damper)
Type	belt drive, rigid plinth
Platter mass/damping	2.9 kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.21%/0.05%
Absolute speed error	+ 0.1%
Speed drift, 1 hour/load variation	synchronous/ – 0.25%
Start-up time to audible stabilisation	6.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 77/ – 78 dB
Size (w × d × h)/clearance for lid rear	40 × 33 × 11.5cm/none
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/very good
Estimated typical purchase price	£280 (optional cover £65)



Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)



Rumble, electrical (above) and total (below)

Note: The platter shell is now acrylic and one or two other improvements have also been made.

Harman Kardon T35C

Harman (Audio) Ltd, Mill Street, Slough, Berkshire SL2 5DD
Tel (0753) 76911

This is the least expensive of three new HK turntables, **all** with a similar appearance and clean styling in silver-finished plinths.

A rigid plinth construction has been chosen for the *'35*, with springy feet to help provide some isolation from the mounting surface. However, acoustic breakthrough is not dealt with, and the resonant lid can couple its stored energy directly to the plinth and hence to the arm and platter.

A 1.33kg aluminium platter is used, belt driven from a small dc servo motor. Speed change is electronic, activated by a convenient switch. Semi-automatic, this player incorporates stop and lift at the end of record side, with variable speed also provided. The integral arm uses a current style of lightweight plastic headshell conferring low mass. Mild play was present in the arm bearings, while the platter main bearing was finely toleranced.

Lab report

Quite good impulse damping was shown, followed by a pronounced low frequency aberration attributed to platter rocking.

Acoustic isolation was weak, with coupled modes also evident in the 50Hz region, these also excited in the vibration isolation graph. Here a deterioration was evident on the higher frequency range.

Wow and flutter was fine at 0.08%, DIN peak weighted, with this mild figure mainly composed of wow, which measured 0.12% **linear. Asbolute speed was on the high side at** +0.7%, a perceptible but probably unimportant error. Slowing under load was fine at 0.2%, the player showing a healthy torque. Start-up was a rapid 1.6 seconds. Rumble was just satisfactory at −68/70dB DIN B weighted, with the unweighted rumble spectrogram showing the presence of a series of motor related harmonics extending into the rumble weighting frequency range centred on 350Hz.

With a moderate effective mass of 9g, the headshell alone weighed 5g, inclusive of hardware. A good geometric accuracy was observed with adjustments provided for lateral angle and overhang via the slotted headshell fixing. A surprisingly high level of lateral friction was observed which may be associated with the end-of-side sensor tip. Laterally, 150mg was noted, which is adequate for cartridges at a 2g downforce, while vertically, a fine 40mg was noted.

Charted for resonances, the arm showed quite serious breakup from 230Hz, the main loss of rigidity seen at the headshell.

Sound quality

This player was unpromising with regard to acoustic feedback. Test results showed a well below average performance which it is believed was associated with the poor isolation.

Stereo focus did not sound very clear, while the bass had a lumpy, softened character. The sound lacked attack or life, and was also

considered undynamic. Tonally it was pleasant enough, being neither seriously colored or unbalanced.

Conclusion

This deck offers a traditionally 'old fashioned' sound from an old fashioned style of player. What might have been acceptable a few years ago in the form of a *PL12D* or a *SR222* is no longer of much relevance in the context of the standard set by the present Dual *505* or Rega *Planar 2*.

GENERAL DATA Integrated player

Motor section

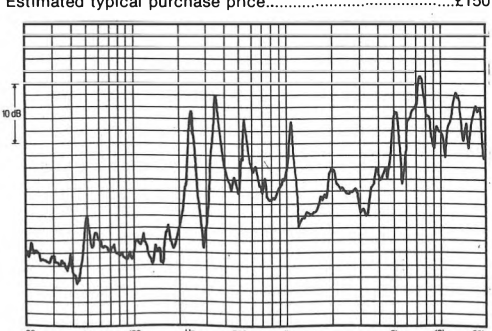
Type.....electronic belt-drive, auto stop and lift
Platter mass/damping.....1.33kg/fairly good
Finish and engineering.....very good/good
Type of mains connecting lead.....2 core/phonos plus earth
Speed options.....33, 45 rpm, variable
Wow and flutter (DIN peak wtc, sigma 2).....0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)...0.12%/0.08%
Absolute speed error.....+0.7%
Speed drift, 1 hour/load variation.....<0.25%/−0.2%
Start-up time to audible stabilisation.....1.6 secs
Rumble, DIN B wtd, L/R average (see spectrum).....−70dB

Arm section

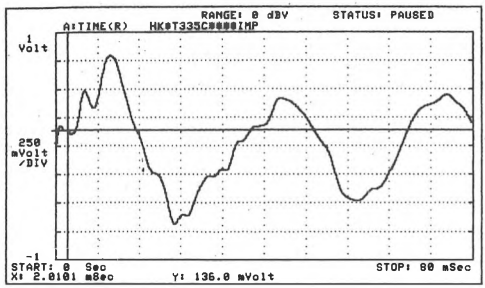
Approximate effective mass, inc screws, excl cartridge.....9g
Type/mass of headshell.....special detachable/5g
Geometric accuracy.....very good
Adjustments provided.....overhang/offset
Finish and engineering.....excellent/good
Ease of assembly/setting-up/use.....very good/very good
Friction, typical lateral/vertical.....150mg/40mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....200mg/200mg
Downforce calibration error, 1g/2g.....0.1g/0.5g
Cue drift, 8mm ascent/descent.....negligible, 2secs/3secs
Arm resonances.....fairly good
Subjective sound quality.....see system result
Arm damping.....decoupled counterweight

System as a whole

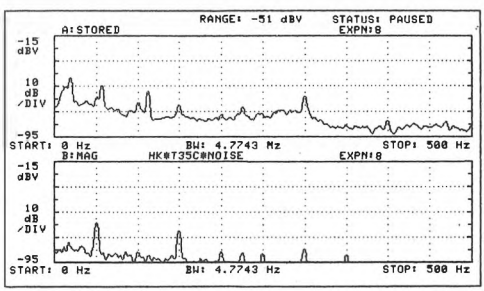
Size (w × d × h)/clearance for lid rear.....44 × 38 × 15cm/7cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....average +
Subjective sound quality of complete system.....poor
Hum level/acoustic feedback.....good/average −
Vibration sensitivity/shock resistance.....fairly good/good
Estimated typical purchase price.....£150



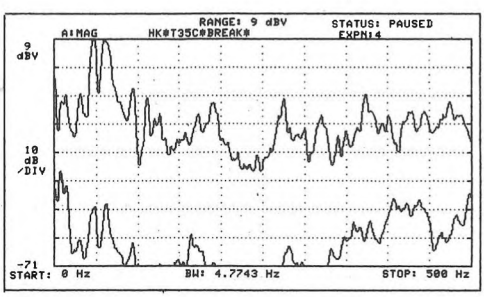
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.

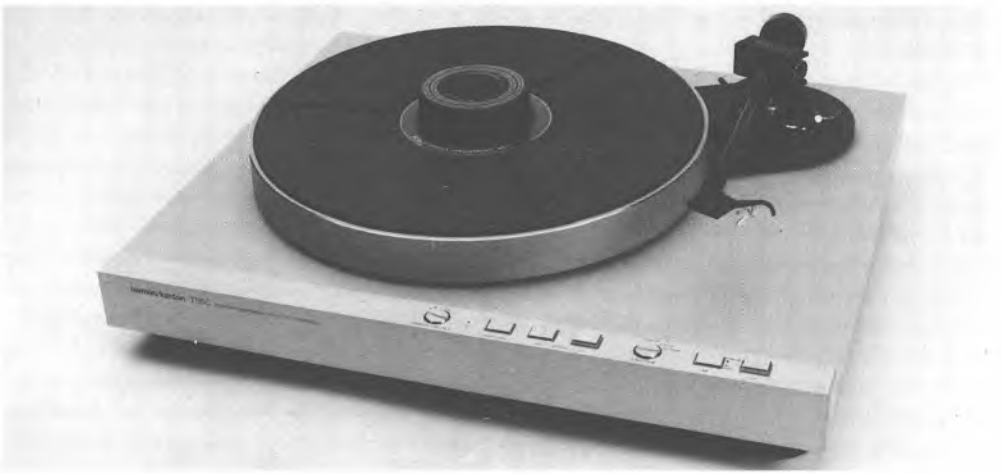


Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is −80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Harman Kardon T55C

Harman (Audio) Ltd, Mill Street, Slough, Berkshire SL2 5DD
Tel (0753) 76911



Largest of HK's new range of turntables, the *'55* is distinguished by certain special features. A pressed steel subchassis is incorporated, suspended on springs which are rather stiff, particularly in the rotational mode. The platter is augmented by a thicker high loss rubber mat, supplemented by a heavy centre clamp.

Other details include an electronic speed control via a quartz locked dc servo motor, the latter driving the platter via a polyurethane drive belt. Under load some platter slowing due to inevitable belt slippage will not be under quartz control. With the quartz lock switched off, variable speed control is possible, while variation of arm capacitance from a nominal 130pF to 230pF and 330pF is provided via a front panel control — convenient for 'tuning' some moving magnet cartridges.

The arm carries the legend 'By Ito', presumably the same Ito who builds the *Ittok* for Linn. However, the *T55C* arm is not another *Ittok*, as is apparent from the evident mild bearing play.

Lab report

Bar one odd reflection at 33ms, the disc impulse damping was classed as relatively good, with the mat and the clamp both aiding the performance.

Vibration isolation was quite good, but was marred by breakthrough at 350-400Hz while acoustic isolation was rather better than average. Shock immunity was about average, but acoustic feedback tendencies were not entirely cured.

DIN peak weighted, the combined wow and flutter result was very good at 0.06%; unweighted, the separate flutter and wow readings were both fine. The absolute speed error was negligible at 0.05% while the quartz reference offered zero drift. Slowing under load was modest at 0.25%, virtually at the level of inaudibility, while start up was rapid at 1.5 seconds. Rumble levels were low at a measured −75dB DIN B.

Arm mass was estimated at 9g, including mounting hardware. The lightweight headshell was a special detachable type with a locking screw. Geometric accuracy was fine and the overall finish was excellent, but some play was noted in the arm bearings, described as 'Micro-race' by the manufacturer. As with the *'35C*, lateral friction was unexpectedly high, here 100mg lateral but only 20mg vertical. Biasing was uneven as well as rather low, estimated by subtraction at 100mg at the rim and a more favourable 200mg at the record centre.

Charted for resonances, the arm was classed as average here. A headshell bearing mode was evident at 250Hz, with a beam mode at 1kHz.

Sound quality

Compared with the *'35*, the *'55* gave improved sound quality. Stereo images showed greater width, plus a little more ambience and depth. The sound also showed more punch and life, with a moderately improved bass definition, though still not to a 'good' level. Some

muddling also remained in the mid and treble, though the overall effect was relatively pleasant tonally.

Conclusion

This player was barely average in sound quality yet commanded an above average price. Some good engineering details were present, but the overall design was, in our view, incomplete, as reflected by its ratings. No recommendation is appropriate.

GENERAL DATA Integrated player

Motor section

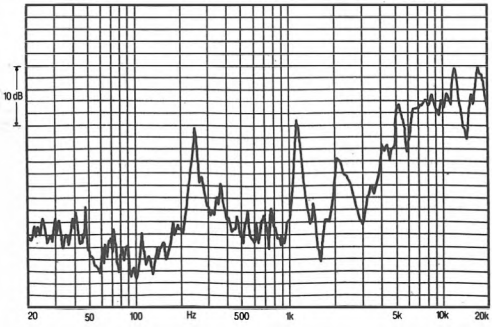
Type.....manual belt drive, sub chassis, autostop
Platter mass/damping.....1.32kg/good
Finish and engineering.....excellent/good
Type of mains connecting lead.....2 core/phonos plus earth
Speed options.....33, 45 rpm, variable
Wow and flutter (DIN peak wtc, sigma 2).....0.06%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.1%/0.05%
Absolute speed error.....0.05%
Speed drift, 1 hour/load variation.....none/ – 0.25%
Start-up time to audible stabilisation.....1.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 75dB

Arm section

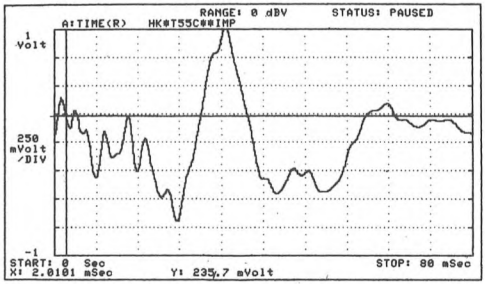
Approximate effective mass, inc screws, excl cartridge.....9g
Type/mass of headshell.....special detachable/5g
Geometric accuracy.....very good
Adjustments provided.....overhang/offset
Finish and engineering.....excellent/good
Ease of assembly/setting-up/use.....very good/very good
Friction, typical lateral/vertical.....100mg/200mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....100mg/200mg
Downforce calibration error, 1g/2g..... – 0.1g/ – 0.25g
Cue drift, 8mm ascent/descent.....2.5secs/3.5secs
Arm resonances.....average
Subjective sound quality.....see system result
Arm damping.....composite tube, decoupled counterweight

System as a whole

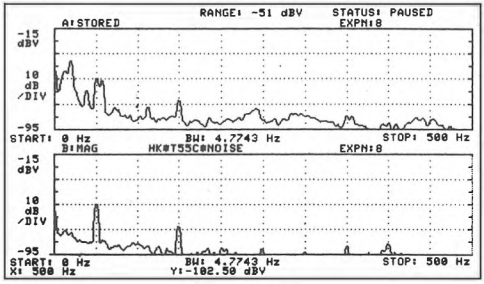
Size (w × d × h)/clearance for lid rear.....44 × 38 × 15cm/7cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....average +
Subjective sound quality of complete system.....average
Hum level/acoustic feedback.....good/good
Vibration sensitivity/shock resistance.....good/fairly good
Estimated typical purchase price.....£210



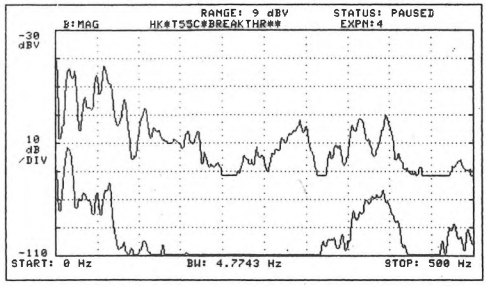
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

RECOMMENDED

Heybrook TT2

Mecom Acoustics, Knighton Hill, Wembury, Plymouth, Devon
Tel (0752) 863188

First reviewed in its original form, the Heybrook *TT2* turntable has since undergone some revision after its first couple of years in production. A new cast aluminium subchassis with reinforcing flanges around the whole of its cruciform shape replaces the original box-section welded steel subchassis, which had a rather high mass. Such a major change indicated that a completely new review of the *TT2/II* was in order.

While this model is superficially reminiscent of a *Sondek,* a closer examination will reveal that Heybrook have used a rather different set of solutions to the problems of turntable design, solutions which do not appear to derive from any attempt to compromise engineering quality or finish. At the same time, the *TT2* is quite competitively priced if compared with certain of the more expensive brand leaders in the specialist field.

A very strongly constructed plinth is used, essentially of 45mm thick composite, only cut away where space is required for the arm leads, motor and associated wiring. Suspended on three multi-turn coil springs, the subchassis can be aligned from above, via three socket-head bolts fixed by an ingenious locking system.

A closely-toleranced main bearing is fitted, consisting of a steel shaft supported on a hardened thrust ball, and running in plain bronze sleeves. The alloy platter weighs 2.8kg, and is in two pieces, the inner section also forming the drum on which the belt runs. A felt mat is standard.

Currently, the *TT2* suspension is set on the firm side, to provide better control, while a fairly stiff short belt has been chosen as likely to minimise wow effects. The main subchassis modes are in the 4.5 to 5Hz range, and correct arm lead dressing offers better control of the higher frequency rotational modes than before.

Arms tried with the *TT2* included the Linn *LVX* and the Alphason, but perhaps the most obvious choice was the Rega *RB300,* the two products complementing each other on grounds of their fine engineering and value.

Lab report

The well-constructed main bearing exhibited negligible play, while the subchassis proved to be well adjusted. A fine weighted wow and flutter figure of 0.065% was recorded, with equally good results for the flutter and wow when separately weighted, at 0.08% and 0.07% respectively. The deck ran fast by an acceptable 0.5%, while high torque was shown by the excellent 0.18% slowing under test loading. Dynamic wow will not be a problem here.

DIN B weighted rumble was very low at almost – 80dB, but spectrum analysis did show some moderate motor related mechanical

frequency components, specifically at 100Hz and 200Hz. The latter however measured at −78dB and in consequence was quite harmless.

The felt mat provided much the usual pattern of results for the disc impulse response; following a large initial transient, damping was fairly good although some mild 100Hz ringing can be seen in the decay response, this possibly platter rock.

Sound quality

On audition the latest *TT2* was felt to offer an improvement over the earlier version, notably in terms of better transparency and depth, tied in with a clearer exposition of the dynamic contrasts in the music.

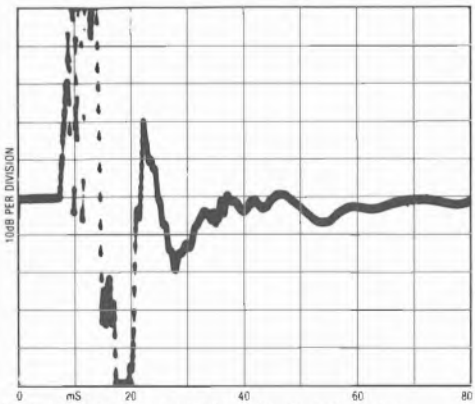
Pitch stability, rhythm and timing were all to a very good standard, while the bass was a strong point, with a welcome firmness coupled with good extension to the lower bass frequencies.

Solo singing focused well in the stereo sound stage, the latter exhibiting good space and depth. It compared well with far more expensive designs, making only slight concessions in areas of detail and dynamics on the most complex material.

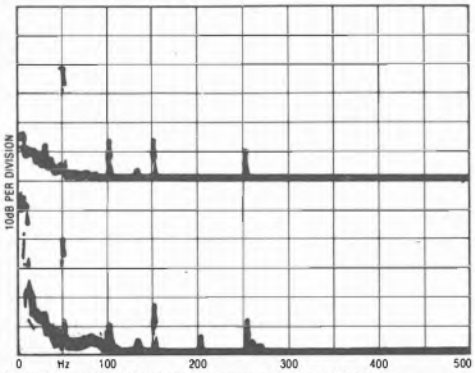
Conclusion

One cannot help but be impressed by the fine finish and construction of this durable subchassis design, as well as by its competitive pricing and good performance both in the lab and the listening room.

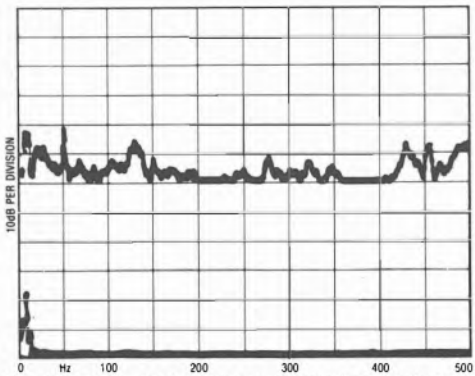
Strong points included very low wow (approaching the Linn in this area) as well as its fine bass. It was easy to set up, remaining stably aligned, and attains a firm recommendation.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

GENERAL DATA — Motor unit

Motor Section

Type	belt-drive, subchassis
Platter mass/damping	2.6kg/average +
Finish and engineering	very good/excellent
Type of mains lead/connecting lead	3-core/ –
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.065%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.007%/0.08%
Absolute speed error	+ 0.5%
Speed drift, 1 hour/load variation	<0.1%/ – 0.18%
Start-up time to audible stabilisation	3.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 80/ – 78dB
Size (w x d x h)/clearance for lid rear	44 x 37 x 15.5cm/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/fairly good
Estimated typical purchase price	£235

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

is this a WIND-UP?

WELL – we could hardly suggest that Edison would have approved, however The Sound Organisation Turntable Stand will improve the sound of ANY turntable ...GUARANTEED... or your money back! For details of your local dealer, see the facing page.

THE SÖUND ÖRGANISATIÖN

Gramophone courtesy of The Talking Machine, Watford Way, Hendon, Middx.

THE AUDIO CENTRE 284 Glossop Road, Sheffield S10 2HS. 0742-737893
AUDIO COUNSEL 12 Shaw Road, Oldham, Lancs OL1 3LQ. 061-633 2602
AUDIO EXCELLENCE 134 Crwys Road, Cardiff CF2 4NR. 0222-28565
AUDIO INSIGHT 53 Wolveston Rd, Stony Stratford, Milton Keynes MKII 1ED. 0908 561551
AUDIO PROJECTS 45 Headingley Lane, Leeds LS6 1DP. 0532 789115
AYLESBURY HI-FI 98 Cambridge Street, Aylesbury, Bucks. 0296-28790
BASICALLY SOUND The Old School, School Road, Bracken Ash, Norwich. 0508-70829
BILLY VEE 248 Lee High Road, Lewisham, London SE13 5PT. 01-318 5755
BRADY'S HI-FI 401 Smithdown Road, Liverpool L15 3JJ. 051-733 6859
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CHICHESTER HI-FI 40 Little London, Chichester, Sussex. 0243-776402
CLEARTONE AUDIO 235 Blackburn Road, Bolton, Lancs BL1 8DR. 0204-31423/399617
CLEARTONE AUDIO 62 King Street, Manchester M2 4WA. 061-835 1156
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EASTERN AUDIO 41 Bramford Road, Ipswich, Suffolk. 0473-217217
ELECTROTRADER 19 Colwyn Crescent, Colwyn Bay, Wales. 0492-48932
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GRAHAMS HI-FI 86-88 Pentonville Road, London N1. 01-837 4412
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RADFORD HI-FI 43 King Edwards Court, Windsor, Berks. 95-56431
RADLETT AUDIO 141 Watling Street, Radlett, Herts. 09276-6497
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THE SOUND ORGANISATION 1 Cathedral Street, London SE1. 01-403 2255 and 3088
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STRATHVISION 51/53 Overgate, Dundee DD1 1QQ, Scotland. 0382-28900
STUDIO 99 88 Fairfax Road, London NW6. 01-624 8855
SUBJECTIVE AUDIO 2/4 Camden High Street, London N1. 01-387 8281
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Dealer List

THE SÖUND ÖRGANISATIÖN

Linn Sondek LP12

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ
Tel 041-634 0371

With a decade or so of production behind the *Sondek*, the 'Nirvana' modification covered by the review in the last *HFC* 'Turntables' edition has now been augmented by a further development called 'Valhalla' (as with the 'Nirvana', this is an easy retrofit). For years now, the popular slow-speed synchronous motors generally fitted to the sub-chassis belt drive turntables have been at the mercy of the mains supply. The latter's frequency, distortion, noise level, transient fluctuations and voltage all affect the motor's output and also the level of vibration emitted from the motor frame. Since the last issue, further refinements have included a bonded rather than a welded subchassis, plinth reinforcements, better springs, loaded main bearing oil and suspension lock nuts.

Ideally such motors should be run from a two phase supply, but the second phase-shifted line has generally been optimised in a less-than-ideal fashion by using a phase shifting capacitor. When a turntable is intended for UK and for US markets, a pulley change is also required.

'Valhalla' solves these problems by effectively isolating the motor electronically from the mains supply. Mains power is rectified and smoothed to feed a bi-phase 100V low distortion power amplifier acting as the motor source. The exact 50Hz frequency is synthesised from a quartz oscillator. When fed clear, stable 50Hz, the motor generates less vibration and mains harmonic components, attaining a near perfect pulley speed stability over both the long and the short term. Power into the belt is more stable, with (in theory at least) a lower rumble and reduced subchassis vibration resulting from the power feed.

General alignment has also been improved with the recent introduction of larger and more accurate suspension springs and deckplate bolts. However the deck is still at present subject to suspension settling with use, and thus requires occasional realignment though new low-fatigue springs are promised to solve this problem in the near future.

To return to basic features, the *LP12* comprises a straightforward full sub-chassis belt driven turntable unit capable of accepting a variety of high quality tonearms. Deceptively simple in design, long experience with the product has shown that it has been subjected to such a high level of detailed development and refinement that almost every component down to the humblest screw fixings can be

shown to have a significant effect on the performance of the whole.

A substantial main bearing is used, with a hardened spindle ground to a slightly radiused point bearing on a thrust plate. High density PTFE sleeves in the bearing provide sufficient rigidity and very low rotational noise levels. The two piece platter is of considerable mass, cast in Mazak and turned to close tolerances, with a special grade of black felt used for the platter mat. Even now, considerable care is needed in setting up an *LP12* in a final installation, and the help of an experienced dealer is virtually mandatory.

Other minor improvements concern the light touch on-off switch with LED indicator, as well as extra screws front and back to help keep the baseboard in position.

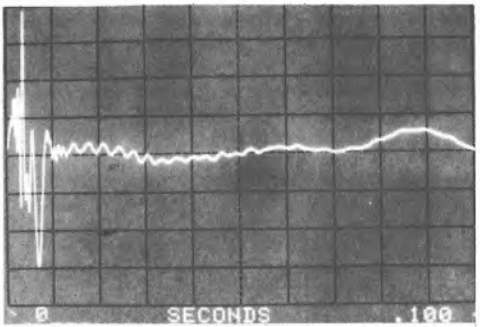
The well damped platter weighs some 4.1kg. Our assessment of disc damping was revised for this issue, and while the initial transient was certainly poorly damped by the felt mat, the impulse died away quickly thereafter, this a good result. A measurement taken last year showing the frequency transform of the felt mat versus an absorbent one has assumed greater significance this time round, inasmuch as it can be seen that while the 'composition' mat produced greater attenuation, its frequency response was uneven, while that of the felt was more uniform, suggesting lower overall coloration.

'Vallahalla' made its mark on the motor results with excellent wow and flutter, plus significantly lower linear wow. Absolute speed and accuracy was satisfactory, while loss under load was very good at 0.13%, another important result. DIN weighted rumble improved to a superb −80dB. In fact the spectrograms for residual measuring system noise and for the *Sondek* were very similar and to check this result the two were submitted to subtraction providing the second rumble photo – no mains related rumble components remain!

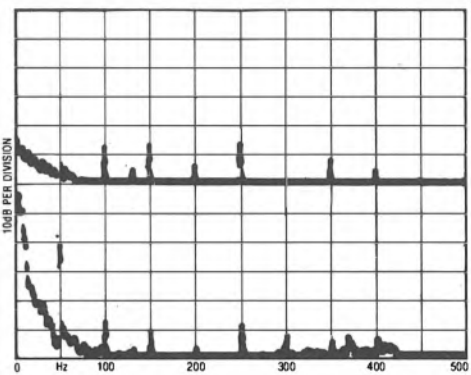
The *LP12* was not the very best in the issue as regards vibration isolation or acoustic breakthrough but the curves did confirm a high standard for these parameters nonetheless. Shock resistance was also quite good, with both acoustic feedback and hum very good.

Sound quality

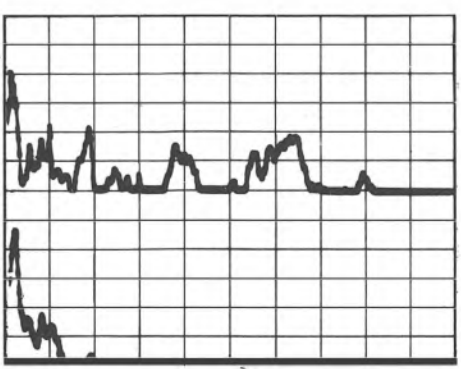
A few years ago it was considered heresy to suggest that turntables could make a 'sound' at all, but meanwhile the *Sondek* has been a leading exponent in demonstrating just how different the subjective performances can actually be. It scored an excellent rating on audition, notwithstanding some mild spectral



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

LINN SONDEK *continued*
imbalance and coloration; a consumer who feels that absolute tonal neutrality is paramount is entitled to reject the *LP12* but should be made aware of the importance of certain other factors. For example the *LP12* has long generated a feeling of 'involvement' with the music for reasons that are only partly becoming understood.

After careful and prolonged listening the *LP12* was found to excel in its ability to retain the timing, tempo, rhythm and pitch of complex percussive sections, failure here producing some loss of interest on the part of the listener. Additional qualities included rapid post-transient decay producing 'transparent silences' between successive notes and these were all too often obscured by hangover in other models. The felt mat also provided a level of tonal integration of bass and treble now considered optimum for the deck. The recent improvements have noticeably controlled the previously mild upper bass excess, this particularly true when the deck is used with a current *Ittok*. The *Ittok* arm still produces a spectacularly good sound with the *Sondek*; the Alphason arm also matched it well.

Conclusion
While many other analogue turntable companies appear to be treading water, Linn have continued to advance the standard of their *LP12*. This year it offered better focus, intertransient silences, stability and solidity. Pitch and rhythm remain excellent though this does depend on precise dressing of the arm cable. Alternatively, very stiff or very compliant arm cables may affect the subchassis dynamics but a good dealer can sort this out. A strong recommendation is maintained for this fine turntable.

GENERAL DATA	Motor unit
Motor Section	
Type	manual, belt-drive, synchronous motor, sub-chassis
Platter mass/damping	4.1kg/good
Finish and engineering	excellent/excellent
Type of mains/connecting leads	2-core
Speed options	33rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.09%/0.05%
Absolute speed error	– 0.2%
Speed drift, 1 hour/load variation	quartz-locked/ – 0.13%
Start-up time to audible stabilisation	6 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 80 dB
Size/clearance for lid rear	44.5(w) x 36(d) x 15(h)/5.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	excellent
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	very good/good
Estimated typical purchase price	£425

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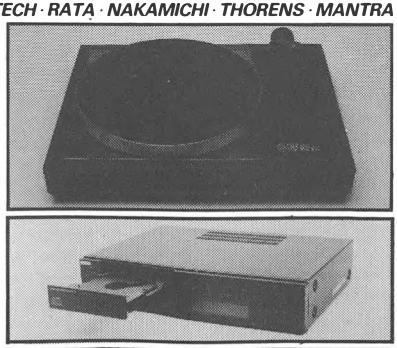

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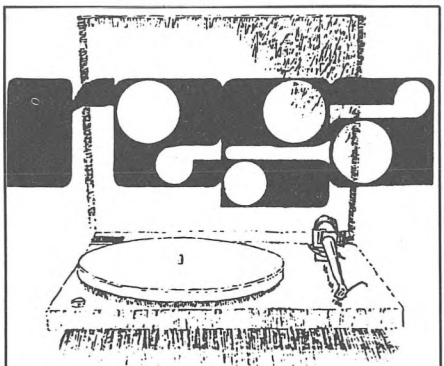

The Planar 3 has been developed to extract the ultimate in sound quality from the Planar design. The turntable is engineered from 12mm plate glass and covered with 3mm thick natural felt. This combination helps stop high frequency vibration feedback to the record and assists the rest of your equipment to produce a stable stereo image and clear unmuddled sound.

The Planar 3and the less expensive Planar 2 are available from:

MAETO MUSIK
14, The Toll.
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Glasgow
Tel: 041-638 8252

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34 Northumberland St.
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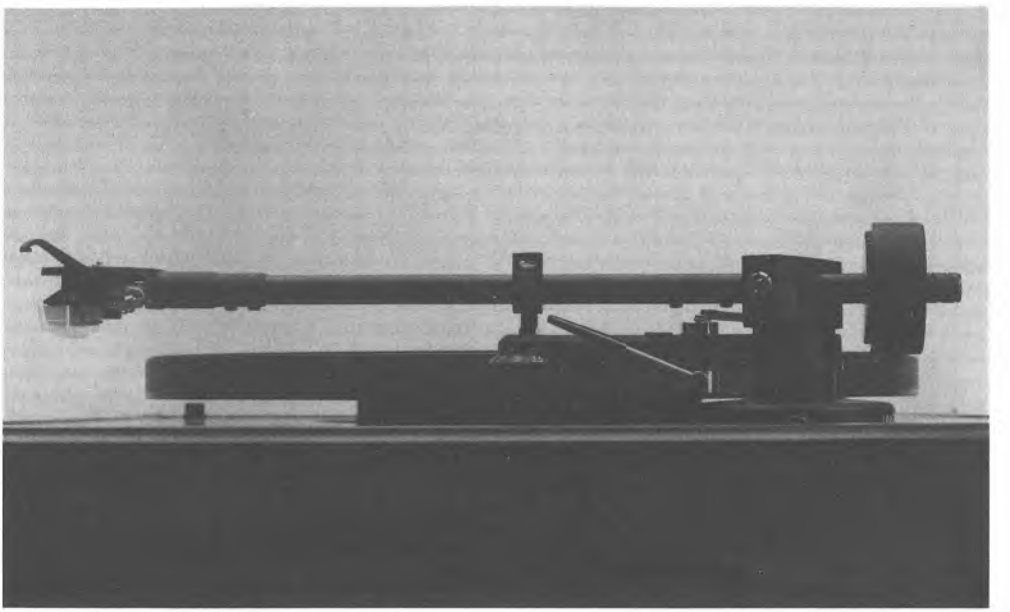
Linn Basik LV Plus

Linn Products Ltd, 235 Drakemire Drive, Castlemilk, Glasgow G45 9SZ
Tel (041) 634 0371



Linn felt that the detachable headshell fitting on their *LVX* represented a weakness, making the arm less suitable, in their view, for low compliance, high energy moving coil cartridges — although the latter have been known to work pretty well in this arm! While continuing to offer the *LVX*, particularly for installation by other turntable makers, Linn decided to revise the arm to produce the *LV Plus*, a model retained for their own distribution.

Here the headshell has been factory fitted and is rigidly as well as permanently fixed. A feature of this relatively inexpensive Japanese-made product is the inclusion of the current *Basik* cartridge, now a competent performer which retails at £15 when purchased as a separate item. Furthermore, the arm is assembled with the bearings set to be free from play, this essential if a satisfactory performance is to be obtained when using a moving coil cartridge. However, on some samples this practice can result in higher friction than usual — indeed this was the case with our arm. A reasonable test which can be applied to check this is to free balance the arm and set it near to the record centre. Dial a small amount of bias, say 0.05g, and observe if the arm swings out slowly and smoothly. If so, the lateral friction is satisfactory, but if not, it should be queried with the dealer. Our sample did have low enough friction to give good tracking, at a 1.8g downforce, but we would have nonetheless preferred less!

Lab report

Effective mass with hardware was around 13g, balanced for a typical cartridge and suited to low to medium compliance cartridges. The geometry was fine, and it proved easy to set up. Vertically the friction was fine at 50mg, but it

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	13g
Type/mass of headshell	fixed
Geometric accuracy	very good
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	good/good/good
Friction, typical lateral/vertical	150mg/50mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	230mg/260mg
Downforce calibration error, 1g/2g	+ 0.1g/ + 0.15g
Cue drift, 8mm ascent/descent	1.0secs/3.5secs
Arm resonances	good
Subjective sound quality	good
Arm damping	decoupled counterweight
Estimated typical purchase price	£95 (inc Basik cartridge)

rose to 150mg laterally. By a double balancing method, the bias correction was estimated at an appropriate 230mg rim and 260mg centre.

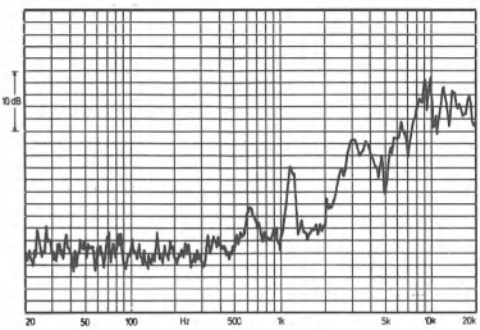
Downforce calibration was fine, though cue descent was a trifle slow. Measured with the *Basik* cartridge installed, the cartridge-coupled arm resonances were charted. The result was notably smooth, showing a good resonance behaviour and with the first mode at 620Hz, the match here being pretty good.

Sound quality

Comparative listening tests showed an improvement over the *LVX*. Midrange coloration was reduced, with an improvement in clarity, detail and punch. Upper bass transients were more articulate, while the treble sounded better integrated as well as more incisive. The arm attained a fine standard for the price.

Conclusion

A worthwhile revision, the *Plus* was a fine tonearm, which in its latest form, and taking into account the inclusion of the *Basik* cartridge, earns a warm recommendation in this 1985 edition. However, a slight reservation remains concerning the lateral friction levels.

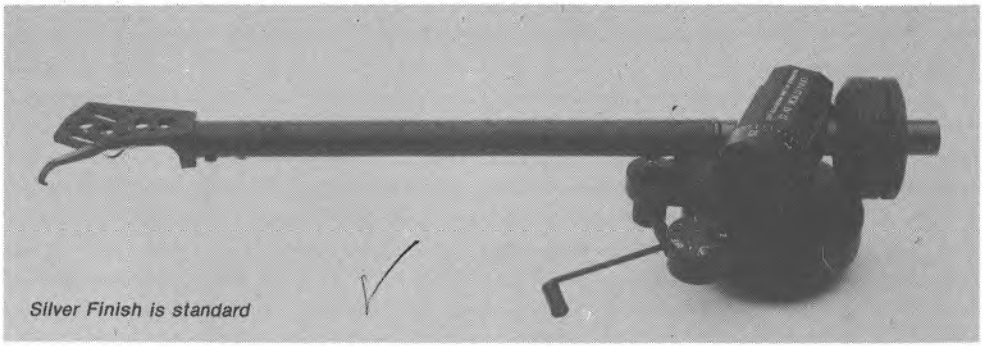


Structural arm resonances, audio band

RECOMMENDED

Linn Ittok LVII

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ
Tel 041-634 0371



Silver Finish is standard

When first released, the *LVII* immediately established an enviable reputation for excellent engineering, sound quality and technical performance. The current version still resembles the original arm, despite some minor constructional changes which have helped maintain a competitive state of 'tune', and the original is by no means rendered obsolete.

A rigid fixed head tonearm, it carries the relatively truthful label 'Direct Coupled' this referring to the ability of this arm to directly couple the cartridge mountlng to the subchassis are board. Considering the requirements for high sensitivty in two planes of freedom at the bearings, this is no mean feat of engineering. While I would not encourage careless handling, my experience of a number of *Ittoks* suggests that not only are they consistently well adjusted but they are also fairly robust compared with many other models.

At close on a 14g effective mass including hardware, the design fits the upper end of the medium-mass group and is best suited to cartridges in the 8-16cu compliance range. Providing a strong foundation for cartridge mounting, the cast magnesium headshell carries a very well designed and non-resonant finger lift and the more recent counterweights exhibit a pretty tight fit on their slightly resilient synthetic bore liners; the importance of this particular aspect may be seen in the improved damping of the resonances at 400Hz, 900Hz and 1.6kHz, when a deliberately loose but non rattling counterweight was substituted.

This arm proved convenient to use, the effective cueing system controlled by a lengthened finger lever fitted with a roller at the top. This aids cueing on floppy subchassis turntables and reduces unwanted spurious shock effects post cueing. In marked contrast to the majority of upmarket audiophile designs, the *Ittok* comes fitted with a well calibrated and respectably accurate dials for both downforce and bias, the latter adjustable during play. A precision low-torque flat coil spring is used for downforce, with a linear coil spring for bias correction. The small but worthwhile improvements noted with later models include an increase in diameter of the main pillar cylinder together with a larger socket head clamping bolt allowing an unrivalled strength three-point lock to be obtained between arm and base. The main tube is now hard anodised in a darker shade of grey with a lacquer coating and the bonding of various parts has also been uprated by the use of larger bolts with heads capable of accepting greater tightening torque.

Lab report

Geometric accuracy was considered excellent, with a properly square headshell and adjustment provided for overhang, lateral angle and height. The alignment is in fact virtually optimised for our two point minimal subjective distortion criterion. Finish and engineering were both excellent and the arm proved easy to assemble, set up and use. Friction was superb at around 10mg or less in both planes, with no detectable slack. Biasing was in the correct ratio if marginally low in our estimation (based on a normal elliptical stylus), but downforce was well within the required tolerance. The cue worked well with a sensible rate and negligible drift. Arm resonances were classed as very good with the first main flexure deferred to a high 1kHz, this suggesting a remarkable rigidity.

As has been noted previously, the close nature of the coupling between arm and mounting board meant that the latter becomes

influential as regards final sound quality.

Sound quality

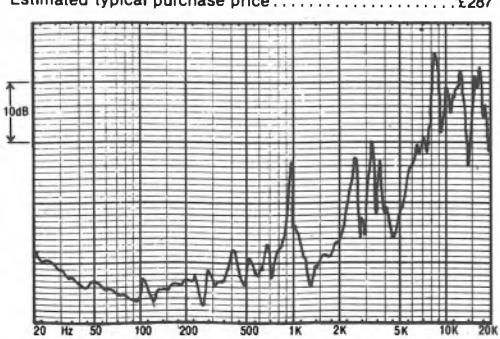
The overall rating is a secure 'very good, but as with all acoustic components the final result obviously represents some sort of balanced compromise. In our view the *Ittok's* strengths lie in its subjective speed of response to transients, its fine transparency and its ability to reveal atmosphere, depth and fine detail. The bass was to a fine standard with good extension and drive, while the treble was also revealing of detail if very slightly brash and forward at times. A trace of upper-mid hardness was also noted, where the stereo focus suffers a mild dilution. The importance of this depends on the final combination of equipment chosen.

Conclusion

A top-quality universal tonearm, recent minor improvements in fixings, counterweight tightness and form, plus a revised cable with superior fittings have all helped it to maintain a highly competitive position. Suitable for many turntables, it performs at its best on the current *LP12*, where the performance of the combination exceeds the sum of the parts.

This superbly engineered and finished arm remains strongly recommended. Experiments with alternative cables may prove rewarding but beware of upsetting the suspension dynamics of the *LP12*.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	est. 13.5g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	height/overhang/lateral angle
Finish and engineering	excellent/excellent
Ease of assembly/setting-up/use	very good/very good/very good
Friction, typical lateral/vertical	less than 10mg/less than 10mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	175mg/195mg
Downforce calibration error, 1g/2g	less than 0.03g/0.038g
Cue drift, 8mm ascent/descent	negligible, 0.8 secs/1.8 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	100 pF/none
Estimated typical purchase price	£287



Structural arm resonances, audio band

Lux PD290

HW International Ltd, 3-5 Eden Grove, London N7 8EQ
Tel 01-609 0293

This moderately-priced integrated player could sell on its Lux, sorry looks, alone! Finish and styling are in the excellent Lux tradition, although to some extent beauty is only skin-deep — the *PD290* is another of those lightly constructed rigid plinth/rubber feet designs.

Powered by a quartz-locked direct-drive motor, the platter has a fine finish and a moderate weight of 1.35kg. The main bearing tolerance was very good with no detectable slack; but conversely the motor foundation on the plinth was none too strong and the platter could be rocked fairly easily with respect to the plinth.

Made from a highly resonant grade of polystyrene, the clear lid is hinged directly onto the plinth — no discouragement to acoustic feedback. The arm was thought pretty flimsy, with a rather weak detachable headshell, and significant play was noted in the vertical arm bearings. Semi-automatic functions are provided, these including motor start with arm cueing.

Lab report

The motor Lux have fitted gives very good speed characteristics. DIN peak wow and flutter measured 0.09% with flutter alone 0.06% and wow 0.11%, these two figures linear peak weighted. Absolute speed was accurate while speed loss under load was zero, due to the quartz locked reference. Start-up time was average at 3.5 seconds, while the motor exhibited a slight speed overshoot here.

Rumble, DIN B weighted, was fine at 74/78dB, the spectrum analysis showing a reasonably low incidence of spurious rumble noise. Most belt driven decks can of course improve upon this standard. The deck did not perform very well with respect to vibration isolation below 100Hz and the acoustic isolation, as predicted, was quite poor, particularly above 250Hz. The disc impulse response was not too encouraging — a wild looking series of higher frequency ringing was followed by long lived resonances fully active after nearly 100ms had expired.

Tonearm bearing friction levels were just satisfactory while the bias compensation was inadequate, at about one third of the optimum value. Downforce calibration was however fine. Charted for structural arm resonances, this design was not judged to be very rigid with the first break seen as low as 180Hz and with serious modes present at both 240 and 460Hz.

Sound quality

On audition the *290* performed a litte better than the lab results might suggest. Although not outstanding in any respect, it provided a pleasantly bland and inoffensive performance. The stereo

sound stage was rather flat and two dimensional, and the natural dynamics of the programme were somewhat compressed, robbing the reproduction of its full excitement. The sound was not really 'transparent' and yet was quite easy to live with.

Conclusion

For the non-critical user who likes Lux styling and finish, and who requires a basic turntable, the *PD290* could be worth considering. In that case the recommendation is to fit a competent moving magnet cartridge in the £15-£25 range and mount the deck on a rigid shelf well away from the loudspeakers.

GENERAL DATA Integrated turntable

Motor Section

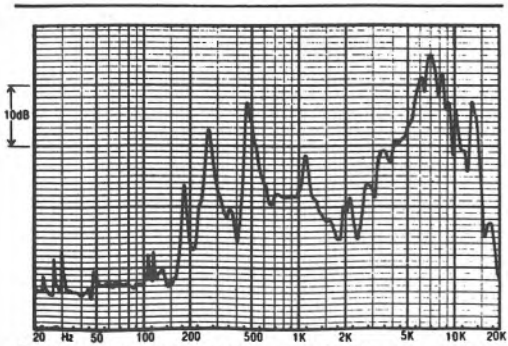
Type	semi-auto, quartz, direct drive
Platter mass/damping	1.35kg/good
Finish and engineering	excellent/good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.09%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.11%/0.06%
Absolute speed error	– 0.05%
Speed drift, 1 hour/load variation	none/none
Start-up time to audible stabilisation	3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 74/ – 78dB

Arm section

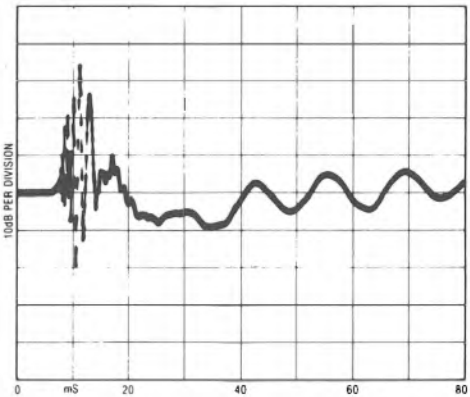
Approximate effective mass, inc screws, excl cartridge	10.5g
Type/mass of headshell	non-standard, detachable/3g
Geometric accuracy	fairly good
Adjustments provided	overhang/offset
Finish and engineering	very good/average
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	60mg/60mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	80mg/80mg
Downforce calibration error, 1g/2g	– 0.02g/none
Cue drift, 8mm ascent/descent	very good, 2.0 secs/3.0 secs
Arm resonances	average –
Subjective sound quality	average –
Arm damping	none

System as a whole

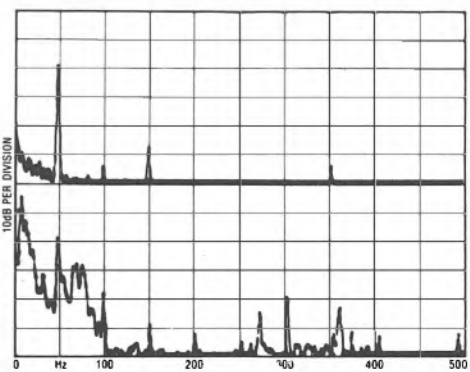
Size (w x d x h)/clearance for lid rear	44 x 37 x 15cm/6cm
Ease of use	very good
Typical acoustic breakthrough and resonances	fairly poor
Subjective sound quality of complete system	average –
Hum level/acoustic feedback	good/poor
Vibration sensitivity/shock resistance	poor/fairly good
Estimated typical purchase price	£145



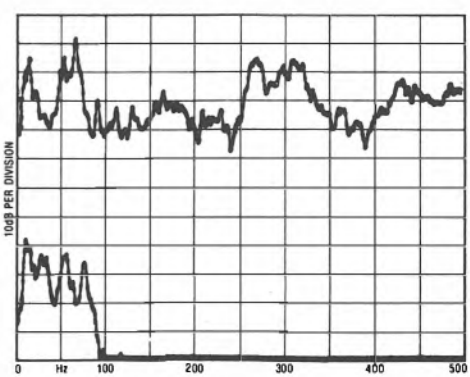
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

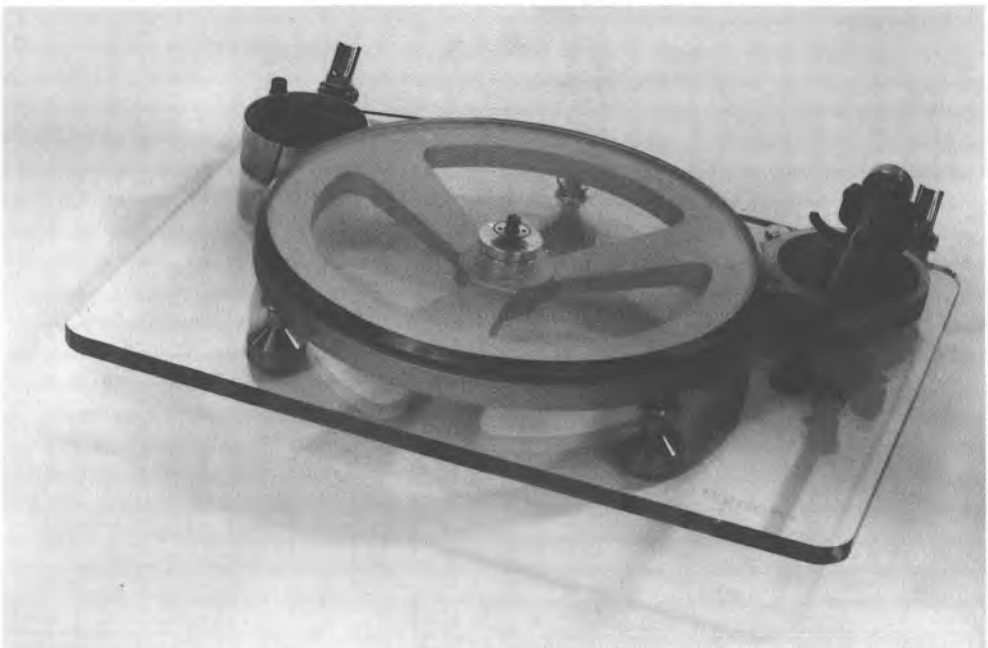


Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Michell Synchro

J. A. Michell Engineering Ltd, 2 Theobald Street, Borehamwood, Herts
Tel 01-993 0771



For quite some time Michell have been producing a turntable in the high price category, the *Gyrodec,* as well as the moderately-priced *Focus.* Now a middle-rank Michell has emerged, this is a true subchassis design called the *Synchro.* In common with the other models it has a striking, 'engineered' appearance, with all the working parts exposed and fully finished.

A cast ring subchassis is used, rather like a scaled down version of the *Gyrodec,* with a strong outrigger platform for arm mounting and a three point coil spring suspension. The assembly is mounted on a pale green tinted, clear acrylic base and the matching, round cornered lid, as well as the thick plate glass platter are all similarly tinted. A thin felt mat is provided in a darker shade of green. The synchronous motor feeds power via a rubber cord to the periphery of the platter. Speed change is effected manually by changeover on the two pulley diameters. The feet are screw-in, with a choice of rubber-faced or hard alloy pointed types, the latter proviing popular at present.

Lab report

The platter proved to have good self-damping, and while the initial disc impulse transient was considerable, it decayed quickly, with minimal subsequent resonance.

The suspension system proved highly effective in blocking both airborne energy and vibration through the feet. What breakthrough was present proved even in character. The suspension did prove rather 'whippy' in the laterial and rotational planes, which unfortunately produced a poor result for shock resistance.

On the combined DIN peak weighted wow and flutter measurement a fine 0.05% was observed, with low individual contributions of flutter and wow. The generous platter mass and fine tolerancing were contributory factors here. On absolute speed it ran a little slow, −0.06%, but drift was negligible while slowing under load held to a fine −0.22%. Start up was comparatively rapid at 2.5 seconds, indicating healthy torque. DIN B weighted rumble was very fine at −77dB with the spectrogram showing low levels of electrical and mechanical noise.

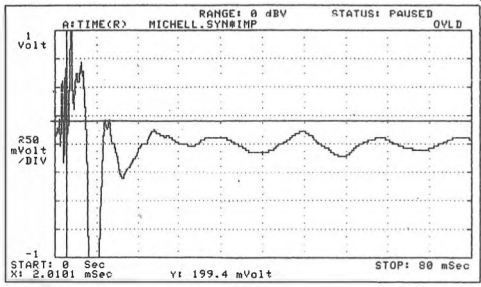
RECOMMENDED

Sound quality

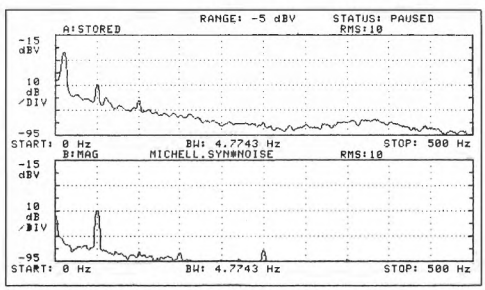
Our initial sample disappointed with a poor subjective pitch stability. The cause turned out to be an almost imperceptible mechanical interference between the close fitting platter and chassis, and when solved, the player then provided a very good standard of sound reproduction, with firm bass and an articulate, detailed stereo presentation with good stage width and depth. Coloration was low while pitch and timing were of a high order. Feedback effects were negligible.

Conclusion

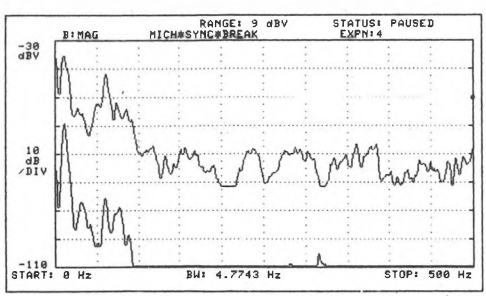
For the price, the *Synchro* offered an appealing combination of finish, engineered style, and a good lab performance, plus a fine sound quality. It was versatile with respect to arm fitting, and complemented the Rega *RB300* well, our test arm choice. As such, the *Synchro* comfortably achieved recommendation.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is –80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

GENERAL DATA Motor unit

Motor section

Type	manual, belt-drive, subchassis
Platter mass/damping	see text/good
Finish and engineering	excellent/excellent
Type of mains lead/connecting lead	2 core
Speed options	manual 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2)	0.05%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.08%/0.06%
Absolute speed error	– 0.6%
Speed drift, 1 hour/load variation	negligible/ – 0.22%
Start-up time to audible stabilisation	2.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 77dB

System as a whole

Size (w x d x h)/clearance for lid rear	46 x 33.5 x 13cm/8.5cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/poor
Estimated typical purchase price	£290

RECOMMENDED

Michell GyroDec

J A Michell Engineering Ltd, 2 Theobald Street, Borehamwood, Herts
Tel 01-953 0771

A recently developed model, the *Gyrodec* represents Michell's concept of a top-quality no compromise turntable. A large design fitted with a costly hand fabricated glass-clear acrylic case and lid, the *Gyrodec* has provision for the symmetrical attachment of one or two arms as required. Carrying a five-year guarantee, it has been well thought out with regard to setting-up and all parts are accessible without the need for the removal of baseplates and so on.

Representing Michell's first subchassis design, the massive spoked 'wheel' chassis casting is preloaded with lead weights to largely counterbalance the arm masses. The whole is suspended in compliant coil springs resiliently mounted within the three suspension towers adjacent to the platter, and as previously mentioned, the system is readily adjusted from above upon removal of the spring covers. Special mounting plates of thick alloy are provided for individual arms, these of different mass to give a constant state of balance without recourse to changing springs. The alloy platter is loaded for both mass augmentation and for resonance distribution by an array of weights on the underside, these heavily gold plated.

A one piece component, the platter is driven at its grooved periphery by a thin rubber cord powered via a large hysteresis synchronous motor made by Papst. This is a low voltage type, fed via a small transformer in the mains supply lead. Two speeds are provide via the motor pulley, with the appropriate section easily selected by hand, since the drive is entirely exposed in this model.

A key feature is the incorporation of a full clamp absorption system for record damping. A polymer mat is used, in conjunction with a record label clamp, this bearing over a central washer and thus tensioning out all but the most stubborn of warps. In this respect the Gyrodec bears a great similarity to the Oracle.

Lab report

The platter weighed some 4.5kg and proved to be well damped with respect to the disc impulse response. The initial transient was well trapped, but a low frequency aftershock was present at about 40Hz — probably platter rock on the main bearing total compliance. Wow, flutter and integrated wow and flutter were all very low particularly for a belt drive. Absolute speed was about 0.2% slow while a further 0.3% slowing (slightly high) occurred on

standard loading. Start-up time to audible pitch stabilisation took a very long 9.5 seconds, mainly due to oscillation of the platter inertia against the belt compliance. Poorly damped, this could be an influence on subjective pitch stability on transient programme.

Rumble was very good at −77dB, showing just the slightest incidence of motor rotational components, and its resistance to acoustic and vibration breakthrough was so extraordinary that the scales had to be magnified by 10dB to bring the residual coupling into sight. Hum levels were fine and acoustic feedback excellent, while shock resistance was also very good.

Sound quality

Just failing to make the top grade the *Gyrodec* scored a very high mark on audition. it sounded very neutral and transparent, producing stable and spacious stereo images with impressive depth. Bass was substantially even with weight, power and attack. Our one reservation concerned a something which may in practice prove less important to other listeners, namely dynamic wow. On rock programme with heavy transients a trace of pitch instability was evident, believed due to this effect.

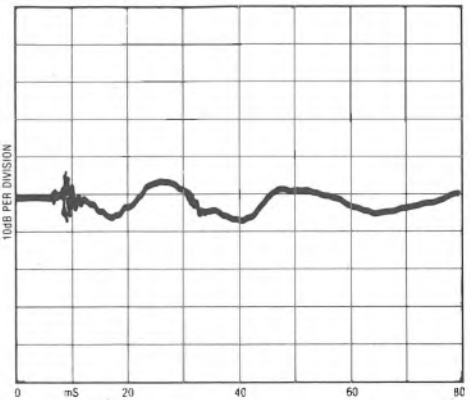
Conclusion

The *Gyrodec* was significantly improved some time ago by the adoption of a double cord drive system (not shown in the photo). This has improved the start time as well as having reduced short-term pitch variations. Subsequent auditioning revealed a more stable sound with much better pitch and timing.

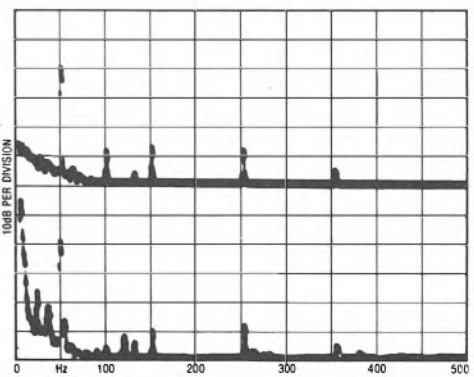
In view of the fine overall engineering and generally good performance, the *Gyrodec* carries a recommendation in the current issue despite its elevated price tag. As many have commented, the appearance does go some way towards justifying the cost.

GENERAL DATA Motor unit

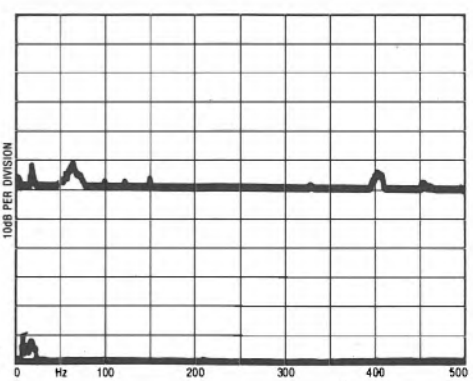
Type.....manual, belt-drive, synchronous motor, subchassis
Platter mass/damping.....4.5kg/very good
Finish and engineering.....very good/excellent
Type of mains/connecting leads.....2-core, line transformer
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....less than 0.04%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)
less than 0.0 %/0.04%
Absolute speed error.....−0.2%
Speed drift, 1 hour/load variation.....synchronous/−0.3%
Start-up time to audible stabilisation.....9.5 secs
Rumble, DIN B wtd L/R average (see spectrum).....−77 dB
Size/clearance for lid rear.....53(w) x 42(d) x 19(h)/4cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....excellent
Subjective sound quality of complete system.....very good
Hum level/acoustic feedback.....very good/excellent
Vibration sensivity/shock resistance
excellent/very good
Estimated typical purchase price.....*£595
includes dealer set-up, arm fittings, clamp mat system



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



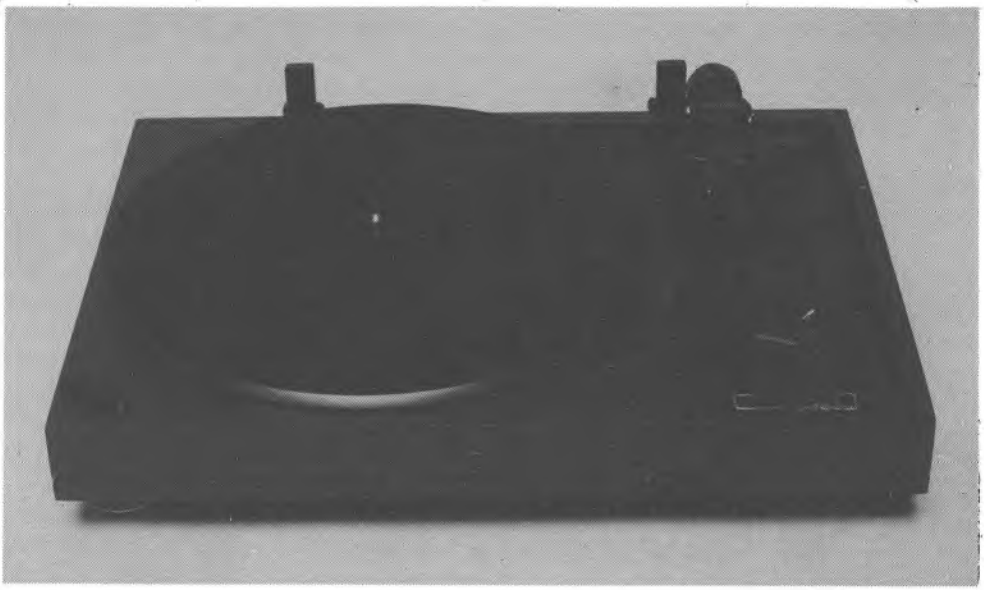
Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

RECOMMENDED

Mission Cambridge 775LCT

Mission Cambridge Ltd, Stonehill, Huntingdon, Cambridge PE18 6ED
Tel (0480) 57477



This new product from Mission forms a significant part of the £500 Mission record-playing system, soon to be followed by a less expensive system which should retail for around the £400 mark. To this end the *775*, benefiting from volume production, has been kept down in price, recently as low as £99 plus arm. In fact, the deck comes fitted as standard with a Mission *774LC* tonearm (see separate review), but it also has Linn-style arm mounting arrangements so can be fitted with a number of other compatible arms.

The prestigious *775SM* was assessed last time round and to all intents and purposes one could regard the *775* as a lower cost development of that design. A solid plinth construction is adopted, the plinth being made from a very thick and highly rigid composition board. Mission aim to 'close the loop' between arm and platter and thus exclude external interference, for isolation the plinth has three non-adjustable sponge feet in high-loss Sorbothane, these capped by load spreading cups.

A fairly resonant polystyrene lid is fitted while the two piece platter has an alloy outer disc weighing about 1.5kg resting on an inner plastic hub. The 500rpm synchronous motor is virtually rigidly mounted on the plinth, and could give rise to breakthrough problems. This is linked to the platter via a neoprene cord running on a 'V' groove pulley. Speed change is manual, effected by flicking the cord from one step in the pulley to the other. No alignment or adjustment is required and if fitted with a tone-arm, the *775* should work, immediately it is unpacked and the platter put in position.

Lab report

The limited shelf or support isolation was shown by the graphs where around 10dB of vibration rejection was apparent in the 30-500Hz range, as compared with 20-30dB for the subchassis designs. Acoustic energy was handled better if still below average, but both of the breakthrough curves were of an even and non-resonant character.

Using the thin felt mat, the disc impulse response was fairly typical of this type of mat, but the subsequent decay was rather quicker than usual. A slight 'ring' was evident at 180Hz, probably a platter rocking mode. Wow and flutter were only just satisfactory on an early sample, but improved with a second one. Rumble was certainly poorer than average but not unacceptably so at around −70dB, analysis showing the predicted emergence of some motor related components at a

satisfactory level. Torque was good with minimum slowing under load and the other speed characteristics were fine.

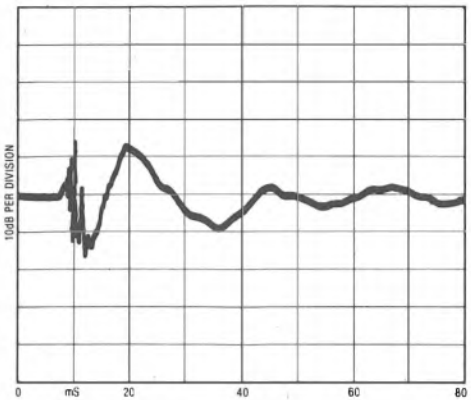
Sound quality

Assessed with the *774LC* tonearm, this turnable confounded some of our prejudices concerning solid plinth designs. It gave a tidy, coherent and well integrated sound. Dynamics were good, with an almost tactile percussive impact. Pitch and rhythm were also good, lending an almost 'boppy' effect with the help of an above-average bass quality, this being a bit lightweight but tuneful.

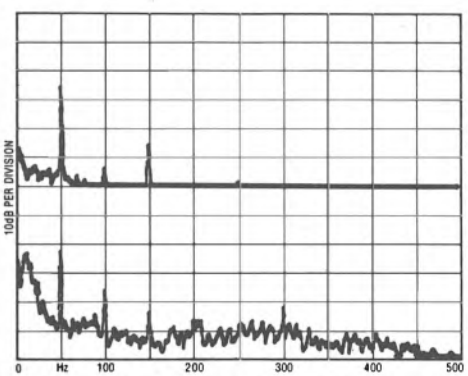
Stereo focus was impressive through the range was a trifle up front with some loss of depth. The sound was distincly improved when the lid was removed, and this is our recommendation for serious listening. Both deck and arm appeared well matched.

Conclusion

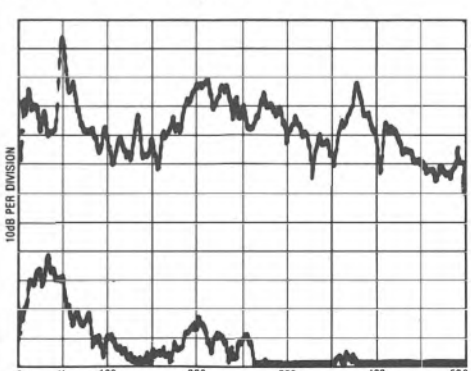
Supplied for this new edition in revised form, complete with cartridge at around £195, this turntable continued to do well despite a noticeable increase in motor noise with recent samples. Its musical drive and integrity remains, allowing us to continue our recommendation. It still sounded a little better with the lid removed despite lid improvements, and it performed optimally on a dedicated wall-mounted shelf.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

GENERAL DATA — Integrated turntable (inc cartridge); or motor unit only

Motor Section

Type	belt-drive, subchassis
Platter mass/damping	2.15kg/fairly good
Finish and engineering	very good/good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.07%
Absolute speed error	+0.1%
Speed drift, 1 hour/load variation	0.09%/–0.21%
Start-up time to audible stabilisation	1.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	–77/–75dB

Arm section (Mission 774LC)

Approximate effective mass, inc screws, excl cartridge	12g
Type/mass of headshell	non-detachable
Geometric accuracy	very good
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	30mg/30mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	120mg/120mg
Downforce calibration error, 1g/2g	–0.08g/–0.2g
Cue drift, 8mm ascent/descent	very good, 0.5 secs/4.0 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none

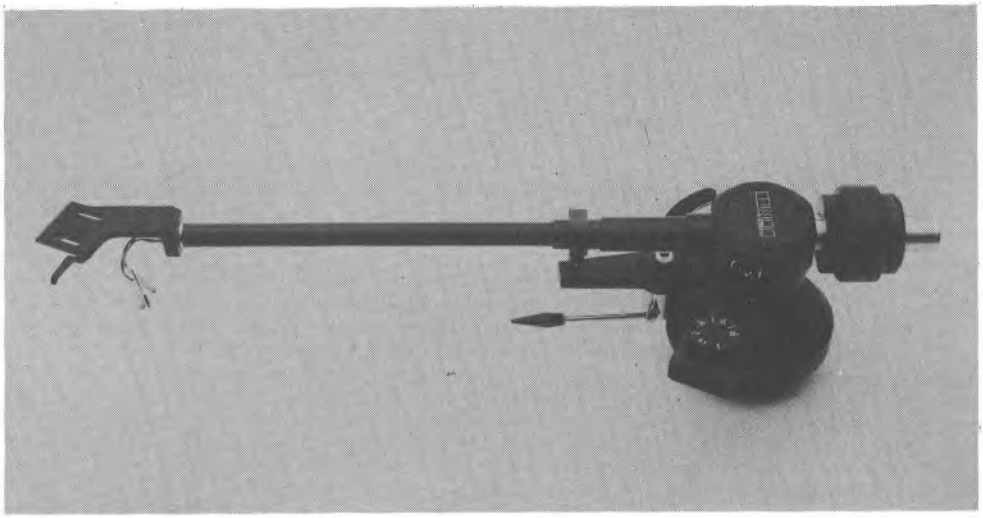
System as a whole

Size (w x d x h)/clearance for lid rear	43 x 33 x 12.5cm/4cm
Ease of use	good
Typical acoustic breakthrough and resonances	fair
Subjective sound quality of complete system	good
Hum level/acoustic feedback	average/fair
Vibration sensitivity/shock resistance	average –/fairly good
Estimated typical purchase price	£195 (with cartridge)

RECOMMENDED

Mission 774LC

Mission Cambridge Ltd, Stonehill, Huntingdon, Cambridge PE18 6ED
Tel (0480) 57477



Supplied with the *775LCT* turntable, as well as with a number of decks from other manufacturers, this tonearm has become well established, in a market containing some notable competitors such as the Linn *LVX*.

Built to Mission's design in Japan, this tonearm is a conventional gimbal type, but with some interesting constructional features. The headshell is fixed, conceived as a rigidly mounted cartridge platform. Step-tapered, the main beam design has been chosen to distribute and moderate self-resonance, and is constructed from aluminium alloy. No damping is used for the counterweight, bar the inherent imprecision of its friction-locked rotating design.

Conveniently, the arm uses the same mounting arrangements as the Linn models, and indeed the arm pillars are essentially interchangeable in their mounting plates. Both makes use a side locking arrangement for arm height, fixed by a large socket head screw.

Current production provides for well adjusted bearings free from slack, and the standard of construction and finish are particularly good. A standard Japanese type connector is used, fitting the usual socket below the pillar.

Lab report

With hardware, the effective mass was noted at 12g, with a typical cartridge balanced out. This is rated as 'medium' and is best suited to cartridge compliance in the 10-20cu range. Geometric accuracy was fine, while adjustments were available for offset angle, overhang and height. The arm was considered to be well adjusted with low friction in both planes, typically 30mg. The internal spring bias compensator worked well in terms of low friction but gave forces around half that normally required, and if this is typical, the user should increase the dialled setting, or even better still, adjust by trial and error using a suitable record. Downforce calibration was set on the low side but not seriously so.

Cue drift was negligible though cue descent was slow for our test 8mm drop. Structural arm resonances were charted and showed a modestly damped counterweight mode at 180Hz but a rather better performance up-band, the next mode bing deferred until 600Hz and almost too small to identify. Something else happened at 800Hz but barring this irregularity, the rest of the range looked pretty tidy. 'Fairly good' is the rating here.

Sound quality

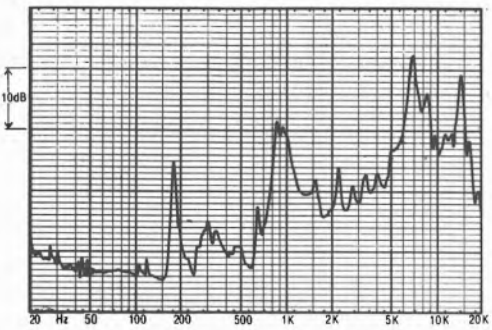
This arm is so popular that potential purchasers could audition it on a number of players to help gain a good idea of its intrinsic sound quality.

Taken overall, a clear explicit sound was produced, with good stereo focus as well as pleasing stereo depth. Depending on the cartridge, the upper frequency range could sound a little untidy, while some coloration was apparent in the midrange. Bass was comparatively secure and gave quite good detail and fairly good articulation. Generally partnered by modest moving magnet cartridges, it will also work well with some of the inexpensive moving coil models, though not in my view with the *TRAK*.

Conclusion

This well constructed tonearm meets a real market need, providing the right product at the right price level. It gave a good all round performance, while to a large degree, its acceptance and use on a number of decks confirms our judgement here. This arm is a candidate for recommendation.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	12g
Type/mass of headshell	non-detachable/—
Geometric accuracy	very good
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	30mg/30mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	120mg/120mg
Downforce calibration error, 1g/2g	−0.08g/ −0.2g
Cue drift, 8mm ascent/descent	0.5 secs/4.0 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none
Estimated typical purchase price	£80



Structural arm resonances, audio band

BEST BUY

NAD 5120

NAD Ltd, Cousteau House, Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 27737

Now significantly revised, the NAD *5120* remains a boldly unusual design. When reviewing the earlier version of this product for another publication, I criticised its floppy, printed circuit tonearm, and felt that it was also a touch expensive. At the time NAD UK reacted adversely, but nonetheless, the 'flat' tonearm has since then been replaced by a conventional tubular type, and the price has been cut to a competitive £99, this including the worthwhile Ortofon *OM10* cartridge.

Amazingly, at the price, this Czech-oslovakian-built turntable is a true floating subchassis type. The suspension needs no alignment, employing as it does the B&O style of leaf springing. The lightweight pressed alloy platter is beefed up by a substantial hard mat insert, bringing the total mass to a still-modest 1.15kg. The inner platter drum is of moulded plastic, belt-driven from the usual type of slow speed synchronous motor. One control actuates the speed change mechansism and another to control cueing. Auto-stop and lift-off facilities are incorporated. The non-resonant lid is formed from acrylic, while the plastic plinth is supported on hard rubber feet.

Lab report

This player achieved presentable results on wow and flutter measurement. Wow and flutter was 0.1%, DIN peak weighted, while the separate flutter and wow contributions were well balanced. Absolute speed was acceptably close and slowing under load was satisfactory at −0.28%. Rumble was however poorer than expected at −68/−64dB, DIN B weighted. Looking at the spectral analysis, some motor harmonics can be seen, at 100 and 200Hz, which were enough to affect the DIN reading.

Vibration isolation was pretty good, but the light platter did not promote a very strong result on rejection of acoustic breakthrough — this peaked at 360Hz. The disc impulse response was also unpromising; the initial transient was handled well, but the platter continued ringing at several frequencies thereafter. Suspension dynamics were fairly good, if a touch 'whippy' in rotation.

Arm effective mass was measured at 9.0g, which suited the cartridge supplied, while lateral friction was rather high and measured 0.3g. This poor value interfered with the measurement of the bias compensation which had to go unrecorded. Downforce calibration was on the low side, which is not the best direction to err. The arm's resonant behaviour was considered poor, the graph being charted with the supplied Ortofon cartridge and hence representative of typical use conditions. The major break was at 350Hz and was particularly severe, but there were no problems over the rest of the range. The damper when used as instructed proved effective and was a useful extra in improving tracking and stability.

Sound quality

For a budget model, this latest NAD did pretty well. With the cartridge at 2.0g, the arm friction noted did not appear to pose any problem. The turntable exhibited some lower midrange

coloration although this was not too serious.

Stereo images were stable and showed some sense of depth and scale, while the bass was satisfactory, possessing a fairly tuneful quality, better than usual for the price.

Conclusion

This player was quite close to our Best Buy classification, but was held back by doubts concerning sample quality. The review model was an early one, but still should have exhibited better arm friction.

(Note: a new sample showed further improvements to the arm, and this deck is now rated a 'Best Buy').

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

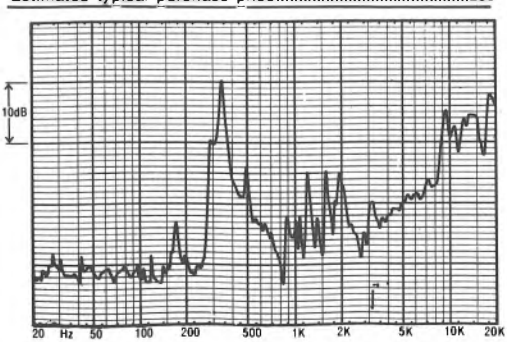
Type.....semi-auto belt-drive, subchassis
Platter mass/damping.....1.15kg/average +
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.12%/0.12%
Absolute speed error.....+0.25%
Speed drift, 1 hour/load variation.....synchronous/ – 0.28%
Start-up time to audible stabilisation.....2.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 68/64dB

Arm section

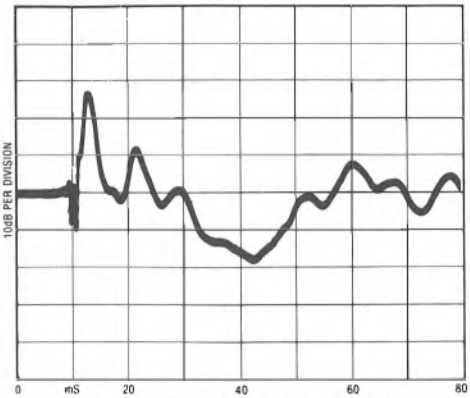
Approximate effective mass, inc screws, excl cartridge.....9.0g
Type/mass of headshell.....non-detachable/—
Geometric accuracy.....good
Adjustments provided.....overhang/offset
Finish and engineering.....good/fairly good
Ease of assembly/set-up/use.....very good
Friction, typical lateral/vertical.....320mg/<20mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....see text
Downforce calibration error, 1g/2g..... – 0.15%/ – 0.3%
Cue drift, 8mm ascent/descent.....<0.5 secs/2.5 secs
Arm resonances.....poor
Subjective sound quality.....average –
Arm damping.....effective silicone dashpot

System as a whole

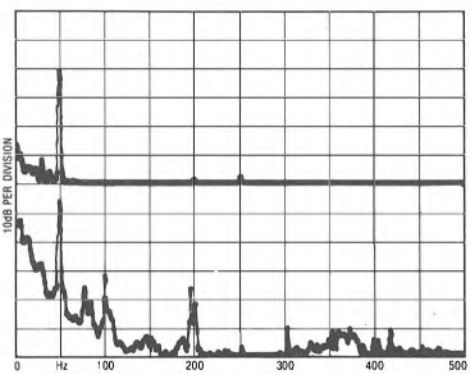
Size (w x d x h)/clearance for lid rear.....42 x 35.5 x 11cm/3cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....average +
Subjective sound quality of complete system.....average +
Hum level/acoustic feedback.....good/good
Vibration sensitivity/shock resistance.....good/fairly good
Estimated typical purchase price.....£99



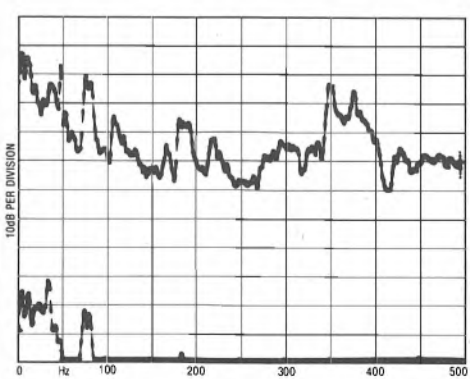
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

RECOMMENDED

Oracle Alexandria

Absolute Sounds Ltd, 42 Parkside, London SW19
Tel 01-947 5047

Generally supplied as an integrated turntable, the *Alexandria* is the latest model from Oracle. It is an attractive design, built into a conventional plinth, and is finished in satin aluminium with a rosewood surround, and a hinged tinted cover.

Three detachable polished cylinders conceal the suspension springs, which are easily adjusted from above. The deck is powered by a Papst dc Hall effect motor, fitted with a large flywheel, the motor coupled to the platter by a precision flat belt. An outboard power supply is used, its external location affording low hum levels. The subchassis incorporates a spirit level to aid alignment and the two-piece platter helps belt loading. The outer platter section is fitted with a dense rubber damping ring on its periphery, and has been carefully balanced — there is an identifying keyway to maintain accurate alignment with the inner platter.

While it still has the established Oracle 'tacky' surface, to improve coupling to the disc, the mat is now carbon-fibre loaded to increase its rigidity. This is made use of in conjunction with a dome washer and the precision screw-down record clamp, which engages with the upper threaded portion of the platter spindle.

An average-sized conventional main bearing is fitted, incorporating oil lubrication. Engineering fit and tolerances are good throughout.

The turntable came ready fitted with the *Prelude* tonearm, which has a separate connection panel for a flexible signal link from the subchassis, to help allow free movement of the suspension. A conventional phono-connected cable runs from the plinth output sockets to the amplifier.

The *Alexandria* is now also available without the fitted *Prelude* arm, in which form the asking price is around £700.

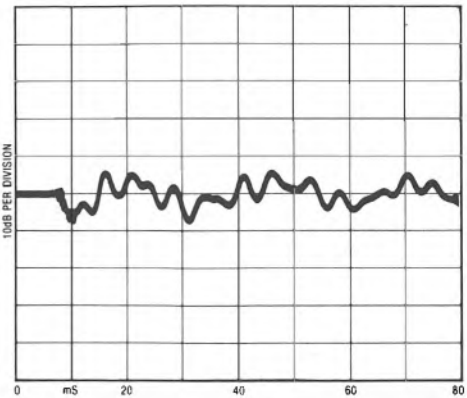
The arm has a fixed skeletal headshell, although this does possess an adequate cartridge mounting area. Many adjustments are provided, including lateral angle, overhang, tilt and height. The height adjustment allows correction for the cartridge vertical tracking angle (vta) during play, which may be rated as highly important by some users. Biasing is via the reliable thread and weight system and the arm also incorporates a sensitive end-of-side lift, a useful extra. Effective mass when set for a typical cartridge is around 9g, suiting it to cartridge compliances int he 10-25cu range, depending on cartridge mass. The arm's vertical geometry is also designed to improve tracking stability over high modulation passages and this behaviour was confirmed on test.

Lab report

The platter's mass was 3.1kg and in conjunction with the mat and clamp system, provided very good disc damping. However the platter itself was not free from resonance, as the disc impulse shows; here the finer long duration ripples are due to platter modes at 240 and 160Hz, identified via the frequency transform, but these aside disc damping was very good.

Wow and flutter, DIN peak weighted, was very good at 0.055%, with moderate linear wow and low flutter. Speed stability was fine, while good torque was also demonstrated, the

continued



Disc impulse transmission showing damping

GENERAL DATA Integrated turntable

Motor Section

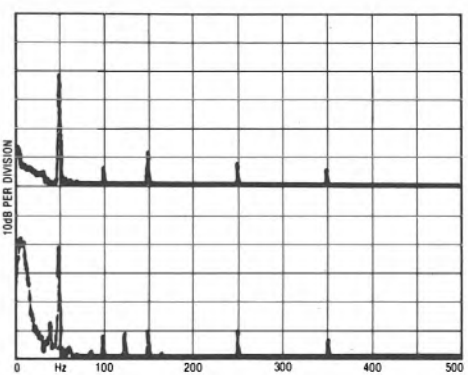
Type	belt-drive, subchassis
Platter mass/damping	3.1kg/average
Finish and engineering	excellent
Type of mains/connecting lead	2-core remote/phonos, earth
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.055%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.07%
Absolute speed error	adjustable pitch
Speed drift, 1 hour/load variation	approx 0.15%/ – 0.25%
Start-up time to audible stabilisation	3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 80/ – 82dB

Arm section

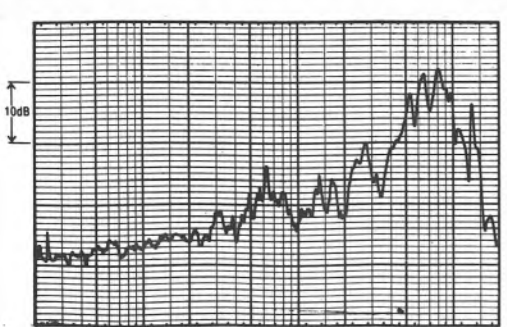
Approximate effective mass, inc screws, excl cartridge	9g
Type/mass of headshell	non-detachable
Geometric accuracy	very good
Adjustments provided	tilt/height/overhang/offset
Finish and engineering	very good
Ease of assembly/set-up/use	good
Friction, typical lateral/vertical	<20mg/<20mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	300mg/250mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	very good, 2.5 secs/1.5 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none

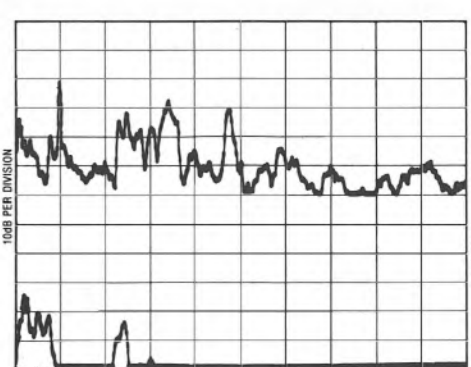
System as a whole

Size (w x d x h)/clearance for lid rear	49 x 38.5 x 15.5cm/6cm
Ease of use	very good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£987(£700 no arm)



Rumble, electrical (above) and total (below)





Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

ORACLE ALEXANDRIA *continued*

0.25% slowing under load confirming this. Rumble was also excellent at better than −80dB DIN B weighted, while its spectrum analysis indicated that spurious vibrations were very low. Acoustic breakthrough was also very low, only slightly marred by a hint of sympathetic platter resonance. External vibration was well handled though this was not an exceptional result, and while the chassis dynamics were fine in the vertical plane, the design was rather stiff in rotation despite its 'hanging' suspension design. It was nonetheless superior to the *Delphi* in this respect.

Effective mass of the *Prelude* tonearm was noted at 9g including hardware, which is usefully below the current average of 13g for good designs. Friction was low in both planes, with minimal bearing play, but some rocking could be induced in the vertical plane due to pillar compliance. The geometry was fully up to standard, while the bias compensation covered a useful range and did not add additional friction. Tested for structural resonances, the main mode appeared at 500Hz with good control, this probably due to the torsional weakness mentioned previously. At higher frequencies however the behaviour was tidy, pointing to a neutral sound. The auto stop/lift device applied negligible extra forces to the cartridge over the final music bands.

Sound quality

On test the *Alexandria* gave a good account of itself. Favourable comments were made concerning its good pitch stability and subjective sense of rhythm. The bass had an even character with pleasing extension, while the mid showed good clarity plus substantial stereo depth but with a hint of clouding in the upper bass lower mid region.

The treble was open and clear, free of false emphasis, and overall the tonal balance was neutral with a low-coloration character. The arm proved pleasantly unobtrusive, and proved to be a good match for a number of good quality moving coil cartridges.

Conclusion

The *Alexandria* can hardly be classed as particualrly good value for money but it does offer a tidy, well designed and highly reliable package. This reliability includes its suspension alignment, which should remain stable for long periods. Taken as a whole its overall 'very good' performance qualifies it for recommendation despite its fairly high price.

RECOMMENDED

Pink Triangle

Pink Triangle Products Ltd, Unit 3, 122 Maidstone Road, Footscray, Sidcup, Kent
Tel 01-300 1918

From the outside, the name and distinctive logo may seem all that is remarkable about this turntable, which has been designed in the UK along classic lines, using a sprung subchassis and belt drive. More detailed examination however reveals many unique features; for example, the platter is solid matt finished acrylic, supplying the record support and termination itself. A semi-gloss black finish is used for the top deck, replacing the earlier tinted glass mirrors, and while the latter were removable the newer alloy plates are fixed. Fine speed control adjustment is available by the use of a screwdriver inserted in the small holes in the deck plate adjacent to the speed change switch, the drive being electronic via a small DC motor.

The subchassis is very light, but is an exceedingly rigid and well damped plate — an asymmetric section of honeycomb-cored aircraft flooring material.

The main bearing has been inverted and comprises an inherently self stabilising single point design. The inverted cup now has a ruby bearing surface as standard. An ingenious system of three small-diameter, but fairly long, coil-springs allows the chassis to hang freely in near isolation, with the vertical mode controlled by spring stiffness, and the lateral and torsional modes assisted by gravity as well — a good feature.

Arm mounting is by means of a 'U' shaped section alloy extrusion, which is firmly bolted to four studs set in the subchassis. Adequate provision for lead dressing has been made, and the unit came fitted with an *Ittok*, which suited it well.

One point to bear in mind here is that the relatively low total suspended mass and high spring compliance results in slightly altered states of level with different record weights. The *Ittok* is little affected by this, but if using a Syrinx, for example, which is sensitive to absolute levelling, it could prove disastrous. However, the deck is easily levelled *via* concealed external nuts in the plinth sides.

Lab results

State of the art rumble figures were achieved, the spectrum analysis revealing nothing of significance. The drive was remarkably stable with very low wow, very good flutter and fine weighted wow and flutter. As no dynamic wow overshoot occurred, this helped to mitigate the fairly low torque which resulted in a significant 0.5% slowing under standard loading. With a moderate 1.7kg platter mass, the flywheel effect was lower than in competing models.

The expanded X10 scaling proved possible for the disc impulse measurement, and the

result was very good, with balanced impulse decay control over a wide frequency range. This performance carried through to the vibration and acoustic isolation results, which were exemplary, and aural testing with a live cartridge showed that this platform was singularly inert overall in terms of resonances, yet the subchassis freedom also resulted in quite good 'footfall' shock resistance.

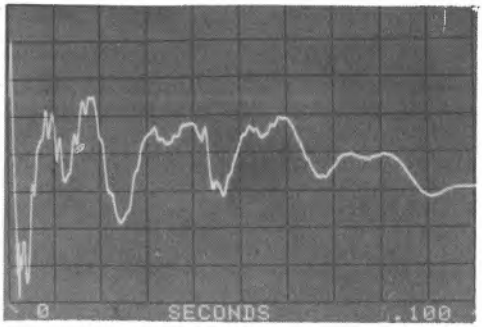
Sound quality

For this issue the Triangle was tried with both the *Ittok* and *Orion* tonearms and qualities of low coloration tonal neutrality as well as a pleasing musical balance were immediately apparent. The bass register was well above average showing an open and articulate quality — tuneful and with good weight and solidity. The sound was alive yet somehow unforced. Disc/platter contact seemed particularly good, with a well focused treble, the whole delivering stable, clear stereo images. With rock-orientated material we heard a mild lack of pitch stability which slightly detracted from the timing and tempo of the music, although this negative effect depended on the listener's sensitivity as well as on the programme type.

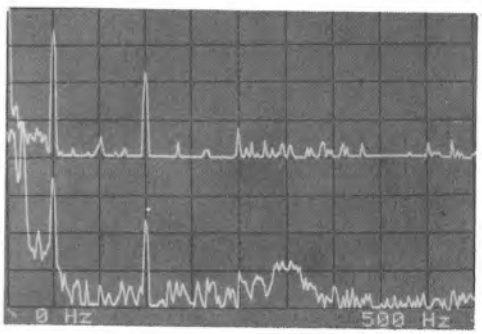
Conclusion

Since our tests for the last edition, Pink Triangle have come up with an interior change which has reduced slowing under load to a perfectly satisfactory 0.22%. On the latest review, a faulty belt (which unfortunately was not replaced by the time we went to press) produced rather high wow and flutter of 0.22%, but based on past experience we feel that this is atypical. Dynamic wow has been virtually banished on current production, so removing our only significant reservation concerning this fine-sounding player, and a full recommendation is thus appropriate.

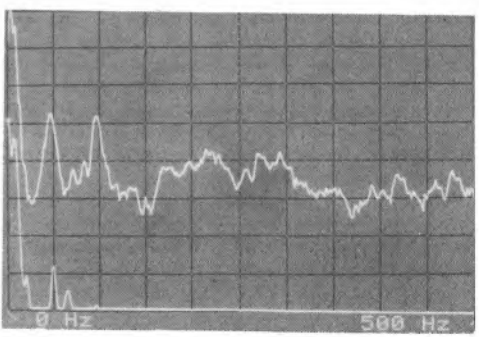
GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	1.7kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/—
Speed options	33/45rpm (internally variable)
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter(LIN peak wtd 0.2–6Hz/6–300Hz)	<0.06%/0.07%
Absolute speed error	adjustable, +1%
Speed drift 1 hour/load variation	+0.2%/0.22%
Start up time to audible stabilisation	3secs
Rumble: DIN B wtd L/R av (see spectrum)	77/78dB
Size/clearance for lid rear	45.5(w) x 38.5(d) x 15.2(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	excellent
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/good
Estimated typical purchase price	£398



Disc impulse transmission, magnified X10.



Rumble (0–500Hz lin): above, electrical only; below, total.



Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

Note: No recent sample was supplied for test, and we can only hope that the standard has been maintained for 1985. On this basis the recommendation still stands.

Pioneer PL340

Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middlesex UB6 8UZ
Tel 01-575 5757

An inexpensive player, ostensibly aimed at inclusion in the matching Pioneer rack music systems, the *340* is also available as a separate component. It comes complete with a Pioneer *P230* cartridge which in view of the price range, the customer is unlikely to discard. A semi-automatic deck, the arm returns at end of side, and the turntable powers up as the arm is moved to the cue position.

A lightweight plastic solid plinth construction is used, with resilient feet to help isolation, but the light, resonant lid is unavoidably coupled to the vibration sensitive parts. This belt-drive machine employs a small dc servo motor, using electronic switching of the two 33⅓ and 45rpm speeds. The lightweight alloy platter has large apertures for belt loading; the thin mat sags a little over these holes which must impair disc contact.

Lab report

With mat included, the platter weighed a rather light 0.57kg. The platter/disc damping was only fair with the impulse transient poorly controlled and the considerable low frequency mode was attributed to platter rocking. Vibration isolation was also poor, with great deterioration in the upper range. The acoustic isolation was also weak, but was at least relatively even in distribution.

Rumble levels were poorer than average, measuring – 65dB DIN B weighted. Inspection of the rumble spectrogram revealed motor vibration breakthrough onto the platter; for example at 230Hz.

Wow and flutter was fine at 0.06%, DIN peak weighted. Both flutter and wow contributions were low, individually, indicating good tolerancing, but conversely, the drive did not offer good torque. On the standard loading the drive slowed a serious 0.7%; while the absolute speed error was small when first switched on, over the first hour a significant drift of 1.8% was noted, which is really outside accepted hi-fi tolerances.

The arm carried a special detachable headshell of around 6g mass with the total arm effective mass at 12g inclusive of mounting hardware. The arm proved to be well aligned but suffered from bearing play. Friction levels were commendably low though the bias levels were rather high at the end of the side position.

Cueing was rapid and reliable. Measured using the attached cartridge, the arm resonances rated as average, with a lumpy characteristic, and with noted breaks at 170Hz and 450Hz.

Sound quality

Auditioned with the fitted cartridge, this player rated below average. Some muddling of detail was evident, but the tonal balance was reasonably consistent. At times the mid sounded a bit 'loud' while dynamics were noticeably

compressed. Pitch and timing were distorted with the result that this player's reproduction lacked interest.

Conclusion

These budget players have apparently not advanced much over the past ten years, and despite their modest pricing, their performance and value are insufficient to merit recommendation. In a sense the prevalence of this type of player has been the *raison d'etre* for the successful Dual *505*.

GENERAL DATA Integrated player with cartridge

Motor section

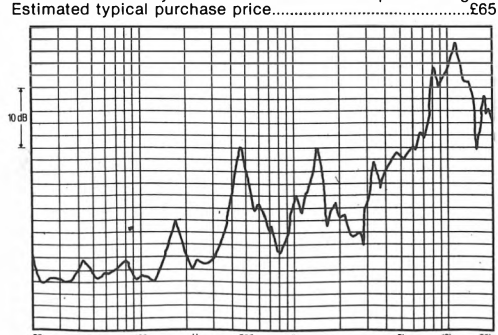
Type.....electronic belt-drive, auto return
Platter mass/damping.....0.57kg/fair
Finish and engineering.....good/fairly good
Type of mains connecting lead.....2 core/phonos plus earth
Speed options.....33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.06%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)...0.08%/0.07%
Absolute speed error.....+0.6%
Speed drift, 1 hour/load variation.....+1.8%/−0.7%
Start-up time to audible stabilisation.....1.8 secs
Rumble, DIN B wtd, L/R average (see spectrum).....−65dB

Arm section

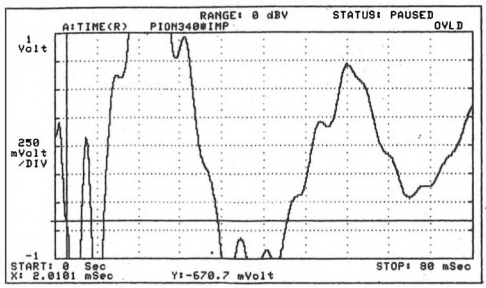
Approximate effective mass, inc screws, excl cartridge.....12g
Type/mass of headshell.....special detachable/6.2g
Geometric accuracy.....very good
Adjustments provided.....overhang/offset
Finish and engineering.....good, fairly good
Ease of assembly/setting-up/use.....good/good/good
Friction, typical lateral/vertical.....<30mg/<20mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....220mg/360mg
Downforce calibration error, 1g/2g.....+0.05g/+0.05g
Cue drift, 8mm ascent/descent.....0.8secs/1.0secs
Arm resonances.....average
Subjective sound quality.....see system result
Arm damping.....seismic mass and counterweight

System as a whole

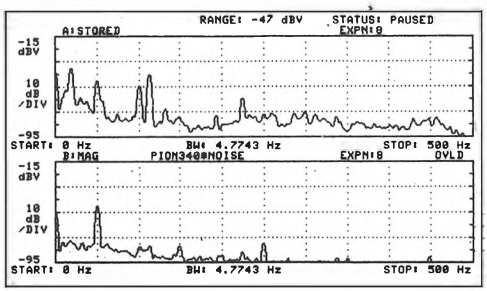
Size (w × d × h)/clearance for lid rear.....42 × 36.5 × cm/1cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....average −
Subjective sound quality of complete system.....average −
Hum level/acoustic feedback.....good/average −
Vibration sensitivity/shock resistance.....poor/average −
Estimated typical purchase price.....£65



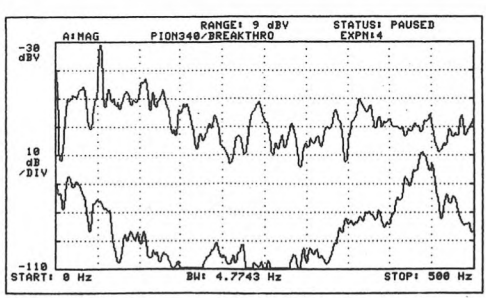
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is −80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Pioneer PL707

Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middlesex UB6 8UZ
Tel 01-575 5757

Lavishly presented, this automatic turntable is surprisingly inexpensive. The 'rosewood' coloured plinth is finished in a piano gloss, with complementary polished metal trim and a clear plastic hinged lid. Fully automatic operation means that only disc size needs to be preselected; the player does the rest. It uses a special detachable headshell tonearm fitted with a medium output moving coil cartridge, this using a 'V' coil system similar to Audio-Technica's and have a detachable stylus.

In construction terms this is a traditional, solid-plinth design with the resonant polyurethane lid closely coupled. Some degree of overall vibration isolation imparted by the resilient feet. Despite its substantial appearance, the platter was a fairly light affair.

Lab report

This player did not perform well with regard to acoustic isolation, where the result was uneven and rather weak in the 50-150Hz range. Vibration isolation was little better, and again peaked in the same frequency range. On both counts it scored below average.

For the disc impulse characteristics, please note that the scale factor was incorrect on the published graph, with the peaks reduced here by a factor of 4. On this basis, the response was unpromising, with evidence of low frequency platter rocking.

Wow and flutter on the combined DIN peak weighted reading was excellent at better than 0.05%, showing how good modern direct drive motors can be. Analysed separately, the individual flutter and wow contributions were very low. Absolute speed error was zero due to the quartz lock control, and long term drift was also zero to all intents and purposes. Likewise, the servo system held 'lock' under load with no speed change. Start up was a rapid 1.8 seconds. DIN B weighted, a fine rumble result of −75dB was obtained.

In the tonearm, some bearing play was detected. Effective mass was typically 12g, including hardware, a moderate figure. The arm was well set up to a good standard of geometric accuracy, and ostensibly little setting up was required since the cartridge comes ready installed.

Bearing friction was held to below 25mg in both planes, with bias levels close to the ideal, and pretty accurate downforce. Cue operation was fine and the arm's automatic functions were smoothly performed.

Charted for resonances with the matching Pioneer cartridge, minor arm modes were well contained, with the main beam mode appearing at 500Hz. The upper resonances did however show some lumpiness.

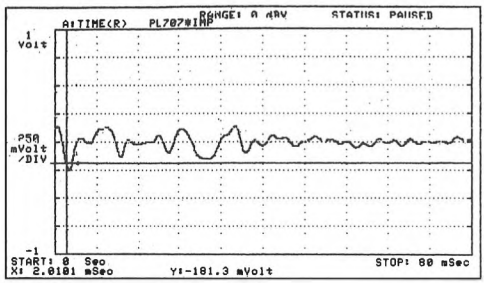
Sound quality

Not too promising as regards feedback resistance, this player was rather too dependent on siting. The sound was rated below average, belying the deck's impressive

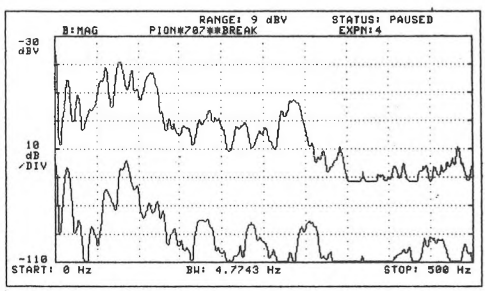
appearance. Stereo images were rather flat and two dimensional, with the tonal balance showing some mid range forwardness and muddle. The bass was a touch boomy with a lack of weight, while the treble suffered from some 'grain' and 'edge'

Conclusion

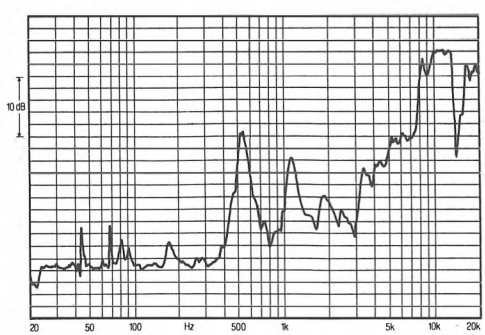
While this immaculate looking player offered a lot in terms of specification, finish and facilities, the sound quality rating firmly precluded any sort of recommendation.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

GENERAL DATA Integrated player with cartridge

Motor section

Type.....direct drive
Platter mass/damping.....1.0kg/fairly good
Finish and engineering.....excellent/very good
Type of mains connecting lead.....2 core/phonos plus earth
Speed options.....33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....<0.05%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).<0.06%/0.08%
Absolute speed error.....none
Speed drift, 1 hour/load variation.....none
Start-up time to audible stabilisation.....1.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 75dB

Arm section

Approximate effective mass, inc screws, excl cartridge.....12g
Type/mass of headshell.....special detachable/6g inc screws
Geometric accuracy.....very good
Adjustments provided.....height/overhang/offset
Finish and engineering.....excellent/fairly good
Ease of assembly/setting-up/use.....very good/very good
Friction, typical lateral/vertical.....<25mg/<25mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....225mg/285mg
Downforce calibration error, 1g/2g..... + 0.1g/ + 0.05g
Cue drift, 8mm ascent/descent.....1.8secs/2.0secs
Arm resonances.....average
Subjective sound quality.....see system result
Arm damping.....seismic counterweight and arm tube

System as a whole

Size (w x d x h)/clearance for lid rear.....45 x 39 x 14cm/7cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....average –
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....good/average –
Vibration sensitivity/shock resistance.....average – /average
Estimated typical purchase price.....£230

QED R232

QED Audio Products Ltd, Unit 12, Ashford Industrial Estate, Shield Road, Ashford, Middlesex TW15 1AU
Tel Ashford 46236

Setting out to produce a complete British-made hi-fi system at a modest price, QED have now followed the successful launch of their *A230* amplifier with the introduction of this integrated turntable.

The *R232* has been loosely based on the Rega design, with a rigid, inert plinth classis. A small synchronous motor is used, this driving a plastic centre hub via a neoprene rubber cord. The plate glass platter is equipped with the ubiquitous felt mat, and needs to be removed to effect the speed change from 33⅓ to 45 rpm by hand. The platter main bearing was well toleranced.

QED have chosen to use a custom designed arm, originally produced by Helius, and sensibly the arm has been matched to the chosen QED cartridge, with the usual adjustments omitted in the interests of simplicity and reliability. The cartridge, as installed, is correctly aligned and balanced at factory-set positions, and is built for QED by Goldring — a custom version of the *Epic* optimised for this deck and arm. By taking control of all the components, QED aim to provide a foolproof system player offering a competitive sound.

The arm is distinguished by its unusually rigid construction, particularly the fixed aluminium cartridge platform, though some mild bearing play was detected on our sample. QED note that in production the arm will be set to a zero slack condition. Overall finish is a medium grey Nextel, with fineline green trim.

Lab report

Platter mass was good for the price, the construction affording quite good damping, limited by the usual felt mat type impulse response. This was also marred by a low frequency platter rocking effect. Combined wow and flutter, DIN weighted, was satisfactory at 0.13%, the separated unweighted figures being in good balance. The deck ran an acceptable 0.6% fast while the slowing under load was poorer than average at 0.4%, this in the range of potential audibility. Start up was fine at 2.5 seconds, but rumble was only just satisfactory at −66dB, with motor vibration components evident in the rumble spectrogram; for example at 100 and 200Hz.

Acoustic breakthrough was fairly well handled while vibration isolation was rather better than average thanks to the high compliance suspension feet. Some mild breakthrough was observed at 450Hz, with the turntable's general shock resistance judged about average.

Turning to the tonearm, moderate friction levels were observed, but these were fine for the chosen cartridge, tracking at a factory-set 1.9g. Effective mass was estimated (via a resonance test) at 12g while the arm and cartridge proved to be well aligned. The cue operated well, with sensible ascent and descent rates and bias levels appropriate for the cartridge, the weight set about half way on the lever arm.

Tested with the QED cartridge in place, the arm resonance characteristics were quite good, and better than with the rigid counterweight originally fitted to this arm. The main arm beam mode was deferred to 600Hz.

Sound quality

Listening test results were promising, particularly in view of the modest price. The bass was to a fairly good standard with good extension, but some uneveness. Overall it sounded well balanced and tidy, with some life and detail in the mid and treble registers. The chosen components appealred to complement each other well, and although in rhythm and timing terms the deck did not seem to 'gel' perfectly, the end result was certainly above average here.

Conclusion

Viewed as a complete player, the *232* was a worthy and competent creation. Its strength lay in its complete foolproof assembly with a matched arm and cartridge, and in consequence, the performance was both consistent and well balanced. A worthy

addition to the QED range, this new player offered quite good value and qualified for recommendation.

GENERAL DATA Integrated player with cartridge

Motor section

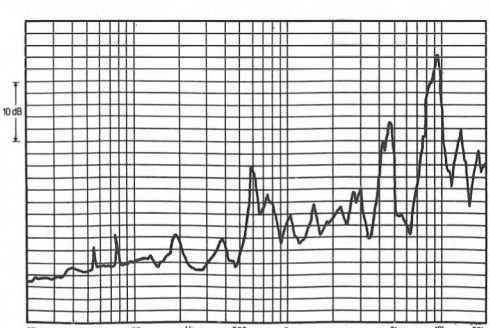
Type.....belt-drive, plinth type
Platter mass/damping.....1.06kg/fair
Finish and engineering.....fairly good/fairly good
Type of mains lead/connecting lead.....2 core/phonos
Speed options.....manual change, 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.13%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.11%/0.14%
Absolute speed error..... +0.6%
Speed drift, 1 hour/load variation.....negligible/ – 0.4%
Start-up time to audible stabilisation.....2.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 66dB

Arm section

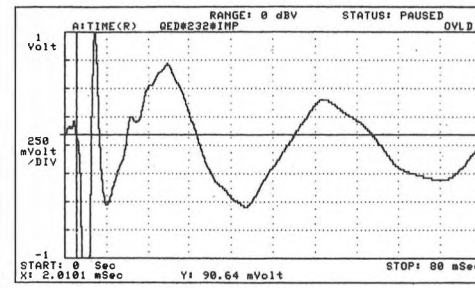
Approximate effective mass, inc screws, excl cartridge.....12g
Type/mass of headshell.....fixed
Geometric accuracy.....very good
Adjustments provided.....none
Finish and engineering.....good/good
Ease of assembly/setting-up/use.....excellent/excellent/good
Friction, typical lateral/vertical.....<40mg/<40mg
Bias compensation method.....thread and lever weight
Bias force, rim/centre (set to 1.5g elliptical).....230mg/280mg
Downforce calibration error, 1g/2g.....fixed at 1.9g
Cue drift, 8mm ascent/descent.....negligible 0.5secs/1.8secs
Arm resonances.....fairly good
Subjective sound quality.....see system result
Arm damping.....decoupled counterweight

System as a whole

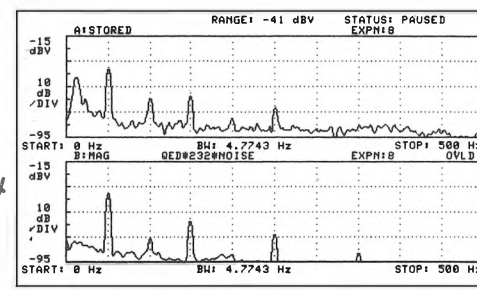
Size (w x d x h)/clearance for lid rear.....40 x 30 x 11cm/6cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....fairly good
Subjective sound quality of complete system.....above average
Hum level/acoustic feedback.....average – /fairly good
Vibration sensitivity/shock resistance.....average + /average
Estimated typical purchase price.....£140



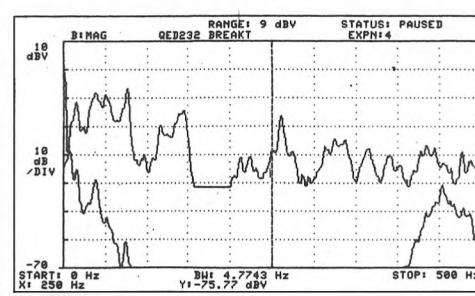
Structural arm resonances, audio band



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



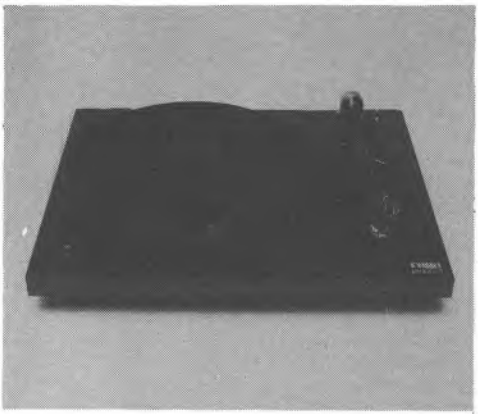
Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

RECOMMENDED

Rega Planar 2 and 3

Rega Research Ltd, 119 Park Street, Westcliffe-on-Sea SS0 7PD
Tel (0702) 333071



Since the last edition, Rega have introduced the *RB300* arm which is now standard fitting on the *Planar 3* deck. The performance of this new combination is discussed fully in the *RB300* review. The *Planar 2* now comes with a simplified version of the new *RB300* arm, called the *RB250*.

A simple design, it comprises a solid chipboard plinth covered in tough matt black laminate. Three fairly stiff stepped rubber feet provide a stable tripod foundation while the high quality lid is directly hinged to the chassis plinth with neither springs nor isolation. A plain main bearing with a thrust ball is used, and tolerances were close here, with no detectable play. Belt-driven via a rubber cord, the inner platter hub is a reinforced plastic moulding, the uppermost projection forming the tapered centre spindle and the outer platter boss. The platter is made of thick plate glass (reduced in thickness for the *Planar 2*), and surmounted by a thick felt mat. In a simple and ingenious gravity suspension, a second drive belt is looped to support the slow speed synchronous drive motor and surpress vibration coupling to the platter.

The old Rega arm was the Lustre unit made to Rega specification in Japan and some demonstrators still favour this unit. The new *Planar 2* arm is a derivative of the Rega built *RB300* and is called the *RB250*. It has the same excellent bearings and one-piece cast arm tube, but has been simplified by the inclusion of a conventional rotating type of counterweight with sliding scale, which is partly decoupled. The leadout cable is fixed and the chassis earth is combined with one of the signal grounds. Phono terminations are fitted.

Effective mass is around 11.5g including Rega's stainless steel mounting hardware, suiting it to moderate compliance cartridges or even modest moving coils.

Rega recommend that the deck should be placed on a light shelf, wall mounted, rather than a 'coffee table' or floor cabinet; this we found to be good advice.

Lab report

The platter was clearly well founded as the minimal low frequency ringing on the disc impulse response shows. The initial transient was poorly damped, however, a characteristic of thick felt mats.

Almost no metal work was present in the unit and this meant very little humfield screening was provided. In fact, hum levels were poorer than average and the choice of cartridge will need some care. Weighted wow and flutter was satisfactory but linear wow was on the high side at 0.21%, this measured without the mat as the felt is of slightly variable thickness. Speed was fairly accurate, but slowed a significant 0.4% under load with some overshoot after recovery due to motor suspension tension rocking. Start-up was average for a belt drive at 4.5 seconds.

Rumble levels were just satisfactory for the price averaging −71dB DIN. Spectrum analysis showed a considerable content of mains-related vibrations such as 100 and 200Hz, with 'pole harmonic' components around 200-300Hz. The bearing alone measured better than −78dB with the motor off, however. Acoustic breakthrough was about average and the lid was found to be influential here, and results were better when was entirely removed. The plot is shown expanded by 10dB for lid up and down, the latter being preferred. Vibration isolation was also poorer than average.

The arm was well finished with very good geometry. It was easy to set up and use and demonstrated low bearing friction. Bias compensation was set to sensible levels and the cue worked well. Downforce calibration proved satisfactory.

Sound quality

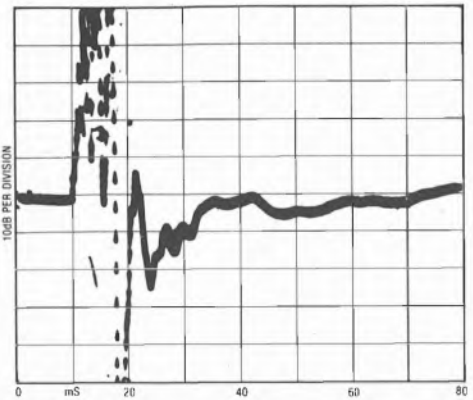
Belying traditional assumed relationships between a number of technical parameters and sound quality, the Rega proves that a well-developed, subjectively-assessed balance of performance counts for more than technical

excellence with regards to any one parameter. On the debit side the Rega did suffer from a modicum of programme wow, particularly on rock programme, but this was not considered serious at this price level; a mild loss of stereo depth was also noted, together with an accompanying impairment of low bass definition and evenness. Conversely it sounded 'musical' in a balanced and coherent manner. With the latest arm the *Planar 2* sounded more confident. In the upper bass it was surprisingly articulate while mid and treble were notably smooth and sweet with better detail than before. Presentation of detail was considered well above average, little inferior to super-fi models in this respect.

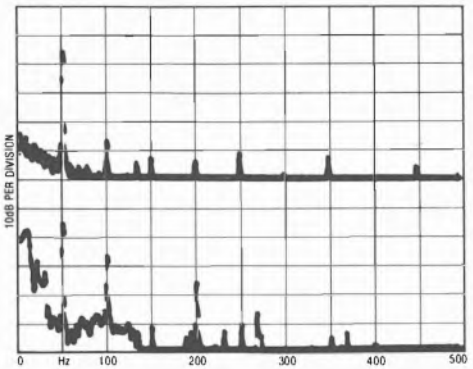
Conclusion

The *Planar 2* offers a fine subjective performance and is both very well made and finished. All in all, this places it in the Best Buy category.

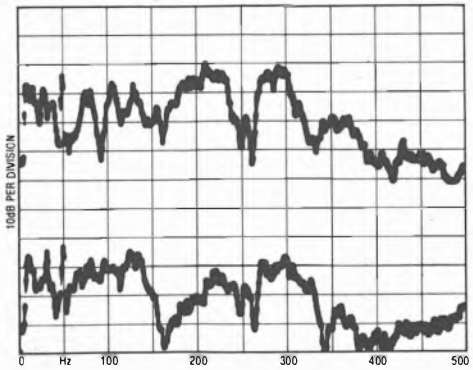
The *Planar 3* is also good, but does not offer quite the same value, and here standard recommendation is appropriate, especially with the excellent *RB300* arm (see review).



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, lid up (above) and down (below)

Charts above characterise general turntable behaviour. See text for commentary on these results.

GENERAL DATA Integrated turntable

Motor Section

Type	manual, belt-drive
Platter mass/damping	2.2kg/good
Finish and engineering	very good/very good
Type of mains/connecting leads	2-core phones
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	*0.21%/0.45%
Absolute speed error	+ 0.4%
Speed drift, 1 hour/load variation	synchronous/ – 0.4%
Start-up time to audible stabilisation	4.5 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 72/ – 70dB

Arm Section

Approximate effective mass, inc screws, excl cartridge	11.5g
Type/mass of headshell	universal detachable/8.0g
Geometric accuracy	very good
Adjustments provided	overhang/lateral angle
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	very good/very good/very good
Friction, typical lateral/vertical	less than 25mg/15mg
Bias compensation method	internal magnet
Bias force, rim/centre (set to 1.5g elliptical)	300,310mg
Downforce calibration error, 1g/2g	– 0.1g/ – 0.07g
Cue drift, 8mm ascent/descent	negligible 0.5 secs/1.5 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	70pF/counterweight decoupling

System as a whole

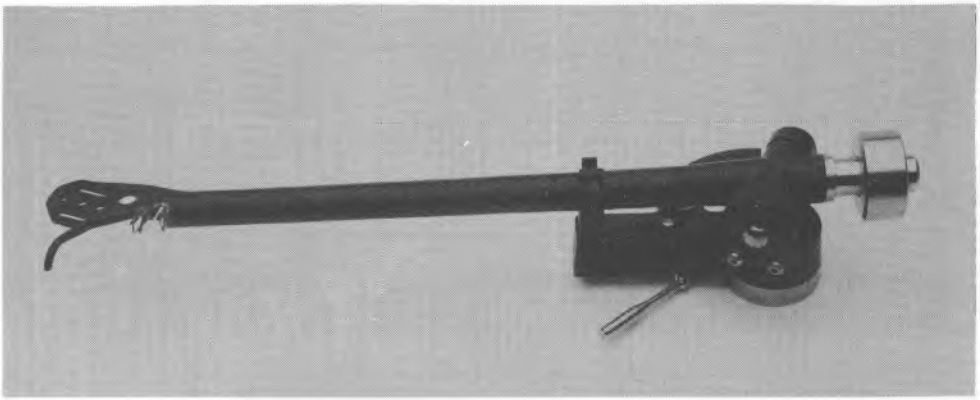
Size/clearance for lid rear	45(w) x 36(d) x 12.3(h)/7cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	good
Hum level/acoustic feedback	average – /fairly good
Vibration sensivity/shock resistance	average – /good
Estimated typical purchase price Rega 2 £125; Rega 3 £188	

**worsened by unevenness in thick felt mat*

BEST BUY

Rega RB300

Rega Research Ltd, 119 Park Street, Westcliffe-on-Sea SS0 7PD
Tel (0702) 33071



For most of these tests the new Rega *RB300* tonearm was fitted to a current-production *Planar 3* turntable, which is in fact the most usual combination and selling for just under £190. The arm can also be bought as a separate component (£90) and proved to be one of the most exciting introductions in this issue. Note that the original Rega tonearm is still available and is currently fitted to the *Planar 2,* the combination selling for around £115. We also subjected the *Planar 3* to a full retest, and comments on its sonic performance are included with this arm review. Very little change was recorded in the '*3* peformance, though the drive components did demonstrate some engineering improvement in terms of both quality and tolerances.

Getting back to the *RB300*, this Rega-made product uses a very rigid one-piece arm beam/headshell, which unusually is constructed from a hollow aluminium casting. No joins are present between cartridge platform and pivot. The bearings themselves are highly pre-loaded and yet mounted to such a high tolerance that friction is negligible while play is physically undetectable.

Rega's traditional magnetic frictionless bias compensator is employed, with a novel touch present in the design of the downforce mechanism. When set to zero, the carefully designed coil spring mechanism exerts a minus force of 3g so reducing the counter-balance requirements. Roy Gandy has aimed for the smallest possible counterweight in order to reduce its moment of inertia and consequently its effect on the dynamics of the rear section of the arm. To this end the counterweight is machined from a very dense tungsten alloy, permitting a still smaller counterweight diameter.

The bearing gimbal is itself a substantial casting and Roy has abandoned the usual adjustable vertical pillar design, regarding this a structural weakness. His alternative is a threaded stem and large locknut; vertical height adjustment only possible using various washers, this assuming that the arm/cartridge combination will in any case fit the chosen turntable. For example the arm was a mite too high for an EMT cartridge, though fine for an *Asak*, when mounted on a Linn deck; on the Lux *300*, the height was right for the EMT.

Lab report

Tests showed the *RB300* to have some of the finest bearings in the business; furthermore it was very competent in the important area of beam/headshell rigidity. Friction was very low in both planes, without a trace of play, and while biasing worked well, the calibrated figures were a little on the high side (by about 25%). Downforce calibration was accurate and cue operation fine. Geometric accuracy was to a high standard, while the effective mass was moderate at 10.5g, including the good-quality steel mounting hardware. A wide range of moving magnet and moving coil cartridges are judged suitable in the 8-22cu range.

Looking at the structural resonance response, the picture suggested good control and excellent rigidity. The 400Hz mode was probably the counterweight and was mild, while the first bending or torsional mode was deferred till to a remarkably high 1.5kHz — an

outstanding result. The treble was also remarkable for its absence of resonances after 4kHz.

Sound quality

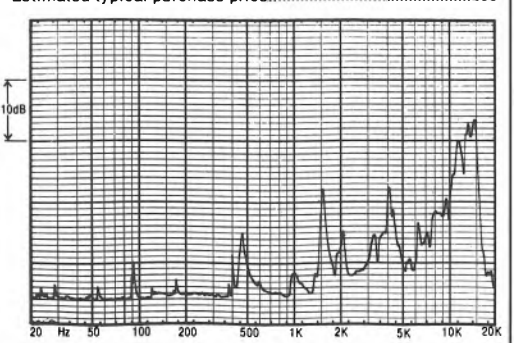
It was clear after only a few minutes audition, that the *RB300* was a top flight performer. Depending on the chosen player, it proved quite comfortable in the company of other reference tonearms in the £250-£400 range.

The sound was notably dry and neutral with excellent control throughout the range. It proved capable of making one 'reference' arm sound dull and another hard and brash; and while the latter comparison could be interpreted by some as a lack of 'life' in the *RB300*, personally, I do not believe this. Its transients were judged excellent, while it offered a very well-focused sound stage with first rate depth. Cartridges up to £800 were tried without any embarrassment. Its only significant failing was a slight muddling of detail on complex musical passages.

Conclusion

The *RB300* is an excellent product which Roy Gandy can be justly proud of. Despite its modest price it sets new standards in performance, and a Best Buy rating is obviously appropriate. In conjunction with the turntable it forms the new *Planar 3* combination, and its benefits were clearly apparent in the *Planar*.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	10-11g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	very good
Adjustments provided	overhang/offset
Finish and engineering	very good/excellent
Ease of assembly/set-up/use	very good/excellent/ver good
Friction, typical lateral/vertical	15mg/15mg
Bias compensation method	magnetic
Bias force, rim/centre (set to 1.5g elliptical)	340mg/330mg
Downforce calibration error, 1g/2g	+ 0.05g/ + 0.03g
Cue drift, 8mm ascent/descent	negligible, 0.5 secs/3 secs
Arm resonances	see graph
Subjective sound quality	very good
Arm damping	none
Estimated typical purchase price	£90



Structural arm resonances, audio band

RECOMMENDED

Revolver

Sundown Electronic Engineering Ltd, 23 Austral Avenue, Woolston, Warrington WA1 4ND
Tel (0925) 826223

The *Revolver* is a British designed and built motor unit produced by a company called The See Corporation, who were initially known for their oddly-named 'PIG' rubber record clamp. Another product of their is the Starmat — a record mat comprising a partially-conductive, impregnated disc of stiffened black felt. The turntable, not surprisingly, came fitted with both these items.

Essentially, the *Revolver* is a solid plinth design, founded on a Medite (MDF) board which is mounted on three rubber feet, one at the rear and the others at the front, these similar to those employed on the Rega models.

Some decoupling from the plinth-mounted motor and lid is provided by a secondary element, namely the top plate on which the arm and platter are fixed. This plate is marginally isolated via stiff foam rubber strips, these joining it to the plinth proper. The platter is rather light and cut from, MDF. Most striking is the first-rate red hammer paintwork of the plinth itself (the *Revolver* is alternatively available in grey hammer finish), as well as its excellent moulded lid — here the purchaser certainly gets his money's worth.

The platter is driven at its periphery by a long endless belt. Motive power is from the usual double pulley synchronous motor.

A hidden feature of the upper plate is the rumble vibration canceller, which comprises a pair of lead weights mounted under the rear corners to avoid a coincident resonance and hence improve signal to noise ratio.

The main bearing is a simple design, with a steel shaft and brass sleeve, run 'wet' with a charge of oil supplied. The tolerance on our sample was very good with no significant slack.

Lab report

The *Revolver* ran fast, by a measured 0.4% on load — acceptable. Wow and flutter was a little

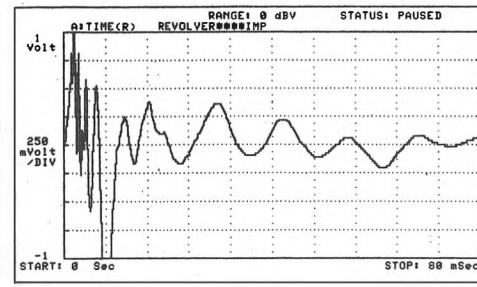
below par at 0.18%, with both wow and flutter components in evidence. Slowing under load was however negligible — a good point. Platter mass was quite low, and the disc damping quite typical of the genre. Rumble was also below par at −62/−65dB, with 200Hz motor rumble apparent, a result which strictly speaking took it out of the true hi-fi category. Acoustic and isolation breakthrough were also poorer than averate, although shock resistance was quite good.

Sound quality

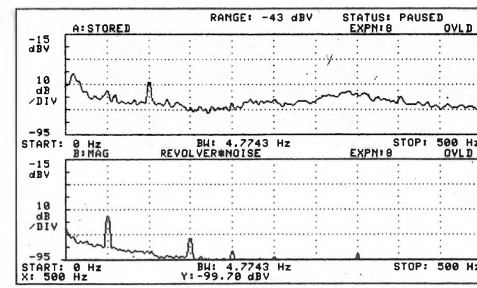
In view of some dealers' glowing reports we felt the sound quality to be just a little disappointing. It scored 'average plus', and was rescued largely by the competent performance of the chosen tonearm. The overall sound was nicely balanced however. Mild wow was occasionally heard, while neither pitch nor timing in music seemed too secure. The bass was free of boom or emphasis, but also lacked attack and weight, and consequently sounded a bit 'soft'. Stereo depth was good however, and had pleasant perspectives.

Conclusion

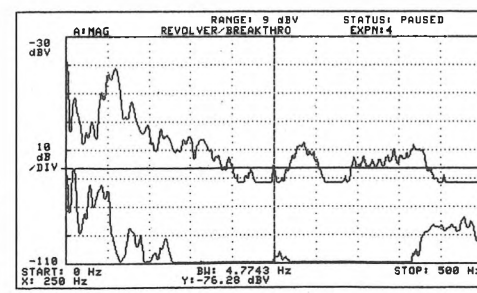
Arriving too late for full test, the latest series *Revolver* sports a thicker top deck with a natural veneer finish in black ash. Build quality is much improved though the main bearing still needs considerable running-in to reduce audible grinding on rotation. Priced under £200, with a Linn *LVX* and *Basik* cartridge, this improved model provided a decent sound quality, and our recommendation is therefore continued.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is −80dB.

GENERAL DATA — Motor unit

Motor Section

Type	plinth, belt-drive, synchronous
Platter mass/damping	1.0kg/fair
Finish and engineering	good
Type of mains lead/connecting lead	3-core
Speed options	manual change, 33⅓/45rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.18%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.14%
Absolute speed error	+0.4%
Speed drift, 1 hour/load variation	negligible/−0.12%
Start-up time to audible stabilisation	2.0 secs
Rumble, DIN B wtd, L/R average (see spectrum)	62/65dB
Size (w x d x h)/clearance for lid rear	42 x 36 x 13/8.5cm
Ease of use	average
Typical acoustic breakthrough and resonances	average −
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	fairly good/average −
Vibration sensitivity/shock resistance	fair/good
Estimated typical purchase price	£108/£118 (depends on finish)

**measured on an early sample*

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Rotel RP850

Rotel Hi-Fi Ltd, 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks MK12 6HS
Tel (0908) 317707

Outwardly quite conventional, the new *RP850* turntable from Rotel in fact shows much evidence of careful design, and attains correspondingly fine results. Priced at £190, it is actually a very different kind of product from the visually-similar but in reality much less competent *RP830*.

plinth which affords a good foundation for arm and platter. Supported on moderately-compliant feet, the deck is fitted with a rather resonant polystyrene lid, but Rotel were quick to point out that they recommend that critical listeners should leave it off during play. A fairly generous die-cast aluminium platter is employed, weighing 1.8kg, and the main bearing was well toleranced with negligible slack. A thick rubber mat covers the platter, helping to mask any effects of the two apertures provided in the platter surface for drive belt access. The player is powered by a large synchronous motor with a double crowned pulley. Speed changeover is by hand, only requiring the mat to be lifted for this operation.

The arm is rather better than those usually encountered on integrated players, having well adjusted slack-free bearings. The beam is of light alloy tube, while the adjustable die-cast metal headshell is clamped in position using a proper sleeve clamp with socket head bolt tightening. This arm is in the medium-to-high effective mass range, so cartridges with compliances of the order of 8-20cu should prove suitable.

Lab report

The motor proved to be well isolated from the vital vibration-sensitive points, this proven by the fine DIN B-weighted rumble result of −80dB. Spectral analysis of the rumble revealed a couple of harmless motor harmonics at 25Hz, and 200Hz, but electrical hum was fairly low.

A high-powered motor enables the player to reach rated speed in a fast 1.7 seconds, and its good torque was also shown by the very mild slowing under test loading, here measured at 0.2%. Consequently pitch stability was very good, while DIN peak wow and flutter was fine at 0.07% with equally promising results for flutter and wow when these were separately weighted.

Concerning its isolation performance, the *RP850* did fairly well on acoustic breakthrough, which was noticeably improved upon lid removal. The feet afforded some vibration isolation — poorer than most subchassis types, but, beneficially, of an even character. On the other hand, shock resistance was better than average.

The disc impulse response showed good initial damping followed by some low frequency platter ringing at 40Hz; this is likely to be a rocking mode.

Arm performance was above average, the unit appearing to be well aligned and adjusted. Charted for structural resonance, the arm showed a minor mode at 100 and 280Hz this probably due to the counterweight but the main break appeared at 1kHz and was rather severe. Good rigidity was indicated by this high resonance value. Arm adjustments included level, angle overhang and rotation. Friction was low at 25/10mg lateral/vertical, while the bias compensator offered appropriate values. Downforce error was minor, and the cue worked well.

Sound quality

Initially tried with the lid on, the sound was more than satisfactory and improved still further when the lid was removed, when it gained an above average rating.

Pitch was secure and stable with inaudible wow or rumble, and tonally it seemed well balanced, with a clean detailed midrange plus good treble, with only slight imprecision heard as a touch of fizz. Bass was of reasonable definition, with some loss of attack noted as a rubbery quality, but it did at least show reason-

able tune playing ability here. Stereo was to a good standard with solid focusing and fair depth.

Conclusion

This surprising player offered a good all-round performance at a competitive price. The above average tonearm was good enough for some modest moving coil cartridges and complemented the deck well. Enthusiasts may run the deck with the lid off for the very best results but in any case, at £190, the *RP850* is clearly a strong contender in Rotel's new range, comfortably gaining our recommendation.

GENERAL DATA Integrated turntable

Motor Section

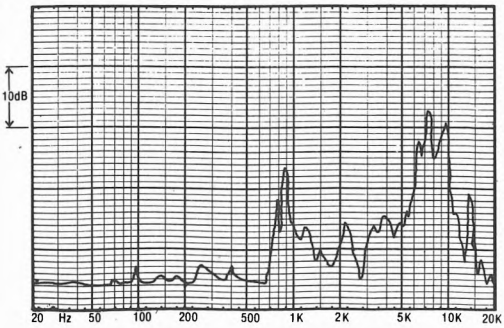
Type.....manual, belt-drive
Platter mass/damping.....1.8kg/fairly good
Finish and engineering.....very good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.07%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.05%/0.08%
Absolute speed error..... +0.25/
Speed drift, 1 hour/load variation.....<0.06%/ – 0.2%
Start-up time to audible stabilisation.....1.7 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 79/ – 81dB

Arm section

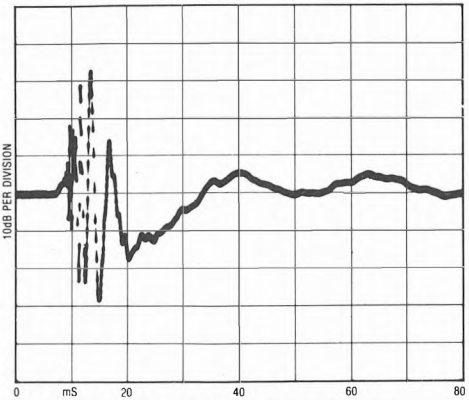
Approximate effective mass, inc screws, excl cartridge.....13g
Type/mass of headshell.....special detachable/9.5g
Geometric accuracy.....very good
Adjustments provided.....tilt/overhang/offset
Finish and engineering.....good/very good
Ease of assembly/set-up/use.....very good
Friction, typical lateral/vertical.....25mg/10mg
Bias compensation method.....internal spring
Bias force, rim/centre (set to 1.5g elliptical).....190mg/225mg
Downforce calibration error, 1g/2g..... – 0.05g/ – 0.04g
Cue drift, 8mm ascent/descent.....negligible, 0.8 secs/1.8 secs
Arm resonances.....see graph
Subjective sound quality.....good
Arm damping.....none

System as a whole

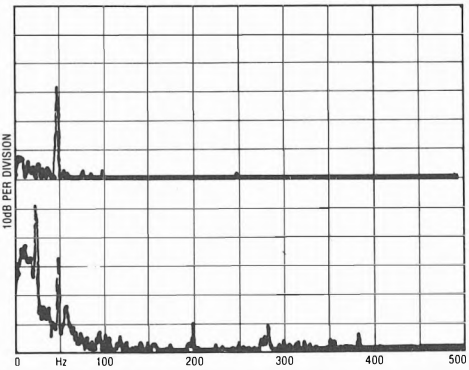
Size (w x d x h)/clearance for lid rear.....43.5 x 37 x 14.5cm/6cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....fairly good
Subjective sound quality of complete system.....good (lid off)
Hum level/acoustic feedback.....very good/fairly good
Vibration sensitivity/shock resistance.....fair/good
Typical purchase price.....£190



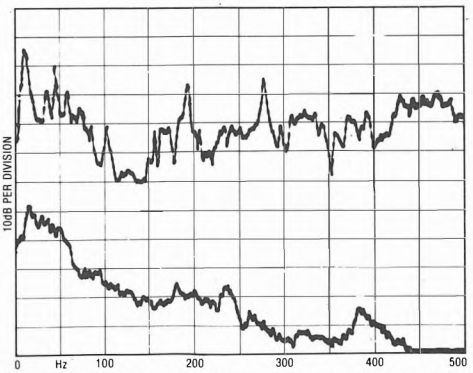
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

SME Series V

SME Ltd, Steyning, Sussex BN4 3GY
Tel (0903) 814321

After several fallow years, SME have come up with a radically new state of the art tonearm. In fact we considered this product to be so important that we took a calculated risk that the results for the only model in existence, a pre-production prototype, would be representative of actual production samples available from about September 1985. It should be noted that this prototype had already travelled to exhibitions all over the world, but despite this it arrived in fine condition bar the lateral bearing friction which was on the high side; in production, figures of less than 40mg are anticipated for this parameter. Fortunately the friction level was not so high as to disturb the tracking of the test cartridge at 1.7-2g downforce.

Expected to cost a phenomenal £800, this arm's design technology, engineering finish and sound quality are all directed towards justifying that cost. Previous SME designs employed a gravity loaded knife edge for the vertical plane bearing, but the *'V* uses firmly preloaded, high force stainless steel ball race bearings of the highest quality, offering zero detectable play or slack when properly assembled.

The main beam or tube, in thinwall cast magnesium, is a complex one-piece structure including the shell/cartridge platform, the massive beam, the yoke bearing assembly and the rear section slide for the counterweight. The beam is heavily tapered both externally and in terms of its wall thickness. No joins are present from end to end though it must be said that the low-effective mass, high density tungsten counterweight block is joined via a cam lock system. Fine control of zero balance is via a thumbscrew, while downforce and bias correction is set by calibrated dials a *la* Linn Ittok.

While the mounting hardware is compatible with existing SME arms — the familiar oval hole with the four point fixing — the *'V* has a highly rigid vice-like clamp system which nevertheless includes the familiar rack for easy adjustment of overhang and offset geometry. Height adjustment is facilitated by a detachable control, which may be temporarily operated during play for fine tuning. Vertical tilt cannot be adjusted except perhaps by special wedge shims at the headshell.

The cable is a special van den Hul type, connected via a Japanese style 5 pin plug while the arm socket is a right angle type, with a viscous-damped free rotation, allowing the cable to take up a natural 'set' for alignment in subchassis turntables; in the current Linn player, the plinth reinforcement comes dangerously close to fouling this socketry, and will probably need cautious shaving away.

SME's internal arm wiring is specially selected for optimum sound quality.

Construction and finish of the test sample was quite excellent — anything less like a prototype I have rarely seen. It felt and operated like a Leica.

Concerning cartridge compatibility, the arm has a moderate effective mass and is suited to medium compliance cartridges in the 8-30cu range; the top limit is higher than expected and results from the arm's damping feature. A calibrated damper engages in a horizontally acting silicone fluid trough. A wide range of damping is possible, with the suggestion that it be used with extreme moderation. As such it can pacify the arm cartridge resonance, particularly with the higher compliance examples, and so stabilise tracking.

In the interests of low resonance, no finger lift is provided on the headshell, which has a milled undersurface for a good cartridge fit.

Lab report

On test this arm was found to be well calibrated with satisfactorily accurate downforce, as well as sensible levels of bias correction, the latter achieved without friction.

Effective mass depends to some degree on the mass of cartridge counter-balanced as well as the selected hardware, typically measuring 12g including fixings. With various fluid choices available from SME, any required damping can be achieved.

Analysis of the arm resonance behaviour was complicated by the necessary use of a new test cartridge. Impulse analysis showed a well damped main arm mode to lie at a high 1.6kHz, but the combination of rigidity and damping made it hard to identify on the swept graph shown. In comparative terms, this suggests a notably clean behaviour with this cartridge.

Sound quality

Perhaps in confirmation of its aspiration to set a new reference standard, this arm has the ability, once heard, to show just how colored and tonally unbalanced many other arms are.

The arm appears to have very little of its own false emphasis and, subjectively, it unleashes the black disc in a surprising manner. Several aspects caught our attention — for example, stage width is notably increased, yet central focusing is more precise over a wide frequency range. Tonally even, it allows previously 'difficult' musical passages such as certain female vocal tracks, to soar through the frequency range without any hindrance or any suspicion of a 'forced' quality. Stage depth is remarkably good, with harmonic perspectives convincingly maintained in free space. Fine detail was excellently resolved, indeed certain detail was heard for the first time on many records. The bass was agreeably firm and extended, lacking any particular emphasis, while the treble was sweet and airy, slightly rich tonally compared with other arms.

Conclusion

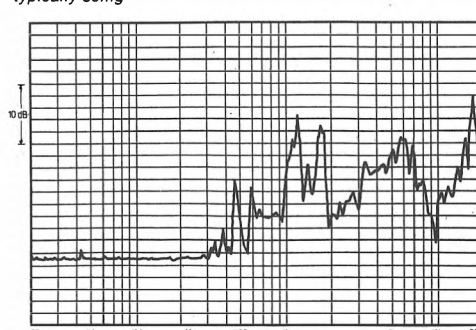
Replying on SME's excellent track record for consistency and manufacturing quality, as well as their obvious dedication to the sonic excellence of this product, the future production model *Series V* can be regarded as an excellent tonearm in terms of design, engineering, build, and sound quality. While the high price constrains considerations of value, it can be argued that this arm does just what it set out to do, namely establish a new reference standard regardless of price. In our view the *'V* has a good chance of re-establishing the old SME slogan, 'The Best Pickup Arm in the World' and must be recommended.

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	10.5g
Type/mass of headshell	fixed
Geometric accuracy	excellent
Adjustments provided	height/overhang/offset/damping
Finish and engineering	excellent/excellent
Ease of assembly/setting-up/use	very good/good/very good
Friction, typical lateral/vertical	100mg*/30mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	150mg/210mg
Downforce calibration error, 1g/2g	+ 0.02g/ – 0.07g
Cue drift, 8mm ascent/descent	negligible 1.5secs/3secs
Arm resonances	very good
Subjective sound quality	excellent

Arm damping.....special structure; adjustable viscous damping

** Over-torqued assembly on prototype; correct setting gives typically 30mg*



Structural arm resonances, audio band

SOTA Sapphire

SOTA UK Ltd, 41a The Grove, London N3 1QT
Tel 01-349 3799

Already achieving notable success on its home US market, this Californian-built model is now available here. Its UK price made is rather more realistic than some other imports by a large planned content of UK manufacture. However at close on £600 it remains one of the more expensive models on the market today, meeting competition such as Michell *Gyrodec* and the Oracle *Alexandria*.

The Sota is a massive subchassis design, the chassis built as a damped medite board forming the lower part of the deck. This damped panel is mass loaded at its corners by the tonearm, and by lead weights, to give a low centre of gravity. The platform in turn is hung on relatively small diameter coil springs and is thus gravity-stable. This assures a low suspension resonant frequency — in the 2 to 4Hz region — for all modes of vibration, this well clear of the likely arm/cartridge resonances.

There is a massive main bearing assembly, inverted so as to exploit the self stabilising action of the platter. A sapphire thrust disc is fitted, hence the turntable's name. The platter itself is a massive aluminium alloy casting finished in a gold colour, the profile chosen to minimise self-resonance. The motor is the well known Papst dc Hall-effect model, used in conjunction with an external power supply. The motor is coupled by a resilient precision belt looping the platter periphery. Immediately adjacent to the motor is a small control panel providing for fine variable speed control plus electronic switching between 33⅓ and 45rpm.

The subchassis is pre-loaded and balanced, and arms may be changed easily by removing a top mounting sub-board. Beneath this is a small tray which contains a measured quantity of lead shot, which can be varied to take up the mass difference between various arms, and so retain chassis balance without further adjustment.

At present a final method for arm lead dressing is still under consideration, and in any case, there is ample space for access without cable encumbrance.

The substantial plinth is made of solid oak, the mitred corners forming a design feature. The lid is low in resonance though not wholly to the expected standard, particularly through its use of apparently inexpensive friction loaded hinges.

Lab report

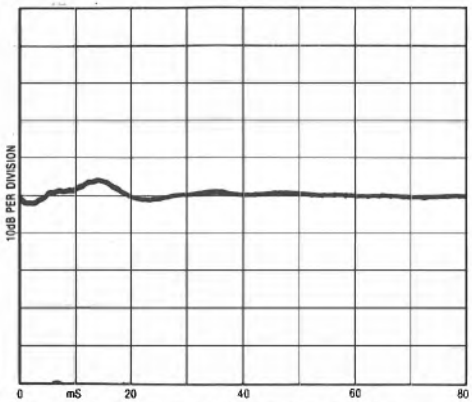
The supplied stroboscope disc was used to set the otherwise uncalibrated speed settings, which needed a mains powered lamp. After a half-hour warm up, the first measurement was combined wow and flutter, for which an excellent 0.06% was recorded. Unweighted flutter was at the limit of measurement though some wow was recorded at 0.15%; this is not uncomon for belt drive models. Drift was low, though the Sota showed some weakness with respect to torque.

Under the standard loading test, the deck slowed by nearly 0.5% and this would be considered serious if it were not for the weighty platter with its high rotational inertia. The flywheel effect will help to control short term load changes while speed recovery was free of overshoot, a favourable point.

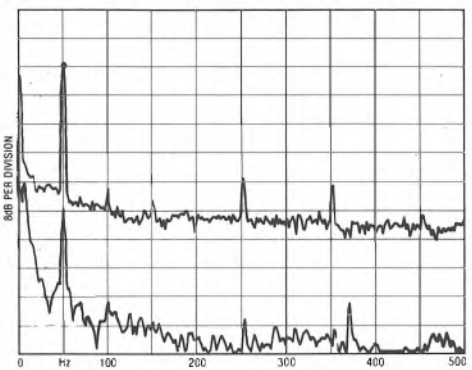
DIN B weighted rumble was excellent at −80dB while spectral analysis showed a welcome absence of the usual motor and mains related harmonics, this helping to contribute to a 'clean' low level sound quality.

Using the mat and clamp, the disc impulse damping demonstrated a high level of dissipation of the vibration transient. Some mild low frequency ripple was evident which when analysed, resolved into a platter resonance at 580Hz, plus a subchassis flexure

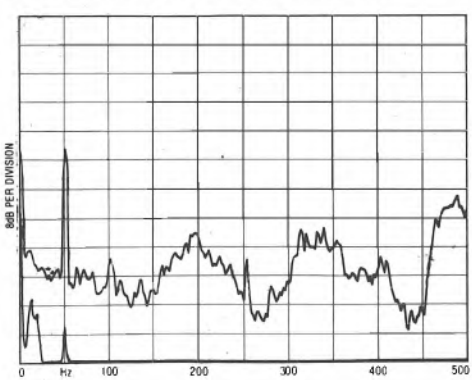
continued on page 193



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

GENERAL DATA Motor unit (tested with Sumiko arm)

Motor Section

Type	belt-drive, subchassis
Platter mass/damping	5kg/very good
Finish and engineering	very good
Type of mains lead/connecting lead	remote transformer
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.05%
Absolute speed error	adjustable pitch
Speed drift, 1 hour/load variation	approx 0.1%/ − 0.45%
Start-up time to audible stabilisation	4.7 secs
Rumble, DIN B wtd, L/R average (see spectrum)	− 81/ − 79dB

Arm section (Sumiko Premiere arm)

Approximate effective mass, inc screws, excl cartridge	16.5g
Type/mass of headshell	universal detachable/12g
Geometric accuracy	very good
Adjustments provided	height/overhang/offset/damping
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	60mg/15mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	320mg/240mg
Downforce calibration error, 1g/2g	0.01g/0.015g
Cue drift, 8mm ascent/descent	negligible, 0.6 sec/1 sec
Arm resonances	see graph
Subjective sound quality	see text
Arm damping	optional lateral, by viscous fluid

System as a whole

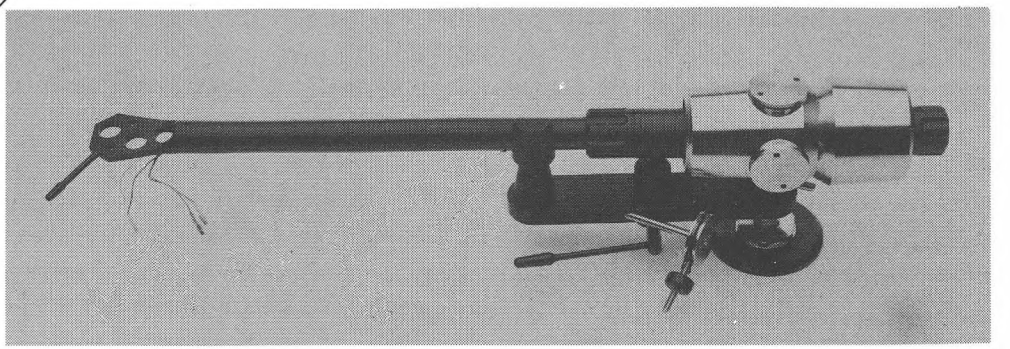
Size (w x d x h)/clearance for lid rear	50 x 43 x 20cm/7.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	excellent/excellent
Vibration sensitivity/shock resistance	excellent/very good
Estimated typical purchase price	£600 (without arm)

Note: Reviewed with the Gyromat, Sota have since noted that improved results can be obtained with alternative mats. In their *Star Sapphire*, a full vacuum clamp mat system is employed.

RECOMMENDED

Syrinx PU3

Syrinx Audio Ltd, Royston House, Caroline Park, Granton, Edinburgh EH5 1QJ
Tel 031-551 2404 (manufactured under new management)



A development of the *PU2*, a promising tonearm which failed to fully convince me of its merits, the *PU3 Ipsissima* is similarly priced at the £300 level — but there is no comparison in respect of engineering or finish, the *3* being far superior to the earlier model.

Like the *LE1*, the *PU3*'s massive main beam may be rotated on a threaded fixing of very fine pitch. As the designer explained, the finer the pitch the greater the locking forces which may be obtained via the centre rotating sleeve. After adjustment, the *PU3* can certainly be set very firmly. A sensible cartridge platform is fitted, well reinforced and firmly bonded to the tube.

A massive gimbal bearing assembly is employed, with large precision ball races designed to accept a substantial pre-load. The pre-load assures a freedom from play with effective coupling from cartridge to mounting base. Best described as cigar shaped, the main beam is profiled to provide a defined resonance pattern chosen for optimum sound.

The polished counterweight moves on the threaded rear stem, and is locked in position by a contra-rotated inner sleeve.

A relatively large alloy plate forms the gantry for the arm rest and cue mechanism, but this was suspected of introducing a minor resonance in the 1kHz region. However, experiment showed that a small wood wedge between the extreme end of the gantry and the arm mounting board (if this is possible) could minimise this resonance effect.

Arm height is adjustable by means of a lock-nut on the threaded pillar, not as convenient as the side locking methods used by most arms. Neither downforce nor bias levels were calibrated.

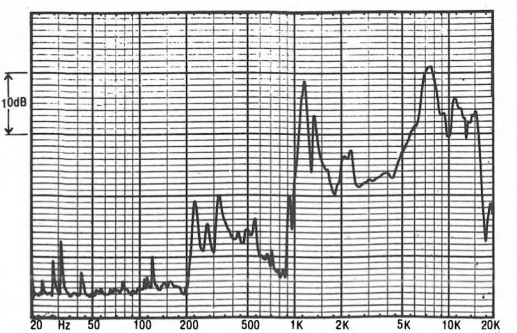
Lab report

Effective mass was found to be around 11g, including fixing hardware, this suited to a broad range of high quality modern cartridges from the Linn to the Koetsus. The geometric accuracy was high, and all the related adjustments were correct. The bearings were devoid of play at the expense of some friction, typically 70mg in both planes for our recent sample, and considered to be satisfactory.

Charted with a Osawa *60L* moving coil cartridge, the structural arm resonance graph presented an interesting picture. Minor counterweight modes were present from 200-400Hz, with the main resonance appearing at a high 1kHz, indicating fine main beam rigidity. The break in energy trend was fairly strong at 1kHz, but above this range the arm was notably well behaved. The main 1kHz resonance could however prove interesting in the context of the listening tests.

Sound quality

The *PU3* was judged to offer a considerable



Structural arm resonances, audio band

improvement over the *PU2*. Tracking stability was notably superior, if marginally behind that of the Zeta for example. The sound was characterised by a light-textured, delicately open quality with a sweet detailed treble capable of bringing out the best from the line-contact type cartridges. The mid was slightly 'nasal', but no more so than several competitors, though in our view this area did not benefit from the Pink Triangle and its alloy plate tonearm mounting. Perhaps a wooden board would provide a superior termination?

Conclusion

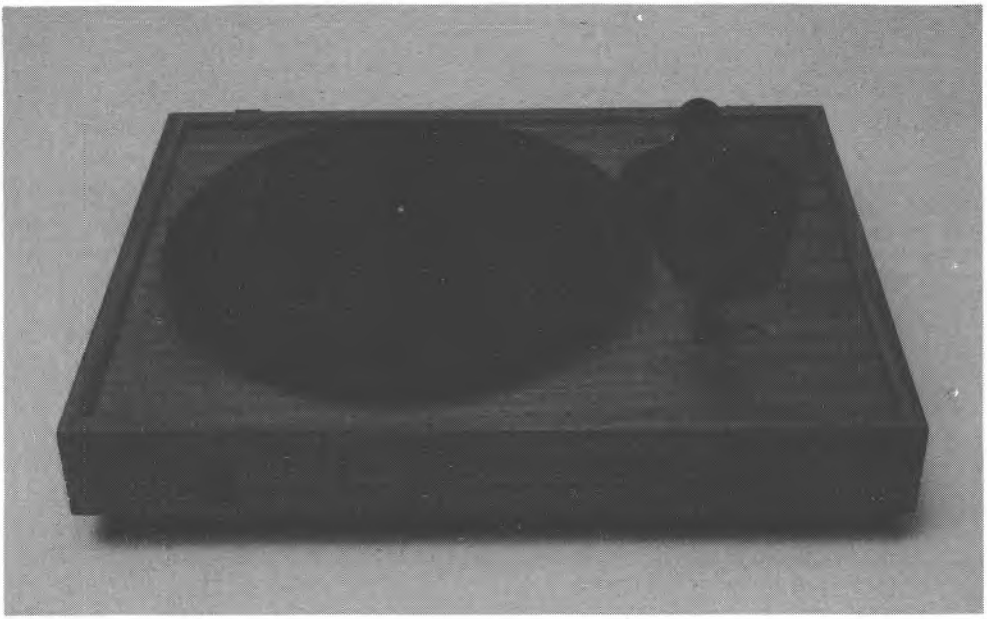
Syrinx have maintained a fully competitive standard with their *PU3 Ipsissima*. In the right turntable — the Sondek is one example — the *PU3* can provide a first-rate sound quality, with the finish and most technical aspects of commensurate quality. Taken overall, the *PU3* qualifies for recommendation.

GENERAL DATA	Tonearm
Arm section	
Approximate effective mass, inc screws, excl cartridge	11.0g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	excellent
Adjustments provided	tilt/height/overhang/offset
Finish and engineering	excellent
Ease of assembly/set-up/use	good/good/average
Friction, typical lateral/vertical	70mg/70mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	uncalibrated
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	very good, 0.5 secs/2.0 secs
Arm resonances	average
Subjective sound quality	very good
Arm damping	none
Estimated typical purchase price	£290

BEST BUY

Systemdek IIX

Systemdek Ltd, PO Box 9, Troon, Scotland
Tel (0294) 71251



The *IIX* is an entirely new model from Dunlop, effectively replacing the successful *Systemdek II*. Floating subchassis models are rare at the £115 level, and the *IIX* is accordingly one of a select few. In the manner of its suspension it resembles the Pink Triangle; the subchassis hangs on fairly small diameter coil springs adjustable from above. Good chassis dynamics are ensured, and it can be seen to swing freely in the required planes of motion. The standard Dunlop oil-feed bearing is used and all vital parts are well engineered.

Formed of steel plate, the subchassis is reinforced by an aluminium girder extrusion linking main bearing to tonearm mount. A plate glass platter plus felt mat surmounts the inner platter drive hub, and a standard synchronous motor (with two-speed pulley) is used to power the deck via a precision rubber belt.

The plinth has a good finish plus a decent lid, mounted on good hinges. Arm mounting is straightforward and cable dressing no problem; for testing we fitted a Mission *774LC,* this ensemble being factory priced at about £180. However, we have been informed by Dunlop that in future they may be able to offer their own Japanese-sourced 'LC' arm.

Lab report

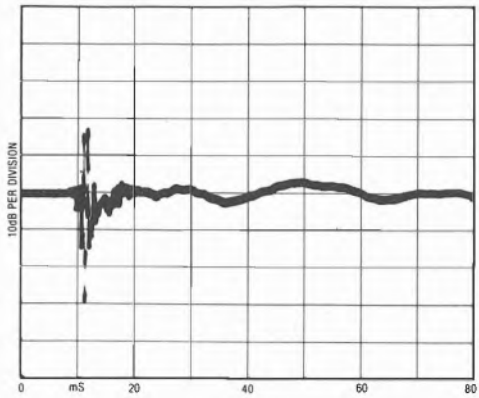
Founded on the good results of the earlier *II,* the *IIX* performed well on test. Platter mass was a realistic 1.8kg with average disc damping accorded by the felt mat. When the Dunlop disc clamp was used, some improvement occurred, this seen in the reproduced impulse response.

Weighted wow and flutter was moderate at 0.09% while unweighted flutter was fine at 0.1% as was wow at 0.12%. The deck did run a little fast but showed excellent torque, the 0.13% slowing under load being a fine result, indicative of the complete absence of subjective programme dynamic wow. DIN B rumble was also very good at −80/82dB, spectral analysis showing some 100Hz motor harmonics but at a harmless level.

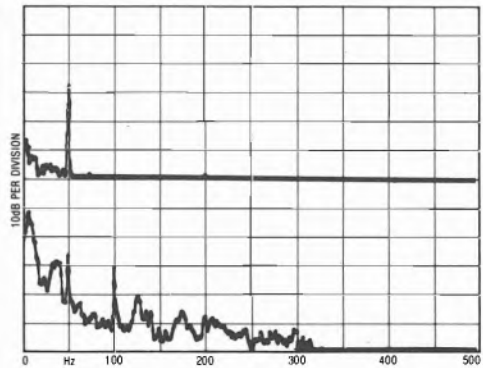
This model was another front-rank performer as regards vibration and acoustic isolation — very little energy gets in above 30Hz.

Sound quality

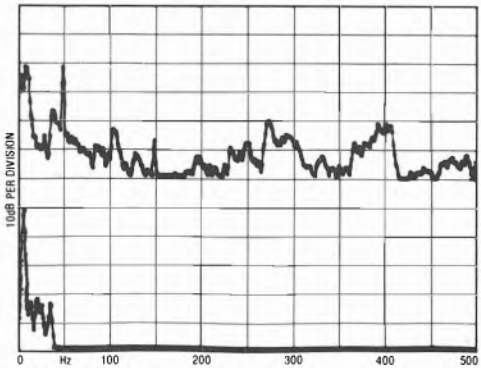
Fine results were obtained on audition. Stereo images were well focused, while good depth and midrange detail were evident. The bass was notable for its clean, even quality, showing good attack and tunefulness.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Tonally, the deck sounded a little bright and forward with a hint of 'echo' in the mid, and it could also sound a trifle 'louder' than the best of its competitors. Rumble and wow were inaudible.

Conclusion

Unfortunately we did not receive a current version of this deck for retest but we understand that some small improvements have taken place. Given Dunlop's consistent standing over the years, we have decided to maintain the Best Buy rating for this deck. An 'electronic' version will also be available.

GENERAL DATA	Motor unit
Type	belt drive, subchassis
Platter mass/damping	4.75 kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.14%/<0.05%
Absolute speed error	+ 0.05%
Speed drift, 1 hour/load variation	synchronous/ – 0.16%
Start-up time to audible stabilisation	4.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 76/ – 78 dB
Size (w × d × h)/clearance for lid rear	41 × 34 × 16.5cm/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£115

RECOMMENDED

Thorens TD166 II

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF
Tel (0992) 716666

Originally popular a number of years ago the *166* has been revised and reintroduced after a long absence. On the face of it, this would appear to be quite a competitive product: for under £120 a good quality, well adjusted tonearm is provided, fitted to a true sub-chassis belt-drive deck.

The arm uses the Thorens detachable wand system offering a low effective mass in the region of 5-6g, and suited to medium to high compliance cartridges. Calibrated adjustment is provided for downforce and bias compensation while plinth mounted, shock-free cueing is built-in. Only manual operation is provided, and the plinth and hinged lid are rather resonant; in practice this is immaterial since the player components are isolated on the spring-suspended internal sub-chassis. A generous cast machined platter is fitted with a main bearing of satisfactory quality. Power is supplied by a slow-speed synchronous motor via a compliant belt. The old-style Thorens mat is used for this economy model, but it could easily be updated by a felt or other type.

Lab report

While a promising 2.5kg platter is fitted, the disc impulse response was uninspiring with considerable post impulse ringing; a good mat would help matters here considerably. Finish and engineering were generally quite good and two speeds are provided with a good mechanical changeover. Weighted wow and flutter was very good, though some mild pure wow was noted. The *166* ran 1.4% fast, which might just be noticed by a someone with absolute pitch acuity, but showing under load was negligible. Rumble was above average at −72dB, DIN weighted, and nothing untoward was evident from the spectrum analysis. As it should, the *166* rated as good on both acoustic and vibration isolation, while hum levels were moderate, feedback resistance well above average, and shock resistance fairly good.

The arm showed good geometry and was adjustable in all planes, which is unusual at this price level. As in the past, I found the Thorens system for cartridge fixing awkward but otherwise the arm was easy to set up and use. The bearings provided very low friction levels and bias compensation was in the right ratio if slightly low, while the cue operation was fine. Experiments with the arm resonances revealed a significant improvement in sound with the finger lift cropped to about one third its original length, or even removed altogether. Curtailing the lift meant that the 400Hz resonance then disappeared, and that at 500Hz was moderated.

Sound quality

Used as supplied, the sound quality was rather special for the price. It portrayed dynamics well and demonstrated worthwhile stereo depth and space, proving to be quite detailed and articulate throughout the frequency range.

The bass was quite good with a surprisingly stable tempo and drive. Substitution of a better mat and altering the finger lift gave greater clarity and smoothness.

Conclusion

The *166* is unhesitatingly recommended. For the price it offers a good arm, a stable motor drive, good environmental isolation and a well balanced performance. The sound quality is well above the general competition, and furthermore the arm's low mass and high sensitivity allow the use if quite delicate higher compliance cartridges while still working well with medium compliance types.

GENERAL DATA Integrated turntable

Motor Section

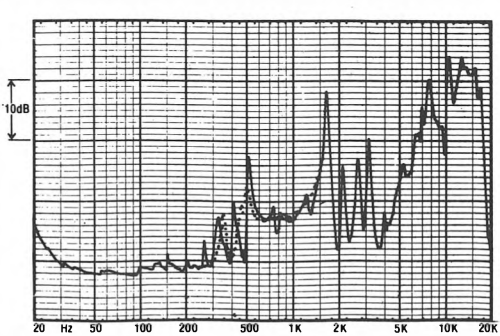
Type.....manual, belt-drive, synchronous motor, subchassis
Platter mass/damping.....2.5kg/poor
Finish and engineering.....good/good
Type of mains/connecting leads.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..0.15%/0.06%
Absolute speed error.....+1.4%
Speed drift, 1 hour/load variation.....synchronous/–0.18%
Start-up time to audible stabilisation.....3.5 secs
Rumble, DIN B wtd L/R average (see spectrum).....–72dB

Arm Section

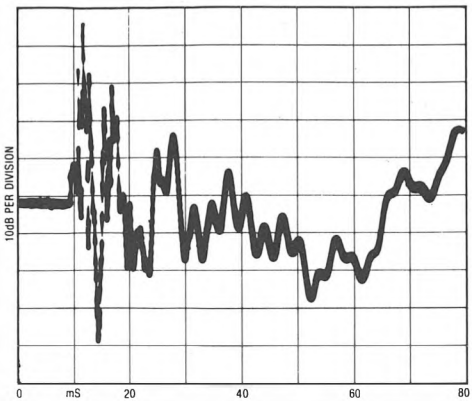
Approximate effective mass, inc screws, excl cartridge...6.0g
Type/mass of headshell.....detachable carrier
Geometric accuracy.....very good
Adjustments provided.....overhang/offset/height
Finish and engineering.....good/good
Ease of assembly/setting-up/use.....good/fair/very good
Friction, typical lateral/vertical.....less than 5mg/10mg
Bias compensation method.....pulley
Bias force, rim/centre (set to 1.5g elliptical).....150mg/150mg
Downforce calibration error, 1g/2g.....–0.2g/none
Cue drift, 8mm ascent/descent.....none, 0.8 secs/3.1 secs
Arm resonances.....*average+
Subjective sound quality.....average+
Lead capacitance/damping method
240pF/counterweight decoupling

System as a whole

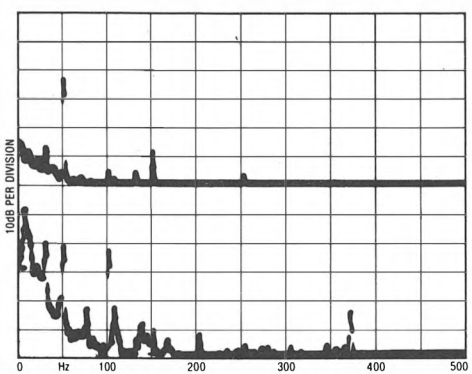
Size/clearance for lid rear.....43(w) x 35(d) x 15(h)/8.5cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....good
Subjective sound quality of complete system.....good+
Hum level/acoustic feedback.....very good/good
Vibration sensivity/shock resistance.....good+/fairly good
Estimated typical purchase price.....£149
**with fingerlift as supplied – see text*



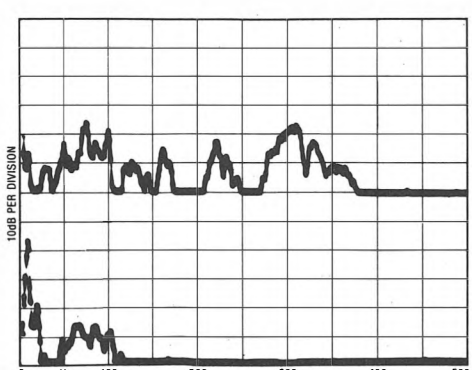
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Thorens TD320 series

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF
Tel Waltham Cross 71666

After a relatively quiet period, Thorens have launched a new range of turntables called the *320* series. Essentially this provides replacements for the long established *160* range, and a new wood subchassis design has been employed. Following in the footsteps of B&O and Philips, Thorens have chosen to replace their usual coil spring suspension with one using flat leaf springs, these hung or cantilevered from the chassis allowing free movement. Centration and consistency are thus improved and the springs are easy to adjust from above.

The massive plinth is of solid MDF, 40mm thick. The section of material cut out for the arm mounting transferred to the subchassis, and the result is a wood-based high-mass subchassis of low resonance properties. Arm mounting boards are interchangeable. Thorens' existing two-part Mazak platter and belt drive has been retained, but a new low voltage synchronous motor has been fitted, this fed by an electronically synthesised two phase power supply with the two speeds directly switched. In *320* form, this deck comes with a factory fitted Thorens *TP16* tonearm complete with a stable arm lift control fitted with a Linn *LVX* as an option, if so desired. Many other arms can also be fitted — our sample had a Mission *774LC*.

The *320* is engineered to a high standard with an excellently toleranced main bearing and particularly good finish. The lid now sports spring loaded hinges. It proved easy to set up except for the restricted clearance available for dressing the arm cable inside the deck.

Lab report

The clutch provided a judder-free start up at a slow 8.7 seconds. Rumble was very low at −76dB with no supply harmonics visible on the spectrogram. The new flat mat offered quite good platter damping with a good termination of disc impule energy.

The suspension offered very good levels of vibration isolation while acoustic energy was also well rejected. No particular emphases were detected in the frequency range.

Wow and flutter was very low at 0.06% DIN peak, sigma 2 weighted. The discrete figures for wow and for flutter were well balanced, while speed accuracy was good, and slowing

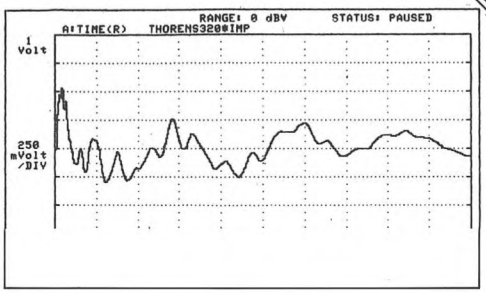
under load was mild at 0.25%. This player also provided quite good resistance to shock though the chassis proved to be a trifle 'whippy' in the rotational mode.

Sound quality

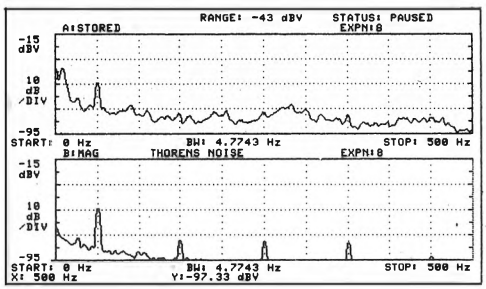
Performing very well in the listening tests, the *320* provided a stable, focused sound, with a feeling of substantial weight and solidity. Stereo images revealed fine depth and space while the pitch and rhythm were well maintained. Acoustic feedback was also very low, while the player was also not too critical of siting, a good sign.

Conclusion

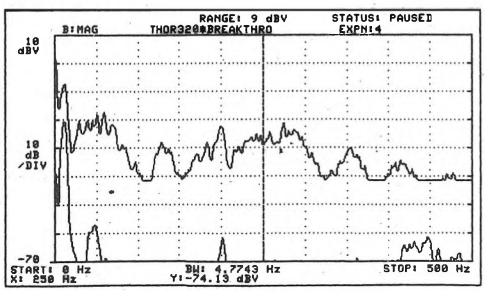
Improving on the traditional strengths of the *TD160*, the *320* series offered a welcome advance in engineering, performance and finish. Fully competitive in their price category, this new range of models is firmly recommended.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is – 80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

GENERAL DATA Motor unit/integrated player*

Motor section

Type.....electronic belt-drive, subchassis
Platter mass/damping.....3.7kg/good
Finish and engineering.....excellent/very good
Type of mains lead/connecting lead.....2 core
Speed options.....33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2).....0.06%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.1%/0.1%
Absolute speed error..... – 0.16%
Speed drift, 1 hour/load variation.....<0.1%/ – 0.25%
Start-up time to audible stabilisation.....8.7 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 76dB

System as a whole

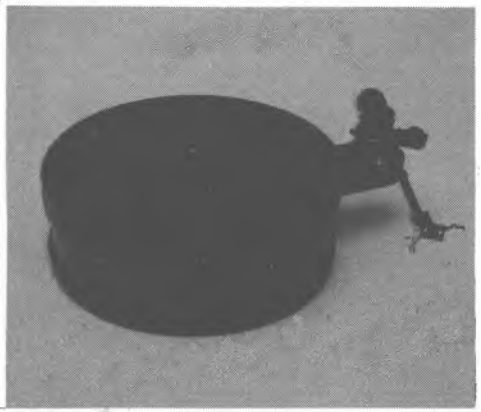
Size (w × d × h)/clearance for lid rear...../ × / × /cm//cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....very good
Subjective sound quality of complete system.....very good
Hum level/acoustic feedback.....very good/very good
Vibration sensitivity/shock resistance.....very good/fairly good
Estimated typical purchase price.....TD321, £220; TD320, £270

**supplied with factory-fitted Linn LVX arm (TD321) or Thorens arm (TD320)*

BEST BUY

Walker CJ61

C W & J Walker Ltd, Brentwood, Red Lane, Frodsham, Warrington WA6 6RA
Tel (0928) 33326



Possibly inspired by the drum-plinth *Systemdek*, Colin Walker has come up with a quite remarkable new turntable. If the purchaser is prepared to forego a cover, this model can offer a true floating subchassis, with a good-quality synchronous motor driving a substantial two part platter via a precision ground drive belt — all for under £90. It is likely that the factory-assembled package of a *CJ61* plus Mission *774LC* arm will retail in the region of £145, a price territory where a proper subchassis, with its attendant performance benefits, is still commonly omitted; only the B&O and NAD have it in the £100 price range.

The *61's* subchassis is of wood composition, as in the *CJ58*, and the properly-designed three-spring suspension can be easily aligned from below via the accessible bolts. Two speeds are provided, manually changed by lifting the belt, while the established Walker Tufnol platter has been retained, this a further major asset at this price level. A new thin felt mat is bonded to the platter. Finish is in satin black, practical and workmanlike.

Our pre-production sample came supplied with a rubber drive cord and gave just audible wow and flutter. During the project, it was however replaced by a full production model which was fitted with a trusty conventional belt drive.

Lab report

The first sample gave high wow and flutter results and this was queried with the designer. The other characteristics were however fine, and start-up was particularly quick. Torque was fine and rumble satisfactory, though affected by the presence of the high flutter, the spectrogram lowered by 20dB to allow recording of this trace. Note that the final sample gave rather better wow and flutter readings than those here, plus reduced rumble; clearly there are no problems on this score now.

Fine results were obtained for vibration isolation and acoustic energy was particularly well rejected. The disc impulse response was above average the initial transient being well handled with a low incidence of secondary ringing. A trace of a low frequency resonance may also be seen towards the end of the pulse recording.

Sound quality

Final auditioning on the second sample provided very good results, these in no way related to the low price! Sound quality was fully equal to that of a medium-range subchassis model and the *774* arm complemented it well.

Bass was pretty clean with surprising 'speed' and articulation. The midrange was free of hardness and yet was explicit with good resolution of detail, while the treble register remained in good tonal balance.

Stereo images were well focused, stable and exhibited good depth, while dynamics were well portrayed without undue forwardness.

Conclusion

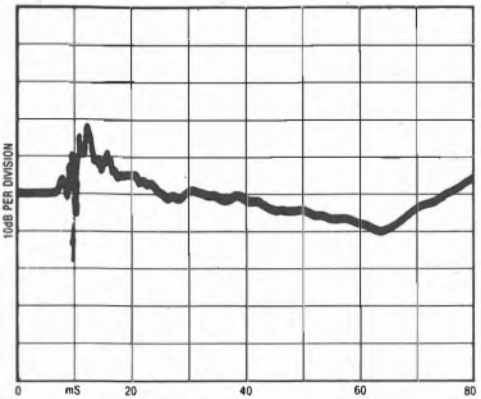
In its production form, this new Walker model has broken a price barrier for good subchassis motor units. Compatible with the Mission *774LC* tonearm, and arguably, with even better models as well, it offers a very good sound at a very modest price. Its fine value for money ensures it Best Buy status in this edition.

GENERAL DATA Motor unit

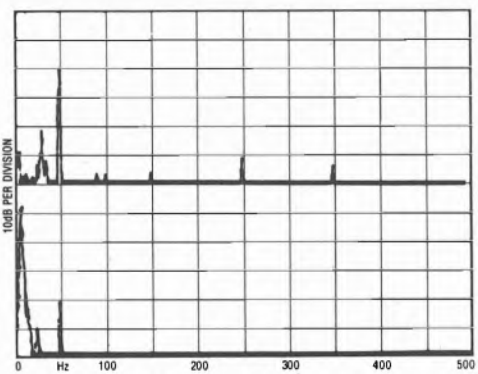
Motor Section

Type	belt drive, subchassis
Platter mass/damping	1.9kg/average +
Finish and engineering	adequate*/very good
Type of mains lead/connecting lead	2-core/ –
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.3g
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.25%/0.2%
Absolute speed error	0.25%
Speed drift, 1 hour/load variation	synchronous/ – 0.25%
Start-up time to audible stabilisation	1.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 74/ – 72dB
Size (w x d x h)/clearance for lid rear	41 x 31 x 14cm/none
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	fair/very good
Vibration sensitivity/shock resistance	good/fair
Estimated typical purchase price	£85

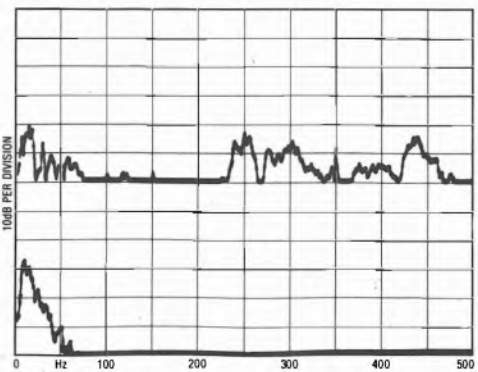
**Prototype review sample, not typical production*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

at around 50Hz, both however quite well damped.

The Sota scored top marks for isolation, both vibrational and acoustic energy being well rejected, and this design should be highly uncritical of location. The chassis also demonstrated good dynamic behaviour with its frequency modes well separated from the cartridge resonance, and as such contributing to good stable tracking even under conditions of mild shock or footfall.

Sound quality

Using top class turntables as a basis for comparison, the Sota was also examined on its own merits, fitted with the Sumiko *Premiere* arm and *Talisman* cartridge supplied. We also tried the Zeta and Linn *Ittok* arms with *Asak* and EMT van den Hul cartridges.

Initial impressions were encouraging, the player providing a stable and spacious stereo soundfield with good tonal neutrality. The frequency balance always sounded even and well controlled, while an air of restraint pervaded the reproduction. Stereo images were well presented with good depth ambience, and fine width of stereo stage. It felt 'relaxed', in fact almost too much so at times, as if some of the feeling of excitement present on some recordings had been diluted. One listener remarked that it was very hard to fault the Sota and yet he did not find the music it produced particularly involving. One area was finally identified namely the bass. While it was undoubtedly even, pretty tuneful and showed good low frequency extension, it also seemed 'slow'. The attack and rhythmic precision present on some tracks was softened and lost impact. We found use of the *Ittok* helped liven up the balance elsewhere in the frequency range, providing a good match for the deck but the 'lack of excitement' question was not wholly resolved.

Conclusion

At close on £600 the Sota Sapphire offered some impressive aspects in terms of both its engineering and performance, and is undoubtedly a fine product. However it is up against stiff competition from UK designs, many of which offer rather better value. It is certainly worth considering the *Sapphire;* indeed its particular balance of performance might prove correct for some systems, so our suggestion must be to consult your dealer, take advice on system matching and audition it for yourself.

Walker CJ58 II

C W & J Walker Ltd, Brentwood, Red Lane, Frodsham, Warrington WA6 6RA
Tel (0928) 33326

Supplied in provisional form, this new Walker deck replaces the original *CJ58* and offered a new chassis design plus a radically improved plinth, well finished in real wood veneer.

The original model used a three point coil spring suspension, with a fabricated wood frame chassis. The new version has a revised chassis still made from wood, but now in the form of composite panels, designed for more flexible arm mounting as well as to provide a more stable suspension.

The heavy highly-damped Tufnol platter has been retained, as well as the inner drive belt hub. A slow speed synchronous motor powers the deck, this offering two speeds via a manual belt changeover on two pulley diameters. A thin high density felt mat is permanently bonded to the platter.

Suspension levelling may be accomplished from above and no problems were encountered as regards arm lead dressing. Standard arms for use with this deck include the Mission *774LC* and the Linn *LVX*, both comparably good choices.

Lab report

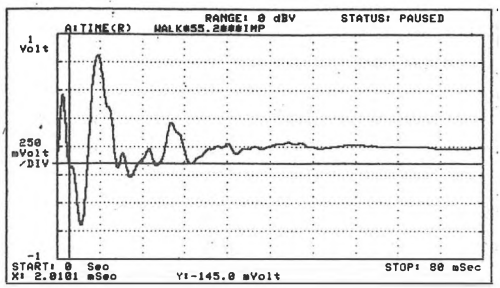
Disc impulse response was good, the transient quickly damped, with low frequency effects at a minimum. Acoustic isolation was very good, as was the low frequency vibration isolation but some breakthrough was observed in the higher frequency range. The DIN peak wow and flutter was a little high at 0.21%, though this did not prove to be a subjective problem. The cause seems to have been the same as that of the poorer than average torque, the deck showing an 0.5% slowing under load; both were believed due to the low selected level of belt tension acting in conjunction with the talc dressing on the belt. This dressing gave a smooth starting but also resulted in a long 6.5 second start-up time.

Absolute speed was slow at −2%, this an audible shift and one for which some allowance was made in the listening tests. Cleaning off the talc effected an improvement here. DIN B weighted rumble was very good at −78dB, with the rumble spectrogram very clean bar a touch of breakthrough at 100Hz.

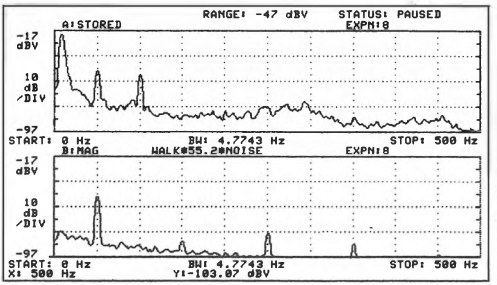
Sound quality

The *'58 II* did well in the listening tests, and was certainly improved by cleaning the belt. Auditioned using a Linn *LVX*, it offered a tidy well controlled performance, to an essentially good 'subchassis standard'. The stereo was clear with good focus and depth. Midrange coloration was pleasantly low, while the bass showed some articulate detail with fair extension.

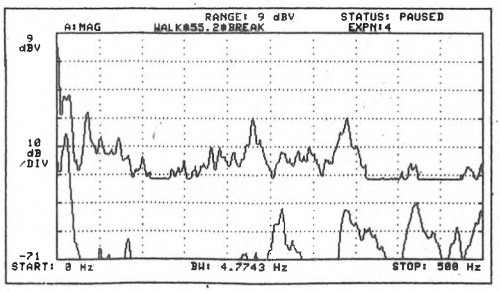
Pitch stability was good but not outstanding; perhaps the drive tolerances could be revised to give higher torque in future production? A 'Best Buy' might then be regained.



Disc impulse response, showing damping. Trace shows spurious output from cartridge when disc is subjected to a standard mechanical impulse.



Rumble and noise. Upper display shows total rumble, lower section electrical rumble only. Scaling is as earlier charts, but with 40dB range.



Breakthrough, acoustic (upper trace) and vibration (lower trace). Note that the baseline for the acoustic breakthrough trace is –80dB.

Charts above characterise general turntable behaviour. See text for commentary on the relevance of these results, but see Technical Introduction for explanation of test techniques

Conclusion

With this deck, a good subchassis sound quality was maintained together with a high standard of finish. The drive and suspension dynamics were not entirely happy as yet, but the '*58 II* did nonetheless qualify for recommendation.

(Note: Production models will have an aluminium motor pulley, giving improved drive.)

GENERAL DATA Motor unit*

Motor section

Type	Synchronous, belt-drive, subchassis
Platter mass/damping	1.9kg/good
Finish and engineering	fairly good
Type of mains lead/connecting lead	2 core
Speed options	manual change, 33, 45 rpm
Wow and flutter (DIN peak wtc, sigma 2)	0.2%
Wow and flutter (Iin peak wtd 0.2-6Hz/6-300Hz)	0.25%/0.21%
Absolute speed error	– 2.0%
Speed drift, 1 hour/load variation	negligible/ – 0.5%
Start-up time to audible stabilisation	6.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 78dB

System as a whole

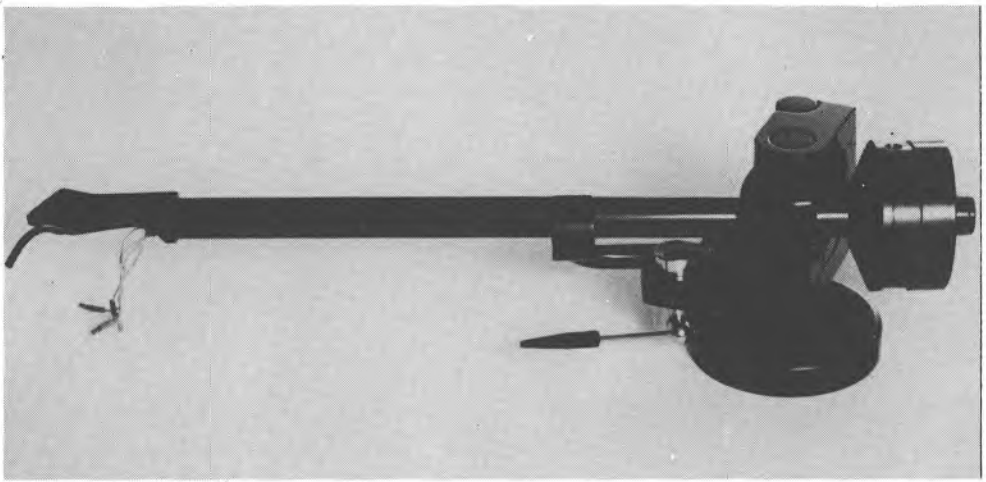
Size (w × d × h)/clearance for lid rear	/ × / × /cm//cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	good
Hum level/acoustic feedback	good/very good
Vibration sensitivity/shock resistance	good/fair
Estimated typical purchase price	£125

**arm may be supplied*

RECOMMENDED

Zeta

Esoteric Marketing, 23 Berrydale, Northampton NN3 5EQ
Tel (0604) 411721



Firmly in the 'super-fi' class at close on £400, the Zeta arm is a UK-designed and manufactured product with a very business-like construction and exterior.

Finished in satin black throughout, the arm comes packed in a handmade, hinged plywood case. A fixed headshell design, rigidity is its byword, with the massive construction clearly amplifying this concept. The entire pillar/base and gimbal support is machined from a solid block and likewise the oversize beam tube is a continuous structure, running right through the bearing assembly. The headshell is free of perforations aside from the cartridge fixing slots, representing an excellent mounting platform. As in the Sumiko, those few parts which are joined are thermally bonded, thus avoiding the variability of the adhesives normally-used.

The large counterweight consists of an aluminium shell containing a series of steel weights, these being selected in combination for the required counterbalance force, then locked in position. The whole assembly may then be locked on the rear arm beam section using large socket head screws and downforce must be set using an auxiliary gauge. An internal hair-spring bias compensator is fitted, integral to the pillar housing and controlled via small knurled wheel. Uncalibrated, this needs to be set by trial and error, using a tracking test record and via listening tests.

Geometrically, the offset is at 23.75 deg in order to bring the stylus tip into alignment with the arm beam centre line and to reduce torsional excitation. Heavily gold-plated professional connectors are used for the arm cable which has fine phono plugs at the other extremity, these also gold plated. The cable was judged to be reasonably compliant and offered a low 100pF lead capacitance.

The gimbal bearings are set virtually to tightness and employed a large number of race balls on superfinished hardened surfaces. Effective mass approaches the 'heavy' category specially suited to low compliance, high performance moving coil cartridges.

Lab report

Estimated at 16g, the effective mass would ideally partner cartridges in the 7-14cu compliance range. The geometric accuracy was excellent, and the arm was superbly crafted and finished. Friction was satisfactorily low at 25mg in both planes, and when set to 'off', very little bias was developed. At the mid click position 200mg was noted, with 325mg at 'max' this is a very sensible control range. The cue worked well with sensibly chosen rates.

Charted for resonances, the start of the graph is low down due to the mass contribution; thereafter it is distinguished by a uniquely even energy trend. A few minor resonances are present, but do not significantly disturb the result. A trace of bearing play was noted with our first sample; unfortunately, later samples still showed some bearing quality variation.

Sound quality

Immediately recognisable as a top-class product, the Zeta was most rewarding on audition. The bass was exceptionally good — deep, powerful, tight and articulate. Tonal balance as slightly 'heavy' in a relaxed, unstrained fashion — full of depth, detail and sharp stereo focusing, while the treble was sweet and transparent with negligible blurring.

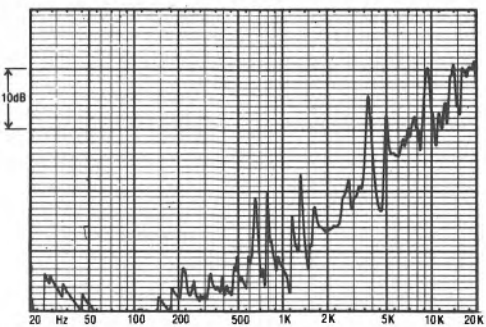
Conclusion

Here is another UK-built, front-rank audiophile product. Its constructional quality, finish and sound were all first rate and would satisfy the most discerning of purchasers, and while a high price must be paid for this, for many the results will justify the outlay. Van den Hul cable will be available as an option, offering improved clarity and depth, plus a still sweeter treble.

GENERAL DATA Tonearm

Arm Section

Approximate effective mass, inc screws, excl cartridge	16.0g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	good/good/good
Friction, typical lateral/vertical	25mg/25mg
Bias compensation method	internal spring
Bias force, rim/centre (set to click-stop position	200mg/200mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	slight, 0.7 secs/1.9 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	100pF/none
Estimated typical purchase price	£399



Structural arm resonances, audio band

TURNTABLES AND TONEARMS SUMMARY REVIEWS

Models covered here have been fully tested in previous issues, but space no longer allows us to print the reviews in full. Although some of the products here are officially discontinued, they remain available, often at attractive prices.

Acoustic Research 'AR Turntable'
Actually a completely modernised revival of the classic AR subchassis design of the 1960s, this well-finished model offered fine all round performance, with an airy, articulate sound; the matching arm was regarded as roughly equivalent to a Mission *774LC*. This model remains very good value though somewhat eclipsed in this respect by the cheaper *EB101*.

Ariston Magnum Opus
A reasonably priced UK-made pickup arm, the *Magnum Opus* showed tidy resonance behaviour and will suit a number of medium-compliance cartridges. A recent sample showed further improvements and recommendation for this model continues.

Audio Technica AT1120
This low effective mass (5g) arms suits fairly high compliance cartridges, and sounded better than an unpromising resonance graph suggested. Tonal balance was quite pleasant, stereo image reasonably well defined, and treble inoffensive. Bass definition was below that of some 'super' arms though, and this model will not suit low-compliance moving coils. Well built and finished, with very low friction, it originally sold at around £110.

Decca International
With moderate 12g effective mass, this unipivot design gives a rather 'rich' tonal balance, with some bass muddling and mid-forwardness; it could be a good match for Decca's individual-sounding cartridges, but constructional quality is not good by modern standards. Out of production, but still available from some outlets.

Dual CS514 and CS515
Superficially resembling the *505* models, the inexpensive *CS514* and *'515* are based on lightweight plastic plinths and have only the most rudimentary isolation, via rubber grommets, of their steel 'subchassis'. Despite the nicely-made Dual tonearm, sound quality was not found very satisfactory, lacking dynamics and showing programme wow, a consequence of poor motor torque. Though the *514* could perhaps be worth considering for the least expensive systems, the *'505* is clearly very much worth the extra money.

Dynavector DV501
Developed from the even more elaborate *505*, this unusual arm pivots laterally at the conventional place, but the front section of its beam carries a smaller secondary arm pivoting in the vertical direction. This means that effective mass is 50g in the lateral plane, and 20g in the vertical. The secondary 'front' arm carries the IEC/SME-type headshell, which itself weighs 15g. The arm's complicated non-rigid structure was reflected in poor resonant behaviour and sound quality was disappointing; and at 1kg it is still too heavy for satisfactory fitting to many subchassis designs.

Fidelity Research FR64S and FX64S
These beautifully-made tonearms are both capable of extremely good results, and are probably best suited to the high-mass type of turntable such as the big Luxman. The *FR64S* has an effective mass of 35g, suiting cartridges of not more than 10cu, while the *FX*, at 20g, is more widely compatible. On test the *FX* sounded a little more secure in terms of focus and image stability, while on audition the *S* was found a little 'cleaner' and with greater bass 'weight'.

Grace G707
This long-established and elegant arm is a rigid yet low-mass (7g) design with a fixed plastic headshell. In terms of tonal neutrality it seems to offer a slightly bright or coarse balance, and while it offers tight, extended and powerful bass, with good stereo depth and precision, recent introductions reduce its competitiveness.

Helius Orion
Built to uncompromising standards, the Helius *Orion* uses a 'tri-ball' pivot system in a massive bearing assembly, giving great rigidity and zero bearing play when correctly adjusted. Of medium effective mass (11g), this excellently engineered arm continues to justify its high price (some £420), and is again recommended.

Linn Basik LVX
While offering the upgraded *LV Plus* version as a separate item, Linn still supply the *LVX* to other manufacturers for fitment to their own turntables. Sourced in Japan but built completely to Linn's specification, the *LVX* is a versatile medium-mass (12.5g) type. With very satisfactory

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HI-FI CHOICE

tonal balance and well defined stereo, the *LVX* gave a sweet and musical treble although the bass lacked some tautness.

Lux PD300
A massively constructed and beautifully finished belt-drive subchassis turntable, the *PD300* also incorporates the Lux vacuum platter system. With a substantial (3.4kg) platter and high torque drive, wow and flutter and rumble measurements were excellent, but the effectiveness of the suspension system is compromised, as supplied, by the addition of foam sleeves and silicone damping washers on the moving parts. Removal of these improved the sound at the expense of a slight 'nervousness' in chassis stability. With notable midrange neutrality and transparency, at time the *'300* sounded almost clinically clear, and in tonal balance seemed slightly 'cold' and faintly 'glassy'. Recommended in two previous issues, the *300* is officially discontinued but currently still available from stock.

Marantz Esotec TT1000
Produced in very small numbers, this 'flagship' motor unit in many ways typifies the Japanese 'heavyweight' approach to turntable design, in which mass and rigidity are relied on to provide acoustic isolation, without resorting to a suspended subchassis. With a glass/aluminium sandwich plinth weighing over 25kg, a 3.4 kg platter and an excellent motor, the *TT1000* does offer a high-quality shock resistant motor platform, tolerant of most tonearms. When well sited, it gives very good reproduction with low coloration levels, but the price of around £1000 makes any value for money judgement inappropriate.

Mayware III
While this earlier version of the Mayware arm received a recommendation when tested a couple of issues ago, the importer has subsequently declined to submit current samples for review, and we are unable to confirm that the arm still holds its own against improved competition.

Michell Focus motor unit
In production for some years now, the *Michell Focus* has undergone many detail improvements. It is founded on a wood/plastic laminated chassis, suspended as a whole on quite effective springs with rubber feet. The distinctive suede 'mat' is permanently bonded to the solid 2kg platter, driven at its rim by a synchronous motor via a round-section rubber cord. Sound quality, assessed originally with a Linn *Basik LVV*, was found quite transparent in the mid, with bass reasonably clean. The acrylic lid rests directly on the baseplate though, and the best results were obtained with lid removed.

Nakamichi Dragon CT
Still a very large player, the remarkable *Dragon* is the more practically-proportioned offspring of Nakamichi's original computing turntable, the first to offer automatic record centring. The system eliminates wow due to record hole eccentricity, which sometimes goes beyond the levels of tolerance, particularly on piano and organ music. Before play, record eccentricity is first sensed by a small secondary 'tonearm', after which a precision mechanism makes a tiny movement of the upper glass platter to bring the record into perfect centration. This special feature worked extremely well and may prove attractive to critical listeners. In other respects the Dragon was competent; it was resistant to feedback and shock, and sounded a little like a good subchassis deck of a few years ago (one with foam-damped springs and a rubber mat). The bass did not have quite the attack of modern designs, and the mid was not exceptionally detailed, but the stereo stage was wide, pretty deep and had good focusing. Worth considering for some, the Dragon's £900 price tag takes this interesting design well out of the 'value for money' range.

Oracle Delphi
Still current, with detail improvements, the original Oracle motor unit design has an 'open' appearance and incorporates many special design features. The elegantly skeletal laminated magnesium subchassis is poised on springs concealed in three piers attached to the thick acrylic base plate. Correct subchassis behaviour with various arms is obtained by choosing the right combination from the total of nine colour-coded springs provided. The platter incorporates Oracle's unique clamp system and a rubber mat with 'tacky' surface.

Subjective impressions were of a rather 'dry' and well-damped character, with a somewhat 'distant' mid and treble. Transients were reproduced very clearly, with good instrumental differentiation, and very good depth and stereo focus. Criticisms in the last edition centred on the failure to keep perfect subjective pitch on the most sensitive material, and the effects of the stiff chassis vibrational mode and residual vibration breakthrough. Nonetheless the Oracle

can produce very good sounds with ancillaries of appropriate quality.

Revox B791
In this 'childproof' design, the arm is a foolproof servo-controlled assembly concealed beneath a cover, the whole forming a parallel-tracking gantry which is swung across the playing surface once the disc has been placed on the platter. The servo responds to forcible movement by instantly lifting the stylus from the groove, and this makes record or stylus damage virtually impossible. The cartridge fitted to the model tested last year was a high-compliance Shure, though this has now been replaced by an Ortofon type. Sound quality was described as 'rich' with some midrange 'thickening'. Overall the sound felt a little 'compressed' in terms of perceived dynamic range, but on the other hand, pitch stability was extremely good.

SME 3009 II Improved
The classic low-mass SME arm design still rated as 'worth considering' when last tested two editions ago, particularly in 'non-detachable' form. The *Improved* designation refers to a reduction in mass applied to the design in the early '70s, the higher-mass *3009R* being virtually a return to a pre-*Improved* version! The *Improved* remains a well-built and finished product which may be available at an attractive price. Sound quality was characterised as somewhat brash and lacking in bass definition.

SME 3009 Series III and IIIS
Designed to combine low mass (5g) with versatile cartridge matching, the *Series III* has extremely comprehensive adjustments; the simplified *IIIS* lacks some of the *III*'s features but we found that it sounded indistinguishable. The sound was characterised by a 'soft' balance, with a subjectively subdued treble. Coloration was comparatively low and the overall sound pleasantly relaxed. Accessory mass loading plates can be added to the headshell to raise the effective mass to around 12g, suiting cartridges down to 8cu, but even so the arm is not primarily suited to low compliance moving-coils. But respectable sound quality, combined with excellent construction and finish, still earns these arms a recommendation.

SME 3009R
This 'R' version of the *3009* offers higher mass primarily for lower-compliance moving-coil cartridges; it is in effect a revamping of the much earlier, heavier *3009* version which preceded the *3009 II Improved*. While construction and finish are to the usual superb SME standard, the subjective performance was in the 'average' group and this did not in our view justify the price.

Sumiko MDC800 The Arm
Based loosely on the legendary Swiss-made Breuer, this medium-mass (13g) arm is produced in Japan for an American company, and imported to the UK by Absolute Sounds, selling at around £1000. In earlier tests the sound was found to be smooth and relaxed, with good bass definition, fine depth, neutrality and tunefulness. Very minor criticisms were made of a slight stereo defocusing and mild coloration in the upper midrange, but the sound quality ranked as very good byt any standards. While the MDC800 once stood alone at its exalted quality level, it has now been joined by competitors, often at more realistic prices.

Thorens TD160BC and TD160S
Long established as the standard Thorens motor unit, the *160BC* was also made available, with many detail refinements, as the *160S*. Both models have been recommended in the past and although now overshadowed by others if viewed in strict value terms, nonetheless offered substantial engineering quality for the money.

Thorens TD147
Essentially a development of the *TD160S*, this upmarket Thorens model proved to be a fine-sounding integrated turntable of honest, well-adjusted conventional design. The substantial construction and subchassis design give this belt-drive model a sound of 'tuneful stability', with good rendition of bass information and considerable detail through the range. The arm could sound a trifle brash at times, but use of a felt mat, removal of the finger lift and packing the cartridge for accurate vertical tracking angle helped matters here.

Thorens TD126 IV
The latest version of this long-lived motor unit gave a fine wow-free performance. An oscillator provides a synthesised alternating power supply to the synchronous motor, allowing user-adjustable speeds. Very good feedback immunity helps this large and solidly built model attain a respectable sound quality, and though at over £400 it cannot strictly be recommended on value grounds, it is probably the only current player of high quality capable of playing 78s.

TURNTABLES AND TONEARMS BEST BUYS

Here we have listed those models we have selected as 'Best Buy', 'Recommended' and also those 'Worth Considering'. For the full picture, readers should refer back to the reviews themselves.

In earlier years we have been very cautious in awarding 'Best Buy' ratings to turntables and tonearms. This was largely because the best products fell somewhat short of the ideal while being very expensive, and the best of the cheaper models showed sufficient short-comings to mute our enthusiasm.

Recently, though, a few outstanding examples have emerged, offering such good value that a 'Best Buy' category can be applied with confidence; but this is only appropriate to relatively inexpensive items — we have set a top limit of £200 for 'Best Buy' players.

In the 'Recommended' category are products which we consider to offer a combination of generally good value plus fine performance — as price increases, so does the importance of absolute performance, while 'value' becomes a less relevant consideration.

Other products may still be above average in performance but are considered less strong on value for money — these we have listed as 'Worth Considering', and in some cases they may offer special features not found elsewhere.

These listings are of course *only* a guide — in any given individual situation, the choice of overall system and the mix of specific components may prove of greater significance than the rating of any individual component. Price is a major consideration when making the judgements summarised here, so the comments and indeed the ratings may need re-interpretation in the light of price fluctuations, be they up or down, or in view of the prevailing conditions in markets other than the UK.

BEST BUYS: INTEGRATED PLAYERS

Acoustic Research EB101 (inc cartridge)	£175
Dual 505 II (inc cartridge)	£110
NAD 5120 (inc cartridge)	£110
Rega Planar 2	£125
Systemdeck 2X/LVX/Basik cartridge	£199
Thorens TD166	£145
Walker CJ61/Mission 774LC	£160

RECOMMENDED INTEGRATED PLAYERS

Acoustic Research with AR arm	£240
Ariston RD40 AC/Opus	£180
Ariston RD80/Magnum Opus	£240
Dual 505-S (inc cartridge)	£130
Linn LP12/LV Plus/Basik	£500
Linn LP12/Ittok	£700
Mission 775LCT with 744LC arm	£165
Oracle Alexandria with arm	£850
QED R232 (inc cartridge)	£139
Revolver/LVX/Basik	£180
Rega Planar 3	£190
Rotel RP850	£190
Thorens TD321/LVX/Basik	£315
Walker CJ58/Linn LVX/Basik cartridge	£199
Walker CJ55 imp/LVX/Basik	£230

BEST BUYS: MOTOR UNITS

Systemdek IIx	£115
Walker CJ61	£85

RECOMMENDED MOTOR UNITS

Acoustic Research	£170
Ariston RD40AC	£160
Ariston RD80SL	£180
Elite Rock	£280
Heybrook TT2	£240
Linn Sondek LP12	£425
Lux PD300	£375
Michell Synchro	£290
Michell Gyrodec	£600
Pink Triangle	£400
Revolver	£105
Thorens TD320	£220
Walker CJ58	£125
Walker CJ55	£150

BEST BUYS: TONEARMS

Rega RB300	£90

RECOMMENDED TONEARMS

Alphason HR100S	£335
Alphason HR100S LC	£400
Ariston Magnum Opus	£80
Helius Orion	£400
Linn Ittok	£253
Linn LVX (Basik)	£85
Linn LV Plus (Basik)	£95
Mission 774LC	£85
SME Series IIIs	£107
SME Series V	approx £800
Synrinx PU3	£290
Zeta	£390

WORTH CONSIDERING

Readers should consult both full and summary reviews to find the many models which we have rated 'worth considering'. Recent additions to the list include the Ariston *RD40E*, B&O *RX-2* and *TX-4*, Dual 514, Nakamichi Dragon, Rotel *RP 830* and Thorens *TD-320* with *TP16* arm.

TURNTABLES AND TONEARMS COMPARISON CHART

	Type	Technical motor p'formance	Vibration and acoustic isolation	Arm effective mass (g)	Arm resonance p'formance	Arm bias and friction	Arm lead cap. pF	Ease of setting up	General engineering quality	General sound quality	Typical price rating	
Acoustic Research EB101	manual b.d.(c)	v. good	v. good	13	good	v. good	—	good	good +	v. good	£180	B
Acoustic Research (w/arm)	manual b.d.	v. good	v. good	12	good	good	—	good	good +	v. good	£165(£220)	R
Akai AP-X1	semi-auto b.d.(c)	average	average –	8	good	good	—	v. good	average +	average –	£60	
Alphason HR100S	arm	—	—	10	v. good	excellent	95	v. good	excellent	v. good	£285	R
Ariston RD20	semi-auto b.d.(c)	average –	average	9	average	average –	—	v. good	average	average –	£110	
Ariston RD40AC	manual b.d.	v. good	good +	—	—	—	—	average +	good +	good +	£160	R
Ariston RD40E	manual b.d.	average	good +	—	—	—	—	average +	good	average +	£200	
Ariston RD80SL	manual b.d.	v. good	v. good	11.5	average +	average +	—	good	good +	good +	£180	R
Ariston Magnum Opus	arm	—	—	—	good	average +	—	good	good +	good	£80	R
B&O RX2	auto b.d.	v. good	good +	3.0	average –	average +	—	v. good	average +	average	£115	R
B&O TX4	auto b.d.(lin)	v. good	v. good	3	average –	v. good	—	excellent	good	average +	£240	
Dual 514	auto ret. b.d.	poor	poor	9.5	average –	average	—	v. good	average	average –	£70	
Dual CS505-2	auto ret. b.d.	good	good	10.0	average –	v. good	—	v. good	good	good	£110	B
Dual CS505S	auto ret. b.d.	good	good	10.0	average –	v. good	—	v. good	good	good	£125	R
Elite Townshend Rock II	motor b.d.	v. good	good	—	—	—	—	good	v. good	v. good	£280	R
Grace G707	arm	—	—	7	average +	good	—	v. good	v. good	good +	£198	
Harmon Kardon T35C	semi-auto b.d.	good +	average	9	average	average	—	good	average +	average –	£150	
Harmon Kardon T55C	semi-auto b.d.	v. good	average +	9	average	good	—	good	good	average	£210	
Hellus Orion arm	arm	—	—	12	gppd	excellent	73	average	excellent	v. good	£245	R
Heybrook TT2	motor b.d.	excellent	v. good	—	—	—	—	good	v. good	v. good	£235	R
JVC L-L1	auto b.d.(lin)(c)	average	average	4	—	average	—	excellent	average –	average –	£139	
Linn Sondek LP12	motor b.d.	excellent	good	—	—	—	—	average –	excellent	excellent	£408	R
Linn Basik LVX arm	arm	—	—	12.5	good	good	100	v. good	v. good	good	£85	R
Linn Basik LV Plus	arm	—	—	13	good +	good	—	good	v. good	good +	£95	R
Linn Ittok LVII arm	arm	—	—	13.5	v. good	excellent	100	v. good	v. good	v. good +	£253	R
Lux PD290	auto stop q.d.d.	average +	poor	10.5	average –	average	—	good	average +	average –	£145	
Lux PD370	manual q.d.d.	v. good	average +	13	average +	average	150	good	v. good	good	£200	
Lux PD300	motor q.b.d.	excellent	v. good	—	—	—	—	—	good	excellent	£375	R
Lux PD310	motor q.b.d.	v. good	good	—	—	—	—	good	excellent	good +	£550	

Marantz Esotec	motor q.d.d.	excellent	good	—	—	—	—	good	excellent	good +	£1000	
Michell Focus One (S)	motor b.d.	v. good	good	—	—	—	—	good	v. good	good	£135(£185)	
Michell Synchro	manual b.d.	v. good	v. good	—	—	—	—	good	v. good	v. good	£240	R
Michell GyroDec	motor b.d.	excellent	excellent	—	—	—	—	good +	excellent	v. good	£595	R
Mission Cambridge 755LCT	manual b.d.	v. good	average –	12	average +	good	—	v. good	v. good	good	£99(£165)	R
Mission 774LC	arm	—	—	12	average +	good	—	v. good	v. good	good	£85	R
NAD 5120	auto stop b.d.(c)	average –	good	9	poor	poor	—	v. good	average +	good	£99	B
Nakamichi Dragon	auto ret. q.d.d.	excellent	v. good	18	average	good	—	v. good	excellent	good +	£1500	
Oracle Alexandria	auto lift b.d.	excellent	v. good	9	average +	v. good	—	v. good	excellent	v. good	£820	R
Oracle Delphi	motor b.d.	v. good	v. good	—	—	—	—	average +	excellent	excellent	£1200	
Pink Triangle	motor b.d.	excellent	—	—	—	—	—	excellent	v. good	excellent	£398	R
Pioneer PL340	semi auto b.d.(c)	average –	average –	12	average –	average +	—	v. good	average +	average –	£65	
Pioneer PL707	auto, q.d.d.(c)	v. good	average –	12	average –	good	—	v. good	good	average –	£230	
QED R232	manual b.d.(c)	average +	average	12	good	good	—	v. good	good	good	£140	R
Rega Planar 2(3)	manual b.d.	good	average	10.5	v. good	v. good	—	v. good	v. good	good +	£125(£186)	B(R)
Rega RB300	arm	—	—	10.5	v. good	v. good	—	v. good	excellent	v. good	£90	B
Revolver	motor b.d.	good	average	—	—	—	—	v. good	good	good	£105	R
Revox B791	auto ret. q.d.d.	excellent	average –	3	—	v. good	—	—	excellent	good	£420	
Rotel RP830	manual b.d.	average	poor	13	average –	v. good	—	v. good	good	average	£115	
Rotel RP850	manual b.d.	excellent	average +	13	average –	v. good	—	v. good	v. good	v. good	£190	R
SME Series III(S)	arm	—	—	5	good	v. good	280/75	v. good	v. good	good	£150(£107)	R
SME 3009R	arm	—	—	12	average +	v. good	280/75	v. good	v. good	average	£190	
SME Series V	arm	—	—	12	v. good	v. good	—	good	excellent	excellent	£800	R
Sota Sapphire	motor b.d./arm	v. good	excellent	16.5	average	good	—	v. good	v. good	v. good	£600	
Sumiko MDC800 'The Arm'	arm	—	—	15	good +	v. good	75	average	v. good	v. good +	£1250	
Syrinx PU3 arm	arm	—	—	11	average	average	—	good	excellent	v. good	£290	R
Systemdek IIX	motor b.d.	v. good	v. good	—	—	—	—	good	v. good	good +	£115	B
Technics SLQX200	auto ret. q.d.d.(c)	excellent	average +	7.5	v. good	average +	—	excellent	v. good	average +	£135	R
Thorens TD166 II	manual b.d.	v. good	good +	—	—	—	—	good	good	good +	£115	R
Thorens TD320	manual b.d.	v. good	v. good	—	—	—	—	average +	v. good	v. good	£240	R
Thorens TD147	auto stop b.d.	excellent	good +	6	average +	v. good	240	good	v. good	good + +	£240	R
Thorens TD126 IV	motor b.d.	v. good	good +	—	—	—	—	good	v. good	good + +	£440	
Walker CJ61	motor b.d.	good	v. good	—	—	—	—	good	good	good +	£85	B
Walker CJ58	manual b.d.	good	good +	—	—	—	—	average +	good	good	£125	R
Zeta arm	arm	—	—	16	v. good	v. good	100	average	v. good	v. good +	£399	R

Notes:
'motor' indicates turntable only, without arm
'b.d.' = beltdrive 'd.d.' = direct drive 'q' = quartz lock
(lin) = linear tracking (c) = including cartridge
Ratings (B = Best Buy, R = Recommended) are based on the typical prices quoted, believed correct at time of going to press, and only apply while these prices are in force.

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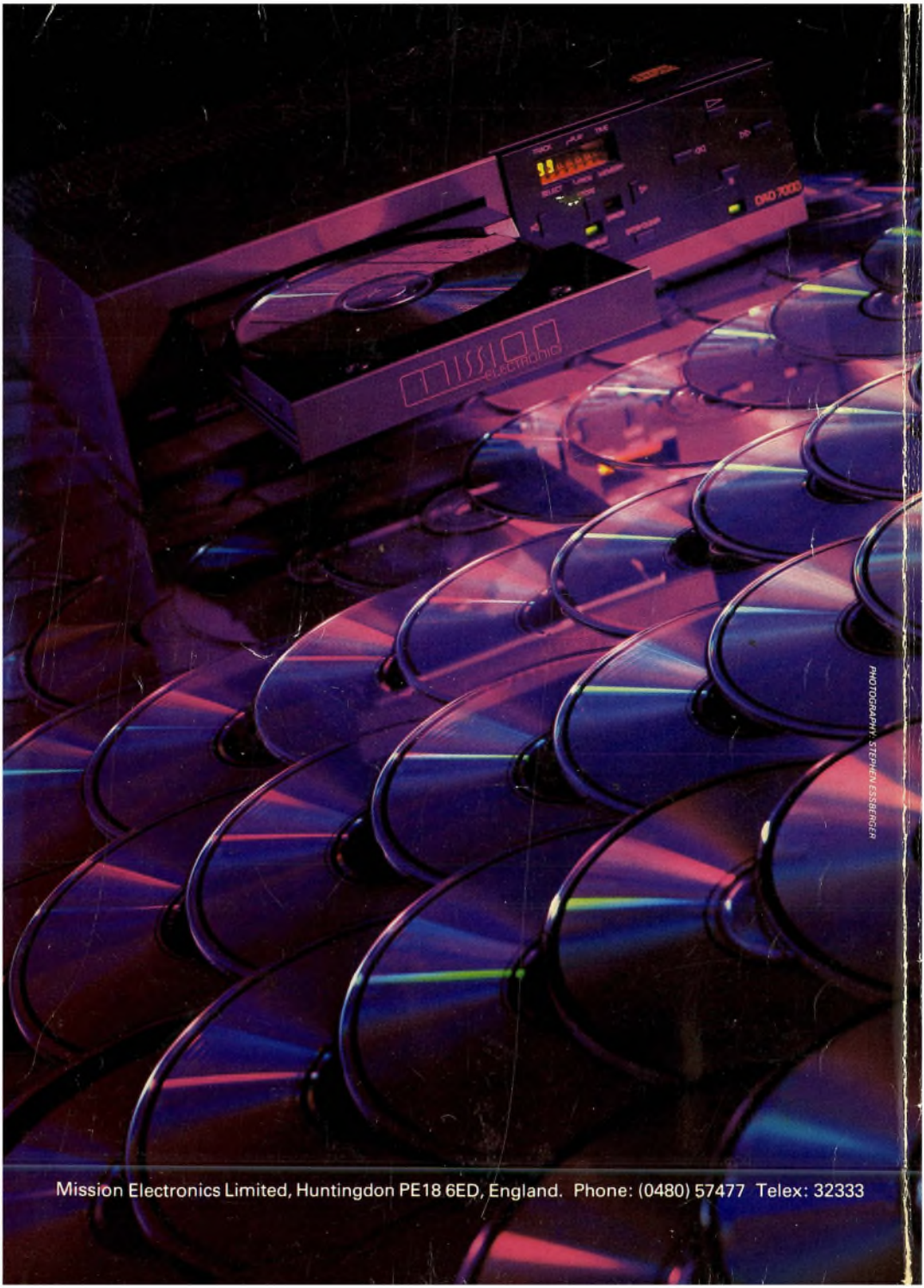

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