HI-FI CHOICE

TURNTABLES AND TONEARMS

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Hi-Fi Choice No 18 — Contents

Turntables & Tonearms 3 by Martin Colloms

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Note: many of the value judgements within this publication are based on the estimated typical prices printed. While every effort is made to ensure that these are correct at the time of going to press, they are subject to variation and fluctuation, and are clearly only applicable to the UK market. Readers should therefore bear in mind the current prices operating when interpreting value for money comments.

Product Index

How to use this book

The *Hi-Fi Choice* series of publications are intended to provide the most comprehensive and detailed examination of the models available in every hi-fi product category. Each project involves extensive lab testing and generates a considerable amount of data, so this page is included to help the reader to obtain ready access to the data he requires and best suits his needs.

This particular volume contains a considerable number of products, some of which are available in slightly different versions to the models reviewed. So to make it easier to find a particular model or a representative alternative we have included a *Product Index* that lists as many variants as we have been able to find, while referring the reader to the appropriate entry.

The *Consumer Introduction* is an attempt to deal with some of the technical considerations of disc replay and record deck design in non-technical language, while also providing some advice for the novice who would like to make the best possible use out of the book but is unsure where to start.

The *Technical Introduction* describes the tests that were undertaken and explains why particular measurement techniques were used. Many of the traditional measurement techniques used to assess turntables are incapable of fine discrimination between models, and do not reflect the differences that can be heard under controlled but 'typical use' conditions; consequently we have attempted to derive more meaningful results by using rather more sophisticated techniques. This in itself has pitfalls, as there are as yet no 'standard' test conditions for aspects of performance such as 'environmental sensitivity' that can dramatically affect and frequently dominate the performance of a system, albeit in a somewhat unpredictable way. Successful interpretation of this sort of data requires considerable experience of the different mechanisms that combine to produce it, so while the results may be interesting in themselves they are somewhat experimental and should be taken with caution and in the light of the interpretation.

The *Reviews* themselves include description, data, and interpretation thereof in sufficient detail to allow necessary qualifications to be made; while we attempt to assist readers by using a 'recommended' flash and summarising our findings elsewhere in the book, this invariably involves over-simplification and requires us to make value judgements that in some cases relate merely to particular choices of compromises (for this reason also we have decided not to include a distinct Best Buy category this time around). To avoid the danger of misconstruing such a summary, the reader is advised to consult the complete reviews as much as possible.

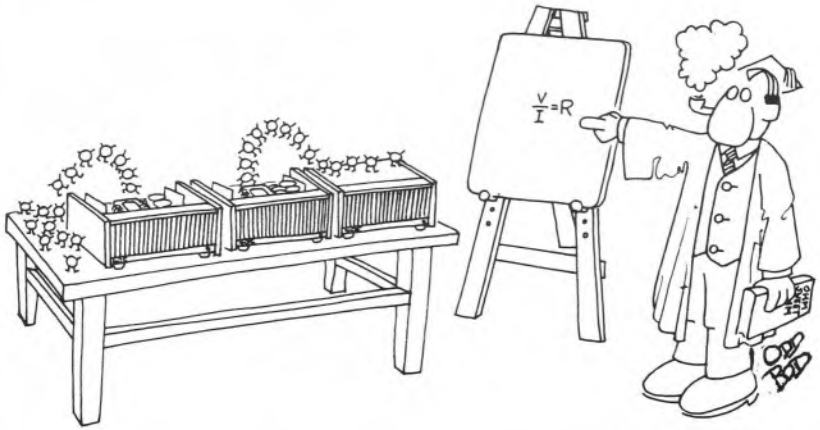
The *Conclusions* section discusses the findings of the project in general terms, examining the relative effectiveness of the methods employed in different designs, taking an overview of the market as a whole, and contrasting the results with those found in the earlier project some eighteen months before.

In the *Best Buys and Recommendations* section we pick out some of the designs in different price brackets that appear to offer a good overall balance of performance for their price. This includes some models from the previous book which have been covered in summary form. Naturally our recommendations are based on our own interpretation of the relative importance of different aspects of performance, and the reader should try to establish how these coincide and conflict with his own, and interpret accordingly. It is also an incontrovertible fact that 'value for money' will always depend on how an individual values his money!

The *Overall Comparison Chart* is an equally useful (and for the same reasons dangerous) method of summarising the findings contained in the book. By presenting abbreviated data in tabular form, it is easy to establish which models within the book have a particular characteristic in common, and therefore it is very useful for shortlisting models according to a particular profile. The entries under price (throughout the book) are particularly subject to variability and change, although we have done our best to ensure that they are representative at the time of going to press; our value for money judgements have been made according these prices, so may need to be re-interpreted if relative prices change.

Note also that separate tonearms and motor units are necessarily assessed under optimum conditions with the best ancillaries, and will only necessarily attain our assessed performance criteria (especially sound quality) under such conditions.

Finally, at the back of the book, there is a short *Glossary* which we hope will help relieve bafflement and frustration at the inevitable use of technical terminology in the book.



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Fortunately the electrons which whiz through the circuitry of your equipment are not conversant with fashion : if they were they'd probably die laughing and we would have H.I.D. (hysteria induced distortion) to add to T.I.D., T.P.D., B.L.T., and sundry other initial ailments which supposedly afflict your equipment. As it is, they behave predictably whatever others might wish to believe.

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Editorial Introduction

Thanks to the munificence of Our Publisher, this is the largest edition of *Hi-Fi Choice* to date, beating the long standing record of the original *Turntables and Cartridges*. (Regular readers will remember that one best as the issue which used to fall apart at the binding; this perennial but unpredictable problem with *Choice* has hopefully now been permanently eliminated by our recent change in paper type and flashy new cover!)

Despite the large number of editorial pages at our disposal, the influx of new models and continuing availability of some models that we tested last time, has meant that some of the latter have had to be included in only summary form. 'Summarisation' is not necessarily a sign of our disapproval; it merely means that some editing had to be made, so we naturally left out full reviews on some of the older models. In the case of the B&O *4000*, for example, this was because our data dated from the original issue, so its comparative validity was questionable, even though we have had recent subjective experience with the model; other models summarised have a limited remaining lifespan, or perhaps have received minor revision which we have not been able to check. Further 'shoehorning' has taken place on some of the repeated tonearm reviews, leaving out earlier data that has diminished relevance in the latest context. A number of established models have been completely retested, either because we understood that there had been significant revisions, or because they provide a useful degree of continuity in value judgement.

The comparative value judgement lies at the core of a *Choice* project, but at the same time it is the most difficult and controversial part of the undertaking. In our early discussions, the author and I decided that the traditional *Choice* categories of 'Best Buy' and 'Recommended' models did not really apply; in the previous edition we had used only a 'Recommended' category, but in retrospect we felt that in the interests of marketplace realities this may have been applied too widely. It remains our experience that the best products tend to be those with limited availability or those which need skilled setting up from an experienced dealer, though at the same time we recognise that many customers are unprepared to get any more involved in the selection and purchase of a hi-fi turntable than a trip to the local radio shop or department store, and that others prize automatic features more highly than the level of sound quality attained. What we really wanted to do was retain the 'Recommended' category for the comparatively few products which either offer significant mechanical integrity and decent sound quality, either in absolute terms or in respect of their price, and then a second category, dubbed 'Worth considering', which would spread the net a little wider to include products which attain a pretty good standard considering facilities and price, but usually with some reservation to prevent our recommendation.

A further source of worry, particularly in regards to our 'Recommendations' at the cheapest end of the scale, is a rather depressing tale of 'duff' samples received from all too many manufacturers/distributors. It is always difficult when dealing with matters of quality control, such as bearing rumble/friction/play, to know whether a comparatively poor result is a design or a QC fault. So while we have tried to be as fair as possible to every model, the degree of inconsistency that we encountered does indicate some uncertainty for those contemplating purchasing the cheaper models in particular.

Eagle-eyed readers who compare this edition to its predecessor (such as manufacturers whose products have lost their 'Recommended' flash!) will note that we have adjusted some value judgements slightly, both to take into account tighter criteria for Recommendation this time, and also the fact that the standards at the top have generally improved somewhat, and it wouldn't do to run out of superlatives! This year's Mission arm, for example, doesn't sound any worse than it did last time; rather we felt that because *all* arms are clearly imperfect, the description 'very good' was quite enough for even the best models. This conveniently helps us to avoid getting too involved in the sort of 'sudden death playoff' type of reviewing, beloved of the more sensationalist 'flavour-of-the' monthly magazines. For example, the similarly high subjective rating gained by three of the Scottish motor units does not mean that they sound the same, but rather takes account of the degree of unpredictability in their combination with different tonearms, cartridges and systems, the individual preferences of the listener, and last but not least whether the dealer does a good job of setting up these fairly tricky devices. As a confirmed Linn user myself for some years now, I am looking forward to trying the Ariston and *Systemdek* for myself, and I am frankly thankful that Martin Colloms has not overburdened me with prejudice beforehand; like any self-respecting consumer/hi-fi nut I prefer to have the opportunity to make up my

own mind.

The problems of arriving at finely discriminating firm conclusions, particularly amongst turntable systems, was amply illustrated by one comparison that I did manage to make, between the Rega *2* and Technics *SL10*, with 'matched' cartridges. While it is true enough to say that I 'preferred' the Rega and Mr. Colloms the *'10*, such a simple statement merely obscures. It would be more accurate to say that under completely different circumstances to the listening tests (different systems, rooms, and particularly a strong isolated shelf rather than the 'coffee table' deliberately used for the tests), we found the easily observable flaws in each design differently acceptable. (Furthermore we had each lived with our respective preferences for a certain amount of time, so perhaps to some extent had grown to accept their weaknesses.) All of which is a roundabout way of justifying 'broad-banded' value judgements; of emphasising that even amongst the better players differences are quite significant; and pointing out that anyone who buys a turntable without having it comparatively demonstrated first is taking a chance.

Turning to the product actually reviewed, I feel confident that we have managed to include an unrivalled selection of currently available models, ranging from most of the interesting high quality separates from specialist manufacturers to a pretty representative selection of the more common or garden integrated players offered by 'full-line' manufacturers. It is perhaps sad that Garrard of all people should be unrepresented this time, though this was merely because new products are about to be launched, and the company was in the throws of its takeover by the Brazilian *Gradiente* organisation. Against the manufacturers wishes, but in response to numerous requests from readers, we have included a Rega model this time. This was a particularly difficult decision, as I fully appreciate Rega's reasons for wishing not to have their products reviewed; but at the same time their availability is now rather better than hitherto, and an editor's loyalty must be primarily to his readership.

It would be unrealistic not to make some mention of the impending digital revolution in this editorial. There is little doubt that this has some potential for making the machinery reviewed in this book largely redundant. Against this potential must be laid the fact that many people have considerable LP collections that they will continue to wish to replay to a high standard; there is considerable investment in the current technology at all levels, and while the digital systems look like being quite reasonably priced when compared to the very best LP systems, they are unlikely to approach the sort of prices that have enabled the humble record player and cassette machine to establish the LP and Musicassette as the mass formats. The main problem facing digital at the moment would appear to be the conflicting standards battle that becomes more and more likely: for a while it appeared probable that the combined industrial might of Philips, Sony, IBM and others would be enough to set the standards, but RCA are pursuing their own incompatible course with great resolution, and their software (programme) catalogue plus that of CBS is clearly formidable resource; Matsushita have a further incompatible standard, and other major market forces remain uncommitted. Moreover the digital players and software have yet to prove themselves viable in large scale mass-production. So while some people already enthusiastically hail the revolution, there remain sufficient difficulties to ensure that the analogue LP system will be with us for a while yet.

Finally, it is important to point out that for many observers, myself included, the signal source, which of course means the record player in particular, dominates the sound of a hi-fi system. To assist in getting a good match, we draw attention to appropriate matching cartridges in terms of their compliance throughout the reviews: full details relating to some 80 cartridges appear in our companion edition *Cartridges and Headphones* which was published Spring '79, is still largely current, and will be revised October 1980. I would like to emphasise once again that our intention is to guide the reader rather than make up his mind for him. I hope that this book acts as a useful first step, but should emphasise that it is not our ears that you are trying to satisfy but your own, and that finding a good dealer is likely to be more than half the battle.

Prior to the commissioning of this project, the author has produced private reports as a consultant on prototypes of the following models: Ariston *RD11S*, Michell *Focus*, Monitor Audio *ET500*, Optonica *RP7100*, Philips *877*, STD *305M, 305D*.

In my opinion this creates no conflict of interest whatever, but by making the facts public, the reader can make up his own mind.

The Greeks had a word for it

"Archimedes, are you going to stay in that bathroom all day?"

"Just coming, my dear."

"You've been saying that for two hours. Now get out here and shift these scrolls. I can't get anything done with all your old rubbish laying around."

"One moment, my sweet. I feel I'm on the edge of some great new discovery."

"On the edge of the bath, more like. Playing with them silly iron balls again and slopping water all over my clean floor. Why can't you be an orator or a slave-merchant like other men instead of lallygagging round the house all day doing sums?"

"Someone has to do the thinking, my love."

"Then go and do it somewhere else. I can't abide people who are always looking for the easy way out."

"But my dear, don't you realize how much harder life would be if I weren't here to invent all these labour-saving ideas for you?"

"I was perfectly happy getting our water out of the well with a bucket, same as everyone else. But no, you had to go cluttering up the place with your automatic contraptions and have all the neighbours calling me a lazy wotsit."

"You just wait a year or two. Soon everyone will be doing things our way. All the stress factors and angles worked out for them beforehand. Just pull a lever and.... Ouch! That water's cold."

"That's you all over, that is. Leave it til it's cold enough to freeze your...."

"Eureka!"

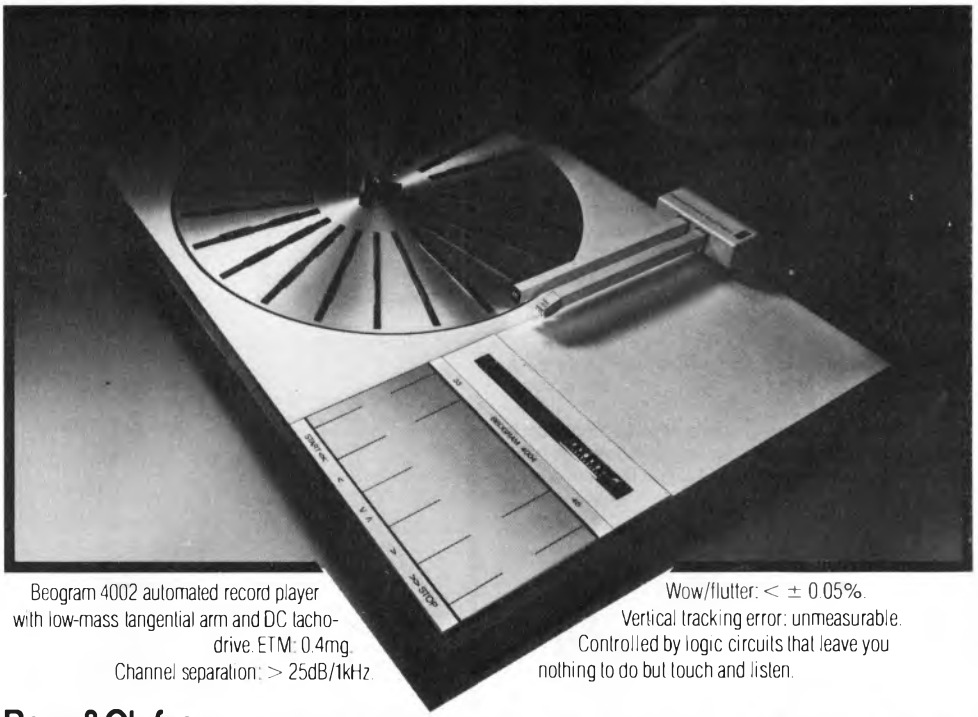
"And that's another thing. You don't pick up language like that at the Syracuse Conservative Club. You've been hobnobbing with them Argonauts again. Don't lie to me...."

(Continued on next page.)

Don't cry for us, Archimedes!

We, too, know that there are people who insist upon doing things the hard way, even when a choice exists. When asked why, they say "it's worth it in the long run" or "what was good enough for my father. . . ."
Rubbish!
Well, we admit it may be true about building a boat or growing prize chrysanthemums, but not when it comes to playing records.

Of course, we are talking about playing records – not *playing with* them. There is a difference. If the pleasure you get from hi-fi comes from fiddling about with the hardware, then go right ahead. Buy a box of bits and enjoy the challenge of trying to make something out of them. But if you actually prefer listening to good music, then buy the equipment that gives you the best performance for the least effort.
Buy Bang & Olufsen.



Beogram 4002 automated record player with low-mass tangential arm and DC tacho-drive. ETM: 0.4mg. Channel separation: > 25dB/1kHz.

Wow/flutter: < ± 0.05%. Vertical tracking error: unmeasurable. Controlled by logic circuits that leave you nothing to do but touch and listen.

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General Description and Evolution

The best place to begin is to discuss what a turntable consists of, and what precise meanings we shall be attaching to terms used in the rest of the book. Strictly speaking the word *turntable* refers to the rotating platter only, but there are few models marketed in this format these days; the term we will use to describe a turntable only is *motor unit* (and this will almost invariably be complete with base or plinth, cover, and arm mounting board.) An essential companion to the motor unit is the *tonearm* or *pickup arm*, and there are rather more of these available as separate units. By far the most common form of presentation however is the *record deck, integrated player* or *turntable system* which combines the motor unit and tonearm in a plinth, and this can allow the system to perform such functions as controlling the tonearm movement automatically. This integration should give designers tremendous benefits in optimising the performance of motor, arm, and cartridge, to achieve the best possible performance, and the benefits here can be great. But in practice, few manufacturers appear to take this very seriously. Quite a number of systems are supplied fitted with cartridges, but in the great majority of cases these have been selected for cheapness rather than optimum performance in the context of the system; in such cases it would be misleading to assess the performance of the combination, and we have used our discretion in the tests.

So there are three basic categories of products that this book is dealing with: the integrated player, the motor unit and the tonearm. These are rather different to the record player or gramophone of yore; in almost every case they will need the addition of a cartridge and must then be connected to an amplifier or receiver and pair of speakers to give music reproduction. Superficially it may seem a retrograde step to replace the simplicity of one box with the complex interconnections of four or five, so its worth taking a skimpy look at the evolution of the record player. The single box has been with us since the early days of the acoustic gramophone, originally sprouting a horn and later with the horn built into the box. This naturally evolved into the record player that was such a familiar sight a decade or two ago, and the more ambitious radiogram versions were imposing pieces of furniture indeed.

The first big change came with the advent and popularisation of stereo which required two separate sound sources. Boldly the radiogram sprouted speakers at each end of the box to become the stereogram, but without a massive piece of furniture it was impossible to get adequate separation, and as public taste became more discriminating and aware of various inherent limitations of the record player format, the 'hi-fi system', which had hitherto been the preserve of the hobbyist, became a mass-market phenomenon. Amongst the constraints of the record player is the problem of feedback between turntable and speakers, as the close proximity and physical connection of these is highly undersirable; secondly, to get good stereo it is necessary to use speakers that are quite closely matched acoustically, and the use of one built in speaker plus a satellite extension for the second channel makes this impossible; thirdly, the best place to site speakers for stereo is very rarely the most convenient place from which to operate the system, so for ergonomic reasons the split up was desirable, too; in fact there are a number of other reasons why record players as completely integrated units are undesirable, but it would serve little purpose to go into it at any further length here.

But why, one might ask, are we not currently using music centres, modules and the like? Why do we not detach the speakers and leave the rest of the electronics etc in one box? Well these alternatives do indeed exist, and are very largely the descendants of the radio and stereograms of ten years earlier. In contrast the separate record deck evolved from the enthusiast end of the market, where one traditionally bought or constructed for oneself motor units, tonearms, plinth systems and cartridges separately. The demand for a similar standard of performance with easier setting up and operation led to the development of integrated players, although it is probably true to say that the very best results are still to be found by optimising (or using a good dealer's knowledge to optimise) the best separate components from the manufacturer who has continued to specialise. It is no exaggeration to say that all extra complexities introduced to make integrated units more easy to use compromise the absolute performance of the system to some extent, yet on the other hand the security of automatic operation, particularly in a family environment, may be preferred by many users.

Looking to the future, the most obvious trend in hi-fi is the introduction of rack-mounted 'component systems', which are an attempt to fuse the flexibility of the separates system with the con-

venience of the music centre. This continuing desire for flexibility is the essence and *raison d'être* of the system built up from individual components, and whatever marketing format may be adopted, there will always remain the choice of separate components at the very heart of hi-fi, so that the individual has the chance to make his own selection based on his own priorities and budget.

Choosing the right turntable system.

The most important and yet in many ways the most difficult thing to do, is to specify one's objectives. What does one require from a turntable? The ultimate in sound quality? The ultimate in convenience? 'Idiot' or baby-proofing? In the majority of cases probably none of these things. Yet if thoughts are not given to objectives then the result may well be disappointment. The majority of people will not necessarily be searching for the ultimate of anything, will rather be working within a budget, and having specified a budget will start to look for certain desirable features. Hopefully they will also take the time and trouble to listen to the goods that they are intending to buy for listening.

Too often hi-fi components are chosen exclusively by reading catalogues and magazines, as this is the easiest way, and for many years the sound quality aspects of turntables has been widely ignored in the hi-fi world; and yet this will be the most important feature of all for many people. We have tried to report on the sound quality of the turntables as we perceived them under our particular conditions in the course of these reviews, which are hopefully 'typical', but will by no means be universal and cannot possibly be absolute. We have also attempted to measure some of the phenomena that have been observed, using test techniques that we believe are meaningful even though these are *not* yet 'typical'. But the mechanisms that account for sound quality differences are not entirely understood, and involve compromises as well as simple straight objectives. And the results of listening tests may vary according to the system or the room in which the system is used. For example, it is well known that the sound quality of some systems can change when the turntable or the speakers are moved around the room to different relative locations (and results have been known to be significantly improved by operating the turntable system in a completely separate room, reducing the acoustic coupling between it and the loudspeakers.) And actually changing the speakers for ones that have a less extended bass response can also clean up the sound coming from the turntable system!

It has often been claimed, and indeed is the majority viewpoint, that the sound quality of the speakers is the most important factor in the quality of reproduction in a hi-fi system. But this attitude is based on the fallacy that the sound quality difference of the other components are of an order of magnitude less important. It is my opinion (as yet as a minority I concede) that the exact opposite is the case. There is little point in having the finest speakers in the world when they are being fed inferior signals, and probably helping to cause these inferior signals by feeding plenty of wide-bandwidth energy into the turntable! I believe that it is perfectly valid to state that the sound quality of the turntable system is the most important single factor in determining the sound quality of the system as a whole, for the simple reason that the amplifier and the speakers can only make the best of the signal they receive from the record deck. (It is true that many people find FM radio an equally satisfying signal source, but I would respectfully suggest that for the majority of people the record deck is comfortably the most important signal source on grounds of accessibility, freedom of choice, quality of musicianship etc.; the cassette machine can not really yet be considered as anything other than a 'bastard' source, as the best recording will inevitably have originated from radio or disc, and will naturally lose a significant amount in the transcript.)

So in choosing a turntable system, it is worth considering that it may have more effect than any other component on the overall sound quality. It is also worth emphasising ergonomic significance, to avoid damage to records and styli (the latter can be most vulnerable if one is given to holding parties or returning late from the local to play a few discs!) And to confound the situation, the more complicated the record deck becomes in order to assist the ergonomics, the more sound quality compromises have to be made (this statement is not always true, but is more a generalisation that nevertheless holds true in a great many cases.)

The Job of the Turntable System

The prime function of the turntable system is to mechanically 'interface' the disc and the cartridge, so that the cartridge is able to extract the maximum amount of the musical information from the disc.

Ideally this is accomplished by ensuring that the cartridge is rigidly fixed with respect to the groove on the record at all times, but there are all sorts of reasons why this is impossible to achieve in practice. If we look first at how a record is cut, the disc is held down securely onto the massive platter of the lathe by vacuum suction, while the cutting head is actively driven along the lathe bed to make the groove spiral. This means that the position of the cutter head is always known precisely, and this leaves the cutter itself free to get on and cut the music into the groove. The whole process takes place as isolated as possible from structural or air-borne vibrations, and although things are far from perfect and there are bound to be some unwanted vibrations present, these will be imposed on the recording, rather than doing their best to throw the system out of control.

When it comes to replaying the mass-produced disc the position is very different. The very process of mass production introduces sizeable errors of eccentricity and in flatness, and the 'pitch' of the groove that is cut is not standardised anyway, being a variable adjusted by the cutting engineer according to the content of the recording and running time required. So there is no way we can clamp the stylus in a lathe and drive it across the disc; the system has to allow the cartridge to follow the unpredictability of warps and the like. The normal approach is to fix the cartridge at the end of tonearm about 9" long fixed to a plinth, and then let this track across a platter which should be spinning *steadily* at the cutting speed of $33\frac{1}{3}$ rpm. Some of the signal modulations in the groove are the same order of size as the wavelength of light (you can see the coloured interference patterns in reflected light), so we are perhaps talking about 'reading' signals cut as small as a millionth of an inch. And to read a signal we need to keep the cartridge rigid with respect to the groove, despite spinning the platter at $33\frac{1}{3}$ rpm and hanging the cartridge on the end of a beam that allows horizontal and vertical motion!

In order to further emphasise the inherent mechanical problems that the system has to try and overcome, it is both instructive and disturbing to examine the different magnitudes involved. This was poignantly portrayed by E. B. Meyer in the Boston Audio Society's magazine *The Speaker,* so I will draw heavily upon his data. To start with we must understand that the 'audio bandwidth' is the range of frequencies the human ear can hear, and extends from 'vibration rates' or frequencies from 20 to 20,000 cycles per second (abbreviated Hz). (There are arguments that frequencies below 20Hz are also important, but this is still a matter for debate and it would only further complicate the issue to deal with them here.) Likewise the human ear can easily detect differences in loudness that encompass 60dB, or a ratio of 1,000,000 :1. Even the simplest music is likely to contain enormous numbers of these frequencies at all these different levels at any one time, and the problem for the record deck (and the hi-fi system as a whole) is to get as much of this back as possible, while avoiding adding too much extra of its own.

To understand the dimensions involved in the record system we will construct an enlarged model in which one micron (one thousandth of a millimeter) is represented by one inch. A midband modulation in the groove at a 'typical' level (1kHz, 5cm/sec) gives a 16 inch peak-to-peak excursion for the stylus, while a 50Hz organ pedal at 10dB higher will require 10ft 6ins and the low level harmonic of a violin (10kHz, -40dB) only 0.068 ins! A typical stylus with 'line contact' profile on a high quality cartridge would produce vertical oval 'footprints' on the groove walls 10ins by 4ins. and would deform the vinyl by about one inch (twenty times the size of the violin harmonic.) The stylus itself is about 30ft high, and is attached to a bent pipe that represents the cantilever of 50ft diameter and 275 ft length, extending from a 2000 ft long cartridge body that is some 80 ft from the record surface! The arm has a diameter of 450 ft and crosses 1300 ft above the record surface from its pivot point nearly four miles away! This approach is somewhat deceptive, and deals only with dimension, not mass or velocity, yet it certainly admirably illustrates the problems of relative magnitude that the turntable system has to deal with. In fact it is quite amazing that record decks work as well as they do, and it is hardly surprising that there are differences between them.

Assessing the System's Performance

As far as the motor unit is concerned, we need to know how accurate the speed is, and how accurate it remains under all use conditions. We need to know to what extent vibrations generated within the turntable itself as a result of inadequacies of bearing and motor engineering or due to undesirable decoupling between platter and arm affect the net output of the turntable system, and also the effects of external vibrations, whether through the air or the shelf, ie to what extent the system behaves as an

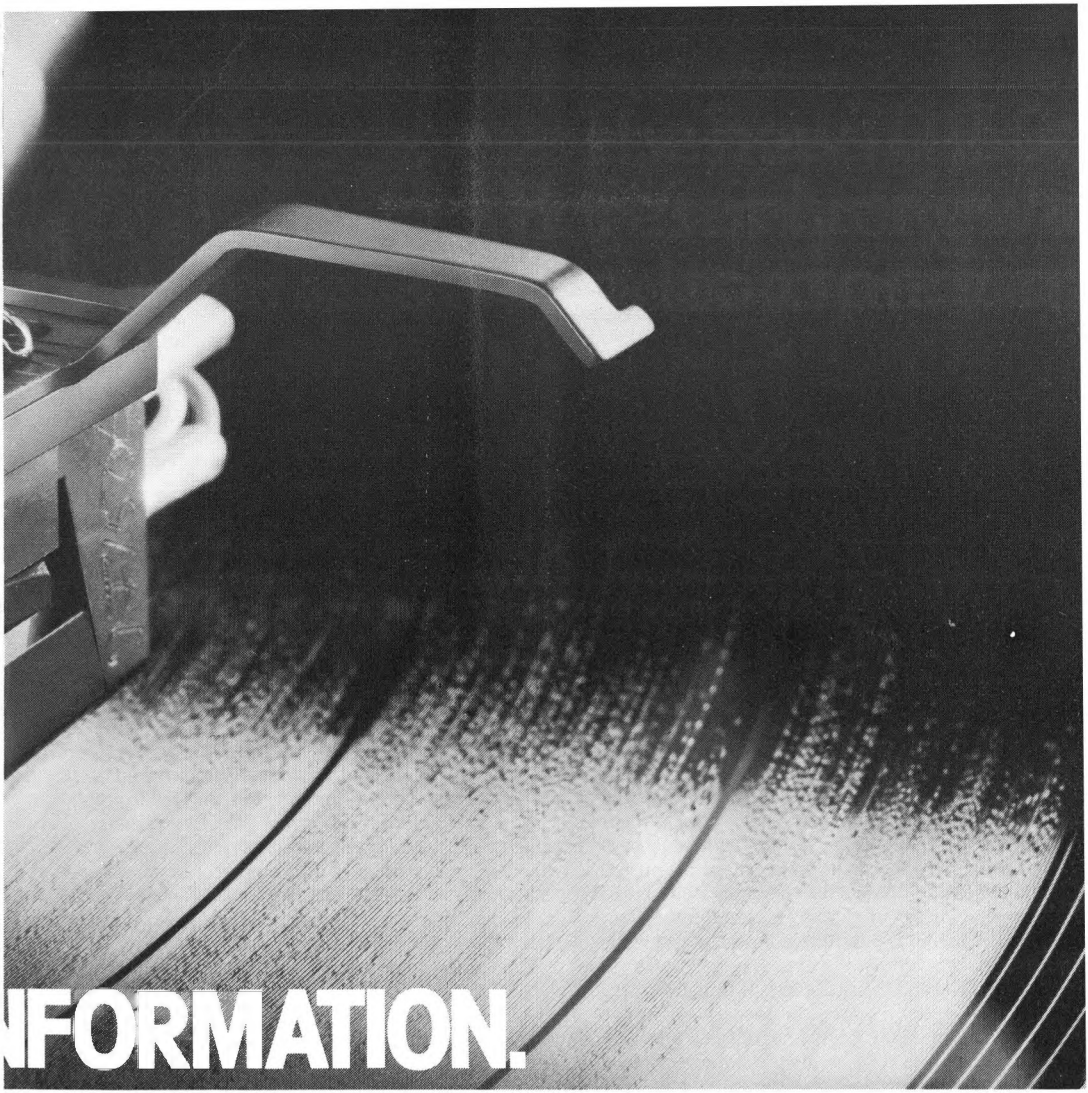
FOR MORE IN

Lurking within the walls of every record groove is a wealth of extraordinarily detailed information. This is contained in groove modulations of a thousandth of an inch at most, reducing in places to an amazing one millionth of an inch.

The more of this complex data your cartridge is able to extract, the less you lose the subtleties that make music an emotional experience – rather than just sonic wallpaper.

And no matter how good the rest of the system is, it can't reproduce information it never receives.

Over the 20-odd years of ADC's history, we've made a succession of



acknowledged contenders in the 'best cartridge currently available' stakes. (Remember the ADC 10E, and the legendary ADC 25 and 26?)

Today there's the remarkable ADC ZLM with its unique Aliptic stylus, a cartridge which prompted The Gramophone to write: "To say that the results were staggering would be an understatement."

Our LMF carbon fibre tonearms have been attracting similar comments. "Firm, extended low frequency range...neutral mid-band ...precise stereo imaging...the LMF-1 gains a recommendation..." (Hi-Fi Choice).

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unwanted 'microphone' that will promote feedback. Turning to the pickup arm, it is neccessary to ensure that the bearing friction is low enough, that the geometry and alignment is correct, the effective mass (inertia) is appropriate (both these parameters will be dealt with later), and that the arm (ideally) does not decouple at the headshell fixing.

I used the word ideally in the last sentence because in practice of course it is impossible to prevent some sort of movement due to bearing play or resonance in even the most sophisticated apparatus. It is here that the designer must make choices, and the best systems carefully play one weakness off against another to give the most successful compromise between a number of undesirables and give a subjectively satisfactory end result. So even though this report has gone far more deeply into measurements and objective assessments than most investigations in this field, the proof of the pudding must remain in the listening. And, in the last analysis, as I have said before, under the would-be-purchaser's own conditions.

Speed stability

Naturally a turntable must have constant speed if it is going to repeat the action of the cutting lathe for the benefit of the stylus. But this is a far from easy task in practice, because the stylus acts as a frictional drag that is never constant because it is related to the content of the music cut into the groove. There are also a number of other mechanisms in the turntable that can affect speed stability in a variety of ways. Speed variations are usually described by the length of time they last, so that a long term variation (caused perhaps by tolerances or electronics changing as a unit warms up) is known as *drift*, while a shorter term change that causes wavering in the pitch of a note (and is particularly noticeable on piano music) is known as *wow*. If you momentarily disturb the rotation of the platter, you can easily hear the results of introducing a gross amount of wow. Even shorter variations are known by the equally onomatopoeic term *flutter*, and this can sometimes be detected by a 'blurring' effect. But how important are these variations, and are there any other important mechanisms at work?

Absolute speed accuracy and drift stability, providing they are not severe, are unlikely to trouble the great majority of listeners at all. A minority of people (typically one per cent) are blessed — or cursed — with a sensitivity to and awareness of 'perfect pitch'; they will probably find variations between different discs of absolute speed and will have to correct accordingly, and will obviously be upset by a piano that drifts fractionally off-tune over a period of time. Fortunately this sensitivity is spared most people, so the absolute speed and drift parameters are of rather limited importance unless errors are gross.

Wow and flutter is normally quoted as a single 'figure of goodness' that can frequently cover a multitude of sins. We have gone a step further by separating these two components because their perceived effects can be rather different. Wow is probably the less harmful, and is often detectable on certain types of music only; some people find it rather more annoying than others, but because it is by definition subsonic it will interfere primarily with the presentation of the music rather than the music itself (think about it!) Flutter on the other hand refers to speed changes of shorter than one tenth of a second duration (ie frequencies above 10Hz.) And this will include frequencies that extend up into the audio band (ie above 20Hz) which will act along the line of the groove rather than across or up and down. So the cartridge will not respond to them directly, but they will have a 'frequency modulation' effect which will cause a blurring in the pitch of a note or interference with the harmonic structure. Although flutter is perhaps rather harder to detect than wow, there is some evidence that its effects are considerably more fatiguing in the long term.

One great weakness of the traditional methods of specifying wow and flutter is that the measurements are taken while the cartridge is replaying a steady single tone, so that the cartridge load on the turntable is constant, whereas in reality this constantly varying force has a considerable effect itself. In fact during the last *Hi-Fi Choice* on Turntables it was noticed that a number of designs exhibited audible 'dynamic wow' as a result of this variable drag. The potential for loss of the vital transient information on the disc by such a mechanism is serious indeed. Let us examine what happens in the simple case of disc that contains a silent passage followed by a single note played loudly on a piano. When the piano note arrives at the stylus, the drag on the turntable will increase significantly, will try to slow the motion of the disc with respect to the cartridge and the initial transient may be 'smeared' and followed by a 'wow' in recovery if the turntable system cannot cope effectively. And this initial part

of the note is the most important part, as it gives one the clues as to *how* the piano was played rather than merely what note was played at what loudness; this part of the note therefore contains much of the emotional content of the performance which helps to distinguish hi-fi from Muzak.

The only way one can cope with these problems of short term speed variations is to 'swamp' the force with a much larger one. In practice various combinations of three different techniques are used, but before even considering these it is obvious that the disc must be mechanically well-coupled to the platter by the mat, or any attempt to use the turntable to help overcome these effects will be in difficulties before it starts. The first technique that is used to keep speed constant is a servo or feedback mechanism which senses the speed and applies correction if necessary; this techique is quite effective for controlling long term speed inconsistencies such as drift, but naturally takes a finite time to react and cannot be of much assistance in preventing transient drag problems. The servo does not of course act as a force to overcome drag but as a reaction to counteract its effects, and therefore does not protect the 'music' content very effectively; in fact detractors of servo systems have described them rather unkindly as mechanisms that ensure that the speed is never exactly correct! Poorly designed servo systems can also introduce an extra wow or flutter component due to poor speed control.

The second mechanism that is used is the constant running power of the motor system (as distinct from the power added by a servo in response to a speed change). A measure of power is necessary in any case to restore and maintain speed, and naturally the greater this is, the more resistance to stylus drag will be offered. The inherent problems of the high power approach lie in feeding increased vibration into the turntable system as the power is increased due to the inevitable 'pulsing' effects of all motors. A high power motor also increases the torsional load on the main bearing and great care must be taken in design and manufacture to avoid problems.

The third and in many ways ideal way of overcoming transient drag problems is to use a high inertia platter. This effectively stores considerable 'force' in its rotational momentum, and yet avoids any pulsing vibrational problems. The use of a high mass platter requires careful bearing design to avoid wear (particularly in the thrust direction), and does not inherently correct for speed variations, so torque sufficient to overcome tne inertia and keep the speed constant is also needed. But with the added advantage that high inertia is inherently stable and can iron out other speed variations effectively as well, the high platter mass would appear to offer some worthwhile advantages over other possible approaches.

Rumble and the like

Rumble is a general low frequency disturbance that is picked up by the cartridge. It can be caused by poor bearing quality but can include hum components from the motor and other general vibrations. Though similar in some ways to flutter, rumble actually causes extra signals in the cartridge as well as affecting existing signals and the results can be equally unpleasant. A problem area that can be adversely affected by the rumble performance of a turntable is the excitation of the low frequency resonance of the cartridge. This will be discussed in a more detail shortly, so for the time being it is enough to point out that it is a bad thing, is to be avoided as much as possible, is one of the reasons why careful matching of cartridge, arm and turntable is desirable, and also why a change in any of these can give unexpected results. This problem of the LF cartridge resonance makes it difficult to measure rumble meaningfully, but provided one is aware of the implications sensible comparative results can be obtained.

Resistance to external disturbances

One area of design that is frequently given only passing thought is the resistance of the turntable system to exterior disturbance. Different approaches are adopted by different designers, but without a doubt the use of a separate subchassis to support platter and arm, the whole unit decoupled from the plinth on springs, can be a very worthwhile approach. Nevertheless this is an area of uncontrollable variables such as the properties of the shelf or supporting furniture, and compromises such as whether the designer aims for vibration or shock resistance. The ideal 'high Q' decoupled system is probably best for vibration isolation and hence absolute performance, but is disliked by many because of the handling difficulties, as it responds to the slightest touch; my own experience of using such a system for several years is that one quickly gets used to the decoupling (this only takes about a week), but I would shudder at the thought of

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grandmother or the baby-sitter attempting to operate it, so its suitablity must depend to some extent on one's domestic circumstances and priorities. The same must apply to shock resistance, which is not strictly a performance feature, but is most certainly an ergonomic feature of some importance.

The turntable does not only receive shock and vibration through the structure on which it sits, but is also very likely be used in the same room as the loudspeakers and will be bombarded by direct air vibrations, which can excite resonances in the structure that result in undesirable coloration. The net effect is that the entire system functions as an inefficient microphone, constantly feeding back the main signals at a lower level and thus reducing the 'dynamic range resolution' of the system (ie the range between soft and loud sounds that can be distinguished simultaneously). We have attempted to make some assessment of the different systems' susceptibility to vibration and feedback of all kinds, and this is described more fully in the *Technical Introduction*. There are as yet no agreed standards for making such assessments, so we have had to develop our own; because this is a new and poorly understood field, interpretation of these results must be made with great caution.

A little practical advice for those who may be suffering from vibration and feedback problems of various kinds may be appropriate here. A drastic but often effective solution is to physically remove the player from the listening room, but moving the unit around the room can also enable one to find a location where there is a significant improvement (typically corners are the worst places.) Improved isolation can sometimes be obtained by making sure the lid is closed, but there are lids and lids, and this again is not entirely predictable. Immunity from shock can often be improved by siting the unit on a wall-mounted shelf or a heavy slab of material like stone, slate or marble, or better still a wall-mounted heavy slab.

A recent trend has been to introduce such heavy materials as part of the construction of the turntable itself, but this is not really the same thing at all. This approach may reduce the susceptibility to a degree of excitation somewhat, but can also store the vibrations that it does receive for rather longer — another trade-off.

The Tonearm

The function of the tonearm is to follow the groove itself so that the stylus can follow the modulations inscribed therein and replicate as far as possible the motion of the cutter. This is normally achieved by pivoting the arm at a point typically 9″ from the stylus and arranging the geometry of the arm to avoid tracking errors as far as possible. Some horizontal tracking error is unavoidable except when using 'straight line' parallel tracking devices like the Revox and B&O 4000 series, because the cutter itself travels along a straight line. It is unnecessary to go into the complicated geometry, but sufficiently low tracking errors can be obtained when the angle of the cartridge is offset by about 25° from the line of the arm. The maximum tracking error of a fixed pivot arm is reduced as the arm is lengthened, but to avoid excessive increase in arm inertia (which will be explained shortly) the 9″ figure makes a good compromise. This does not mean that somewhat shorter or longer arms are not equally viable. It is necessary that the correct offset angle and precise location of the arm with respect to the platter be chosen, and individual reviews comment on the success with which this has been achieved. In fact the relationship is not a purely geometrical one, and the best overall compromise minimises the tracking error towards the centre of the record, where other distortions tend to be higher, in order to achieve the best balance.

An unfortunate adjunct to the use of an offset angle is the introduction of a bias force. The drag between stylus and groove will be along the line of the cartridge, and because this is not in line with the pivot, a force will be generated that pulls the arm towards the centre of the disc. Unfortunately this force has a frictional part which changes according to the program content of the disc (as has been discussed when dealing with turntables), so it is not possible to compensate for bias as accurately as one might like. In practice it is assumed that the highest level signals are the ones which are most difficult for the stylus to track anyway, and are also the ones that generate the greatest bias or sidethrust, so the compensator force is set to cope as well as possible with these high level signals, by means of an opposing outward force supplied by a mechanism built into the arm.

The above descriptions are generalisations that are applied and accepted by the vast majority of arm designers, but the field of disc replay apparatus has always thrown up unorthodox ideas and generated controversy, so there are quite a number of variations. Some designers for example might

prefer to sacrifice some tracking error in order to reduce the bias, as the bias force increases with the offset angle. The real winners in terms of geometry and bias are of course the straight-line trackers which have zero horizontal tracking errors, zero offset angle, and hence zero bias force to worry about.

Staying in the groove.

In order to keep the mass of the cartridge over the groove that the stylus is trying to trace, there is a spring mechanism known as a compliance between the stylus and the cartridge which supports the weight and ensures self-centering horizontally. This spring takes the form of a tensioned elastic hinge or pivot at the inside end of the stylus bar. In practice a spring/mass combination has a specific way of behaving which changes at different frequencies: imagine holding a springy metal rod with a weight at the other end; as you move your arm slowly, the rod and weight tend to move along with the arm and with little flexure in the metal spring, but as you increase the speed at which you move your arm to and fro, the spring starts to flex, the weight overshoots the end of a swing and comes springing back, until at some frequency your arm has to do very little work at all and the mass/spring combination swings wildly from side to side with only a slight wrist movement at the correct frequency. This 'natural frequency' of the combination is known as its 'resonant frequency'. Above this resonant frequency the mass will tend to stay quite still while the spring merely behaves as a spring by flexing. In effect there are three distinct regions: the 'stiffness' region below the resonance, where the spring will hardly flex at all; the resonance region where everything is excited very easily; and the compliance region where the mass will tend to stay still and the spring flex.

Having described the 'classic' mechanical resonance system, it is necessary to add that no system actually behaves in such an ideal way because some degree of damping will be introduced. In the analogy with rod and weight, its behaviour underwater or in a barrel of tar rather than air would be considerably different. Some damping is present to control the resonance in arm/cartridge systems anyway, and this in turn reduces the decoupling effects of the resonance, so vibrations will be transmitted into the arm above the resonant frequency. So the 'classic' situation does not hold, and in fact the entire situation becomes sufficiently complex to make predictions somewhat uncertain.

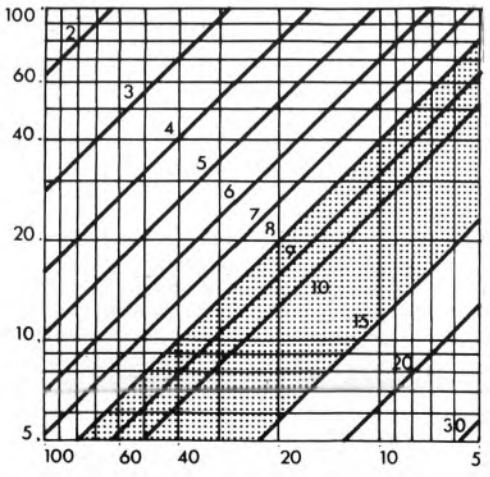
Getting back to the real position of the cartridge, stylus, and groove, we should get little relative movement and hence output below resonance, subtantial output and possible tracking problems at resonance, and 'normal' output corresponding to the groove modulations above resonance. Now we are obviously not too interested in getting signals from the cartridge that correspond to record warps,

MASS/COMPLIANCE/RESONANCE RELATIONSHIPS.

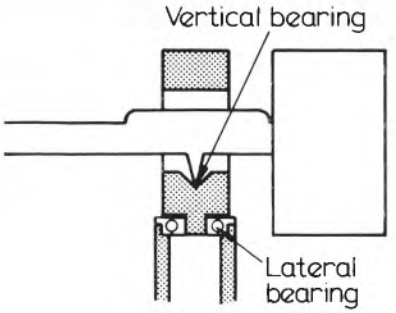
Calculating the main arm/cartridge resonance is relatively simple if one knows the following details; arm effective mass; cartridge mass; cartridge compliance.

Add the arm and cartridge masses together and draw in the corresponding vertical line. Then draw in the horizontal line corresponding to the cartridge compliance. At the point of intersection the resonance can be read from the diagonal frequency lines; the shaded area represents the optimum area within which the lines should intersect.

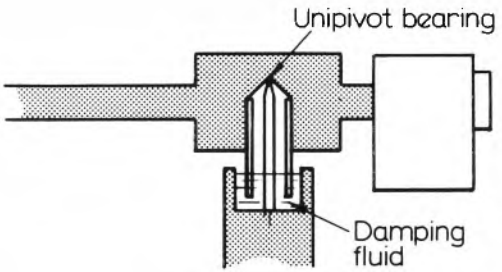
While not infallible, this technique usually gives useful and meaningful results.



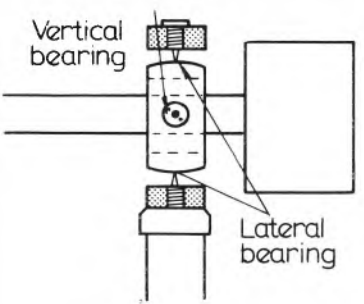
THREE TYPICAL ARM BEARING TYPES



1. Similar to that used by SME, this has knife edge bearings for vertical movement and ball race for horizontal. Many designs use a gimbal type instead of the knife edges. Most designs of this type rely to some extent on the arm weight to hold the bearings tight.



2. A typical unipivot with fluid damping, to assist stability is also 'gravity loaded'. and care must be taken to avoid rocking effects in use.



3. The gimbal type bearing should be independant of gravity or rocking effects, but may require more care in manufacturing adjustments.

and most such pressing faults occur below 8Hz, so it is best for this to correspond to the 'stiffness' region of our system. Audio signals are assumed to start at the lowest audible frequencies of about 20 Hz (and I don't propose to open the floodgates of controversy over this point here), so we need our compliance region to operate above 20Hz. This leaves the resonance in between, and this should be the area where there are fewest signals on the disc (or in the system if it has been designed correctly) and thus minimal excitation of this undersirable but unavoidable phenomenon. So by choosing an appropriate combination of mass and compliance, we have a system where the arm will follow record imperfections like warps, and allow the stylus to follow the groove modulations, which is precisely what is needed.

Various parties have suggested that the resonant frequency of the systems should be deliberately lowered to increase the bandwidth of the signals from the cartridge. There are possibly some gains to be made by adopting this approach, but they are a little nebulous, and it has been shown that if the LF resonance is continually excited then there will be a clearly measurable increase in midband distortions, so it is probably safer to avoid this approach. The interested can try adding extra mass to the headshell via a coin and some 'blu-tack' or modelling clay, but don't forget to reset the tracking weight or the stylus could disappear into the cartridge body! Other arguments for increasing the resonant frequency to nearer 20Hz have also been made, and this may have some benefits on some systems where a reduced LF bandwidth might prevent overload and upset, but by and large the 8-15Hz resonance seems to be the best compromise. The individual reviews will show the range of suitable cartridge parameters to achieve this optimised balance.

Damping

Most cartridges contain damping to help control the LF resonance, and this would seem to be a good thing in practical terms. Some arms contain or provide for pivot damping to assist the cartridge here, and in some circumstances this can improve the sound quality overall; whether this is due to the LF effects is not by any means certain. Damping at LF can help to reduce the magnitude (Q) of the LF resonance, but also increases the range of frequencies that will excite it, so that it will produce a difference, which may but is not necessarily an

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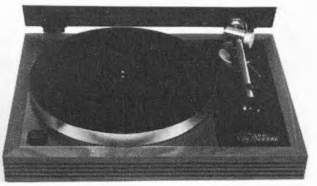

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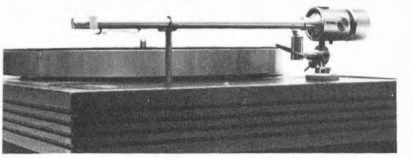

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improvement. Damping can also have the disadvantage that it will reduce the arm's ability to follow warps to some extent, and this means that some of this load will be taken by the flexing of the stylus in relation to the cartridge which will increase some forms of distortion in the cartridge.

Arm vibrations and resonances

A by-product of the compliance necessary to keep the arm and cartridge above the groove, obtain an optimum LF resonance, and ensure correct groove tracing at all frequencies, is that mechanical energy will be fed into the cartridge and also into the disc vinyl. The existence of this vital effect is frequently ignored by manufacturers, and amongst those who do recognise it there are diverse opinions on the best ways to cope with it! It is nevertheless worth mentioning some of the basic ideas involved.

Cartridges with low compliance and which use relatively higher tracking weights, such as moving coil devices, are potentially likely to feed more energy into the system in both directions than typical moving magnet types. So even if the moving coil cartridge does have instrinsic benefits (which is still a matter for debate), it is likely to make life harder for the arm and punch more energy into the vinyl.

Whatever the cartridge, the arm will receive vibrations as a result of tracing the groove modulations. If we go back to the resonance situation described earlier in connection with 'staying in the groove', we had three situations: stiffness below resonance, where movement is transmitted; resonance, where vibrations are absorbed (and in fact converted into heat as a result of relative movement and friction); and compliance through which vibration will not pass because relative movement will take place. In effect the resonance 'decouples' the frequencies above it from transmission. In the arm/cartridge system there are bound to be numerous resonances, all of which will introduce some degree of relative movement and hence degraded tracing accuracy at certain frequencies and decoupling above; and all the resonances will have a degree of damping that will affect their behaviour. If we were to decouple the cartridge from the arm at a frequency only slightly above its LF resonance with a high Q resonance , the cartridge would only generate signals over a narrow band, so it is fairly obvious that stopping the arm vibrations by resonant decoupling is an inherently undersirable thing to do.

Different approaches include avoiding decoupling for as long as possible down the arm and until as high a frequency as possible, selective absorption either at one point or spread through a material, the use of decoupled counterweights beyond the bearings to absorb vibrations and prevent reflections, the use of high quality bearings to transmit the vibrations through to the turntable (to complete the circle?) The situation is further complicated by the fact that resonant decoupling can introduce spurious extra coloration signals by reflecting vibrations back. The same arguments can be used to examine the excitation energy of the vinyl, which can be reflected, transmitted, or damped, and likewise it is difficult to say which approach is the 'right answer'.

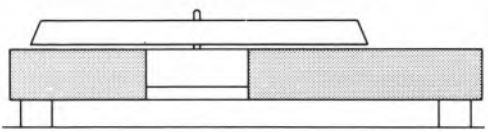
One cannot at this stage make definite assertions about the 'correct' approach to these situations, but evidence does suggest that systems resolving the most musical detail couple the cartridge closely to the arm tube, avoiding resonances as much as possible, and provide the finest bearings to transmit the energy on into the plinth or subchassis, while at the same time being light enough structurally to avoid problems associated with too low an LF resonance. Well-damped systems do perhaps obscure a certain amount of detail, but at the same time avoid introducing colorations. Because of the many imperfections and various trade-offs, once again the prospective purchaser is advised to try and listen for himself.

Arm features

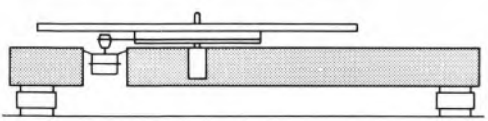
Pickup arms tend to use a limited number of engineering principles, and designers or their advertising agencies can be fiercely partisan about their chosen approach. It is true that some outstanding no-compromise systems can work extremely well for some people, but others may not find them to their taste at all, and a low-cost and heavily compromised system may have the different compromises chosen extremely well for a lot of people and thus become justly popular. There are fairly sound technical reasons why popular features such as automatic arm control or detachable headshells are undesirable, yet they do not constitute a disaster in a system if they are used wisely. Similarly a low cost bearing that uses the weight of the arm to load the bearing will not be as rigid as a high quality gimbal type of bearing, but used wisely can easily produce better results than a poorly chosen or set up 'super-arm'.

So while certain features in a pickup arm may be intrinsically desirable, there are others that are far more a matter of interest to the copy-writer who is trying to sell the device. Only the purchaser can decide the relative importance of such overall factors as sound quality, ease of use, ease of adjustment, stability in use, suitability to different cartridges etc etc, and every arm (and turntable) will have a different balance that will suit different people. The only essentials are appropriate effective mass, adequacy of bearings, correct geometry and alignment adjustment, although one might add a degree of mechanical integrity to ensure that the thing doesn't go out of adjustment or fall to pieces within a few weeks. If automatic facilities are provided, they should at least avoid interfering with the performance of the arm as much as possible, and work accurately without risking damage to the stylus they are designed to help protect.

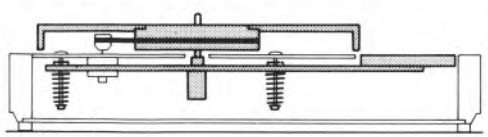
THREE TYPICAL TURNTABLE DESIGNS



1. A direct drive motor integral with the platter bearing is usually mounted on a solid plinth with any decoupling in the feet.



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



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

Summary

In this introduction, I have deliberately tried to avoid dwelling on the inherent advantages/disadvantages of certain design approaches or special features as much as possible, because I believe these are usually of only marginal relevance to the actual performance of the system. Too often the system which is bristling with the latest highly desirable technology throws the majority of it away by making some particularly silly compromise somewhere, in the interests of saving manufacturing costs, at the behest of the marketing people, or even through just plain ignorance and misunderstanding. Consequently I have not even discussed the so-called controversy on the relative virtues of belt or direct drive, as I believe it to be the chimera of the sensationalist (or ignorant) writer. The tools used are invariably less important than the way in which they are used, and there are both good and bad examples of both belt and direct drive turntables.

Instead I have tried to look at the mechanical problems involved in getting back the information that the cutter has put onto the disc, and attempted to give the reader a framework for visualising some of the mechanisms involved. The intention is not to turn every reader into an armchair turntable critic, but to give some idea of the problems involved in order to illustrate how likely it is that turntable systems not only handle differently but also sound quite different as well, a suggestion that would have been regarded as preposterous in many quarters not long ago. The overall intention has been less to lay down set rules that invariably prove to have exceptions than to provoke thought about the different aspects of the system, because there is no getting round the fact that the most elaborate and expensively engineered systems do not necessarily work better than the apparently mundane that has been designed with a bit of flair. It is not an exaggeration to say that the 'art' shows itself all too frequently to be in a pretty sorry state, yet the spirit of enquiry that currently abounds seems to be advancing turntable system design at steady, if unspectacular rate at the moment, even though there is still enormous unrealised potential. And it is only by fostering a spirit of criticism and curiosity within the individual consumer that 'market forces' will start to work in his favour.

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In this third edition of *Choice* to cover turntables and tonearms, the established principle of a wide product coverage has been maintained, and in addition a number of revealing laboratory tests and graphs have been refined and introduced on the technical side. Once again the problem of correlating measurements and subjective sound quality has arisen; the designer of one noted turntable has publicly stated that he can find no significant match between traditional tests and the resulting sound quality of his product. While it must be admitted that conventional measurements leave something to be desired in this respect, certain new and innovative techniques adopted for this report will hopefully serve to advance our knowledge in this still murky area of 'objective versus subjective' assessment.

However irrespective of the intrinsic worth of a turntable as regards its potential sound quality, the record remains a relatively imperfect system for music replay, and inevitably sets its own rather low limit to the maximum fidelity attainable by a system. While a poor player will degrade the results, no deck can improve upon the quality of the disc it is replaying.

On the other hand digital systems potentially offer a domestic programme quality better than studio standard Dolby 'A' mastertapes, the latter being well above the finest disc replay in terms of the resulting subjective quality. Currently I would estimate that the replay fidelity in relation to the original signals from the recording microphones is around 95% recovery for digital, 85% for high speed Dolby 'A' mastertape, and 65% for the best vinyl discs, the latter figure falling to 45% for typical records. I anticipate that samples of domestic digital disc replay machines will be available by the time of the next edition of *Turntables and Tonearms*, in other words, during 1981. If their expected promise is fulfilled, digital players will inevitably dictate a reassessment of our values, for example, a relative 'devaluation' of the more costly LP disc replay systems.

While it might be worth bearing in mind the anticipated emergence of superior digital systems in the not too distant future (an audiophile turntable system is after all a costly and probably long term investment), it would be unfair to dwell unduly over digital possibilities at this time. Essentially this third edition concentrates on revising and updating the previous one, which involves some essential reprints. The latter will of course differ in some respects compared to the layouts adopted for the latest tests, but wherever possible important models have been retested, particularly when product improvements or changes have taken place.

Design and test procedures

While it is true that certain features of turntable design can be translated into potential sound quality effects without recourse to measurement, the importance of a carefully conducted lab assessment cannot be overestimated. By this means alone can one hope to define and quantify the acoustic and mechanical differences believed to be present — to show rather than suppose their existence. That we still have some way to go in this respect is however freely admitted.

Mechanical vibration feedback

The energy levels generated by the stylus/cartridge are necessarily small to provide a large audio bandwidth plus decent wear level and playing time; essentially the cartridge is a highly sensitive transducer or pickup for vibrations. A sound field in a room possesses considerable acoustic energy, which on contact and absorption by surfaces and structures is converted into mechanical vibration. It then appears transmitted along the floor at lower frequencies (below 200Hz) and as significant vibration in shelves etc at mid frequencies (100Hz-1kHz).

It is only too easy for the cartridge to respond to these unwanted vibrations, and to transmit the effects to the amplifier along with the wanted recorded information. In extreme conditions at high volume settings, these unwanted vibrational noises may build up to a level where they 'swamp' the system and the characteristic 'howling' or 'boomy' sound known as feedback (or more specifically regenerative feedback) occurs. The vital factor here is the turntables' susceptibility to external mechanical and acoustic vibration, and for many models their subjective quality (or lack of it!) is determined by this characteristic. Admittedly all turntables under the worst circumstances can be made to 'howl', but the more resistant they are to this effect then the cleaner they can sound. The more susceptible models show a progressive 'clouding' and 'veiling' of the reproduction, particularly in the rendition of ambience and more distant stereo perspectives. Varying degrees of 'boomy' and 'wooden'

colorations accompany poor feedback margins as well as impaired vibration isolation.

Airborne acoustic feedback

In addition to mechanical- or vibration-coupled noise and feedback effects, the turntable system is also susceptible to airborne sound. If light in construction, the deck can be a highly effective trap for the room sound, the parts most affected being the lid, the top and bottom panels, and the disc itself. The latter effect is also affected by the type of turntable mat, the contact area and material used both being significant. Furthermore in exceptional cases the tonearm itself may be rather 'live'.

In simple designs the lid is usually the worst offender, since this light structure of large area is highly resonant and is usually directly coupled to the plinth only a short distance from the base of the tonearm.

Measurement of acoustic and vibration isolation

Both forms of unwanted energy coupling are classed under the heading of 'Isolation', this being the converse of 'feedback susceptibility.' In addition to a 'domestic' test layout, where the maximum feedback-free volume settings of a calibrated amplifier were monitored during the listening tests, two lab measurements were also made which separately serve to illustrate the turntable's isolation from an airborne sound field (upper trace), and shelf-borne mechanical vibration (lower trace). The frequency range runs from a lower limit of 10Hz (indicated by the cartridge/tonearm resonance) to 500Hz, using a linear scale of 50Hz per horizontal division, the centre line being at 250Hz. With the present design of turntables, little useful information exists outside this range.

Included for essentially comparative purposes, fig 1 shows the equalised noise spectrum of a) the sound field at the turntable spindle (90dB lin $^1/_3$-oct), and b) the acceleration of the vibration shelf (loaded with a test mass of 10kg). The energy arriving at the player with the lid down was sensed via a test cartride (*AT13eA*) resting on the first third of a fairly flat record. The cartridge output was subject to RIAA de-emphasis (B&K *4416*) in order to correspond with normal use, and the energy breakthrough was displayed on an averaging spectrum analyser (HP *3582A*). The screen was photographed using a Shackman *7000* Polaroid back camera, with each major division on the graph representing 10dB, and with the acoustic trace moved up three divisions to differentiate it from the vibration trace.

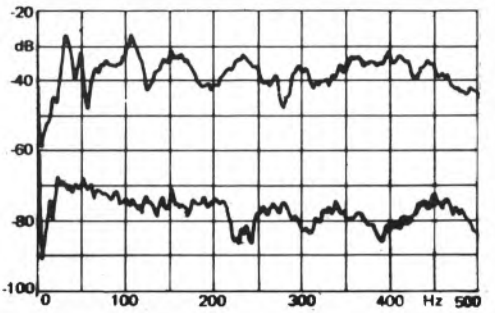

Fig 1. Breakthrough equalisation: acoustic (above) and vibration (below).

The lower vibration trace is derived from movement of a roller mounted shelf driven by a vibration exciter mounted horizontally. This avoided the need for a secondary tensioned suspension to take up the mass load of the turntable, and allowed the vibrator to operate down to a low resonant frequency of approximately 5Hz. Correlation between vertical and lateral excitation was pretty good, due to the imperfections of typical turntable suspensions and foot design. Furthermore, at the lower frequencies (below 100Hz), domestic support shelves adjacent to room walls tend to rock with a horizontal rather than a vertical motion. (Poisson's ratio for most support feet also provides good agreement between vertical and horizontal excitation.)

Taking account of the vibration system resonance, it was also possible to investigate the behaviour of the turntables' mechanical isolation systems, and determine their dominant resonances and stability as well as 'filter' efficiency.

A Technics parametric equaliser was used to shape the power spectrum for both the acoustic and vibration signals, while the 90dB (lin) sound field was generated by an *AR3a* woofer (c. 5 watts input), the equaliser being driven by a pink noise generator. (Rogers.)

Upon careful inspection, the results show considerable isolation differences between the various models. For example, compare the spectra for the 'classic' isolated subchassis models

such as the Linn, Ariston, STD, *Systemdeck* or Thorens *160S*, with those obtained for the simple rubber-foot designs. Further differences are apparent within the latter group, some proving better on the vibration, and others superior on the acoustic side. Details of construction such as the grade and thickness of the lid moulding or the softness of the feet also affects these results.

If a turntable is to possess any vibration isolation it must incorporate a mechanical resonant filter. Above the filter's resonant frequency, vibrations are rejected, below resonance the isolation fails, and at resonance it is inevitably poor. In addition, turntable systems must exhibit another low frequency resonance, namely the arm/cartridge subsonic mode, due to the stylus compliance and the total moving mass. In order to maintain tracking stability and minimise excitation of this arm resonance, the deck plinth suspension frequency should ideally be separated from and below that of the arm/cartridge by an octave or so. A theoretical optimum for the arm resonance would be 10Hz while the fundamental system resonance should be below 4Hz; in practice this is rarely achieved and the arm resonance is often as low as 7Hz, while many turntable system resonances appear in the middle of the arm resonance range or even higher, extending into the audio range.

Tonearm resonances

In the first place, the ideal tonearm could be said to provide the correct effective mass (and low frequency damping if required) for a chosen cartridge. Accordingly, by using a calibrated cartridge of known compliance, the effective mass and damping properties can be measured, using a 5Hz-20Hz lateral sweep record (B&K *2010*) charted on a Rion *LR04* recorder.

Secondly the arm should be infinitely rigid (this stricture to include the bearing and supporting pillars), in order to prevent the possibility of mechanical resonances being excited by vibration energy present in the cartridge body from the moving cantilever. Any spurious or uncontrolled arm movement/vibration due to play or resonance will instantaneously modify the relationship between the cartridge and record groove, adding unwanted modulation to the audio output, audible as coloration or slight shifts in stereo imaging, etc. Inevitably all arms do possess resonances and various forms of looseness or 'play'. The latter may be due to poor bearing assemblies or weak headshell fixings, and the former are present to some degree in any known structure that would be suitable for supporting a cartridge.

In the last issue an accelerometer (B&K *8307*) was placed vertically on the arm beam, approximately one third of the latter's length away from the pivots. The unequalised acceleration output was preamplified and fed to a chart recorder (B&K *2305*), the left channel modulation band of B&K QR2009 being used to vibrate the test cartridge (Dynavector *20A*) from 20Hz to 20kHz.

In order to improve upon the resolution and also to illustrate more clearly the important torsional resonant modes, this issue saw a revision of technique. While a similar cartridge was employed — in this case a Dynavector *10X* moving-coil, chosen for its rigid die-cast metal mounting — the accelerometer was now mounted on the cartridge side plate, and displaced from the arm tube axis by 15mm in order to respond to both bending and torsional modes. The B&K *2009* sweep record was again employed, this time on the lateral 20Hz-20kHz band, the improved signal-to-noise ratio (Ivie *10p* mike pre-amp plus *30A* ⅓-octave analyser) allowing clear plotting from 20Hz (previously from 100Hz). The different mean energy levels noted for arms at low frequencies are of course due to the variations in effective mass of the tonearms themselves — eg the higher output from the low mass Mayware *Formula 4* for example contrasts with the lower output from the high mass Fidelity Research *FR64S*. Low frequency counterweight resonances are also now clearly shown.

The graph corresponds to the acceleration of the cartridge body and theoretically produces a diagonal line rising at 6dB/octave, assuming both the cartridge/cantilever mechanical impedance and the sweep record excitation are constant. In fact, the test disc is recorded with a rising velocity of 6dB/octave from 20Hz-1kHz and constant velocity thereafter, while the mechanical impedance of the cartridge falls typically from 20Hz to 2kHz, again at some 6dB/octave (see fig 2) so largely compensating for the disc up to 1kHz. Above a few kHz the mechanical impedance of the cartridge begins to increase, again at approximately 6dB/octave, imparting rising energy to the cartridge body. However, the ratio of cantilever to cartridge mass (c. 1 : 500)

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means that the output is effectively under mass control, so the acceleration of the cartridge body is thus approximately flat from 20Hz to 1-2kHz, thereafter rising by 6dB/octave 2kHz-20kHz. Inevitably some cartridge body resonances are superimposed on the acceleration *vs* frequency response graphs in the final new octaves, but fortunately these are markedly less severe than those exhibited by the cartridge/tonearm combination, as the review graphs clearly indicate.

Arm resonance interpretation

The arm resonance graphs reflect complex behaviour and require cautious interpretation. As a general guide, the higher the frequency at which the first resonance occurs the better, since this implies good arm rigidity. A large number of sharp, high amplitude resonances suggests significant coloration inducing modes, and likewise frequency imbalances are indicated by regions which are unusually dominant or depressed; ideally one should see a rising energy trend with frequency.

The picture can be confused, as for example in the case of an arm with a sloppy headshell fixing. Here the behaviour may seem quite well controlled above the fairly low 180Hz or so headshell socket flexing resonance, due to the lossy junction damping serving to attenuate the higher frequency modes further down the arm. While the reproduction from such a model will not be particularly well defined, its general tonal balance and coloration may still be quite good.

Subjective data derived from the 100 or so arms reviewed here continues to indicate that good overall arm rigidity is essential to the performance in terms of imparting low coloration, precise stereo imaging, and last, but by no means least, a good rendition of fine detail, depth and ambience. The cartridge must be clamped rigidly with respect to the required vertical axis over as wide a frequency range as possible; at and above the arm's critical frequencies it begins to vibrate and twist in response to vibrational excitation from the groove modulation, and the cartridge/groove alignment is then no longer stable.

In essence the resonance modes produce a complex cross and intermodulation of the otherwise unmodified portions of the spectrum. The need for high rigidity implies that the first major resonance exposed on the graph be at the highest frequency possible, an objective familiar in connection with loudspeaker cones. It can also be argued that when the resonances do occur they should be fairly well controlled or damped — a point relevant once again to the design of speakers as well as to tonearms. Poorly damped resonances colour the sound by storing and delaying energy after the original sound responsible has ceased, with a modified sound 'blur' following each transient, masking fine detail and ambient information.

From the measurement data, major arm resonances (excluding counterweight modes) were charted from 150Hz upwards. Typical universal detachable headshell designs (SME/Ortofon/JEI type fixing socket) flex in the 180-250Hz range, while for the more carefully executed forms (recent Sony and FR designs and the like), this may be deferred to beyond 300Hz, benefits deriving in this case from the close engineering tolerances and special splined clamp arrangements.

Fixed headshell designs are aided by reduced mass and greatly improved rigidity; for example the remarkable *Ittok* exhibited a first major resonance at a high 750Hz, even using a cartridge of relatively high mass. The Mission *774* and Syrinx designs were only marginally less rigid, but these three models are in a class of their own, with the majority of arms showing more numerous resonance modes from 300Hz upwards.

Counterweights and other devices can often contribute their own modes, being attached by threads or beams which are fixed to the arm. Rubber decoupled counterweights typically resonate in the 70-150Hz region, and dynamic balance weights from 120-350Hz; in fact the latter can resonate sufficiently violently at the critical frequency to produce cartridge mistracking For example, one experimental low mass cartridge was found to mistrack in one specific tonearm, which was later found to have a serious and coincidental torsional tube resonance at the test tracking frequency. (A carbon fibre design, the fibre alignment was longitudinal for maximum bending stiffness, but in the process the designer had inexplicably forgotten about the arguably more important torsional modes, which appeared at 300Hz).

Effective mass and the subsonic arm resonance

Over the past three years a considerable amount of rethinking has gone into this subject. Hitherto a large number of heavy arms and cartridges were on sale, the former of typically 18g effective mass and the latter 8g, with excessive stylus compliances of the order of 35-60cu. This resulted in unsatisfactory low system resonant frequencies of around 6Hz. Today's arms are becoming lighter and cartridge mass is also reducing — witness the new Ortofons, and also Dynavector, Mission and Audio Technica moving-coil models — while stylus compliances are more frequently found at the more realistic 12-25cu levels.

Consequently, with more recent combinations, the typical arm/cartridge resonance has risen closer to the 10Hz 'ideal' figure. Care still needs to be taken over the compatibility of arm mass/damping and cartridge mass/compliance to achieve the best results, but in general the danger of gross incompatibility presents rather less of a problem than it has in former years.

Measurement problems

Subchassis resonances

Two problems were encountered with some suspended-subchassis turntables, one in fact mentioned in the previous issue. In this case measurement of the arm/cartridge subsonic resonance on the *Sondek* was obstructed due to subchassis excitation by the arm at similar frequencies (see fig 2). Clamping the subchassis allowed the arm resonance to be plotted. This time when the audio range resonances for the Syrinx arm, also mounted on a *Sondek*, were measured, another interaction was discovered. A chain of unexpected resonances appeared at low frequencies — too low, considering the observed high rigidity of the arm. Substantial clamping of the *Sondek* arm board resulted in the suppression of a number of these modes, which were identified as the rocking and bending of the arm board on a small central steel plate fixing. By comparison the rigid *Ittok* arm gave clean results when mounted on a similar turntable (see Dunlop *Systemdek*), but here the motor board fixing girder ran directly beneath the arm, minimising flexure relative to the subchassis and platter. By implication the structural rigidity of the arm mounting board coupling to the platter may need more attention than hitherto suspected, if the latest high rigidity arms are to be fully exploited.

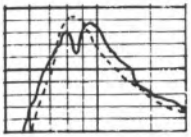

Fig 2. Linn/Breuer resonance interaction: subchassis free (solid) and clamped (dotted).

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 the last 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 balance 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.

Motor Unit/Arm Matching and Coloration

Obviously arm sound quality is further complicated by the addition of the turntable. Ideally this should not contribute any sound of its own, but in practice it often adds further varying degrees of mild coloration. These derive from a number of sources which can be summarised as lid induced resonances; energy storage in the disc due to inadequate record support; resonances in the plinth and/or on its support system; and finally if the latter is inadequate, floor borne vibration. These may prove either beneficial, as in the case of the Michell *Focus* system where the end result is quite well-balanced musically, or alternatively they can prove detrimental; for example, the Monitor Audio *ET500* motor and Micro *MA505* arm were found to make an unfortunate combination in terms of the resulting sound quality, and yet the motor alone partners most other arms well, while the *MA505* was itself satisfactory when used in its own Micro *DDX1000* turntable.

Thus when one attempts to describe the sound of a turntable unit, one has to take into account a seemingly never ending combination of circumstances — floor-borne vibration; direct acoustic transmission; disc support; the arm and its audible and subsonic resonances; whether the lid is up or down (in some models the feedback margin can change by 10dB); what room position and what kind of shelf the deck is mounted on; and finally, such factors as the tightness of the cartridge fixing.

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 detected as flutter sidebands in the lateral plane*. Fortunately, for this issue a new rumble measuring method was adopted, utilising an energy coupler developed by Thorens which has pushed the 'Din B' measurement from a -73dB limit to around -80dB.

* A difficult but sophisticated measurement of flutter has been developed for research purposes by B & O, which readily resolves such sidebands. An optical sensor is used, with accurate computation of irregularities in periodicity.

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 of 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

While still to the DIN standard, the measurements for wow and flutter in this edition differ somewhat from those previously published. The same Matsushita master acetate was used as before, but this time 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

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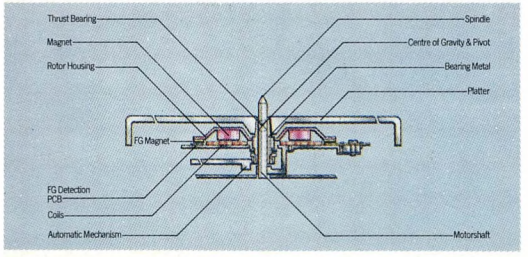

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difficult to estimate from the usually wildly fluctuating meter pointer, while the picture is further complicated by occasional random noise excursions; consequently with a conventional meter one tends to under-read. However this new instrument has the ability to reject random effects and accurately records the peak periodic wow and flutter over either three selected intervals, or σ functions. We used 'σ2', (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 Ultimo) The finest examples recorded 0.04% DIN peak-weighted (σ2), 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%.*

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 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 undersized 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 or arm/cartridge in origin. Since the two latter resonances should not coincide, we are left with the suggestion that the subchassis resonance should be below 3Hz 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 a low compression engine is fairly tolerant of poor engine tune, but a higher performance model is utterly dependant 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 pickup. At present the importance of accurate arm alignment is highly underated. 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 a 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 those protractor cards that are supplied with a number of universal pickup 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 45 rpm 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

* 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.)

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 as 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 compatibility, 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 Shibata tips where a small tilt will cause the long contact walls to miss the intended groove sections, resulting in mistracking.

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 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.

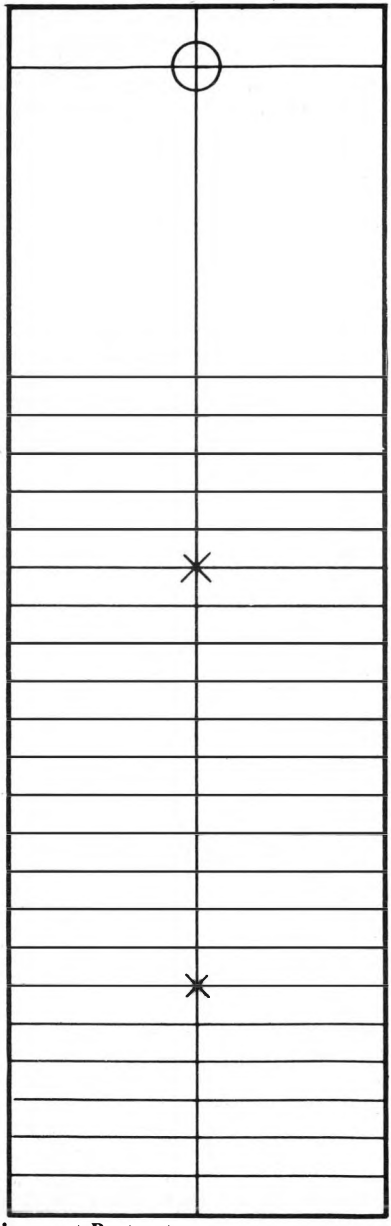
Leaving aside the doldrums of optimal alignment, it is disheartening to report that not only did the majority of arms examined make no provision for vertical alignment, but also many have their headshells fixed in a permanent 1-2° canted attitude. Likewise, very few of them made provision for height 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 manufacturers' making, but reflect the inaccuracy of the disc playing system, which is so tolerant of niceties of alignment that despite a compounded multiplicity of errors the cartridge will nonetheless continue to play records, and many users remain oblivious of the musical information they are missing!

SUBJECTIVE TESTS

Each turntable was placed on a substantial wooden coffee table, located some 2m from the loudspeakers, on a normal suspended timber floor. 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.

The loudspeakers used included the wide-response KEF *R105II* and the Spendor *BC1*. In the main a Sansui *AU919* served for amplification; this model has useful switching facilities, a well proven performance and a dynamic range suited to these tests. The cartridge predominantly used was the Mission *773* moving-coil model — a low mass medium compliance design of fine all round performance, which does not need special line amplification. Others used included the Technics *305MC*, Dynavector *DV100R Karat*, B&O *MMC20CL* and ADC *VLM III*.

A closely-matched pair of Missions were

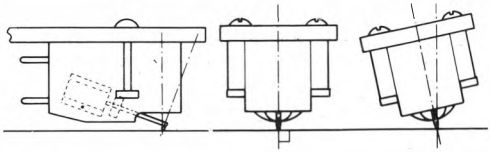


Alignment Protractor

selected from a batch of samples, and these were used for the comparative A/B testing of players and arms (except where cartridge choice was not available). While differences were revealed over a wide range of music types, clean percussive bass with some echo proved particularly revealing of bass and midrange colorations. Singing voice showed up uppper midrange problems, while the handling of sibilants and brass revealed the upper treble performance. Crossed-pair microphone recordings with minimal 'doctoring' illustrated the stereo and depth/ambience qualities.

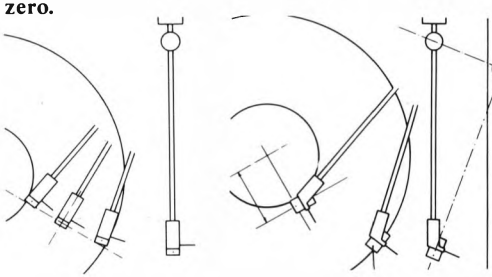
Acknowledgements

Thanks are due to KEF for the extended loan of the *R105 IIs*, to Mission for their cartridges, to Sansui for the *AU919*, to James Moir for the vibration exciter, to Stephen Liebman and Paul Crooke for practical, technical and aural assistance, and not least to Marianne Colloms for forbearance and help with the editing and typing.



Viewed from the side, the vertical tracking angle (v.t.a.) should be about 20°. Largely controlled by the cartridge design/manufacture, arm height adjustment allows 'fine tuning'.

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



The above diagrams show that the arm with offset head angle reduces lateral tracking errors. The left hand column is a full size alignment protractor that may be removed or copied and stiffened with card: with the circle removed it is placed over the spindle and the cartridge adjusted so that it is parallel with the horizontal lines when the stylus is on each of the points marked 'X'.

CARTRIDGE AND ARM MATCHING IS CRITICAL

Whatever turntable you choose there is no doubt that the arm and cartridge combination is the most critical of the record playing system. Because of this we have spent many hours trying the hundreds of arm and cartridge permutations – measuring and listening to find the correct combinations. As a result of this we are able to match cartridges to your arm, or arms to your cartridge to ensure complete compatibility. We can also advise on the correct loadings to obtain the optimum matching between cartridge and amplifier.
Of course we are able to give comparative dems of any cartridges we stock, along with all the best in ancillary equipment – phone for details of hourly appointments.

Agents for:–
ADC, AKG, A+R, Aiwa, Ariston, Breuer, Connoisseur, Decca, Denon, Dual, Dunlop Systemdek, Empire, Entre, Fidelity Research, Formula 4, Glanz, Grace, Grado, JVC, JDE, Hadcock, Koetsu, Lentek, Linn, Mission, Micro Seiki, Mission, Nagoaki, Optonica, Ortofon, Reference, Revox, Rotel, STD, SME, Sansuit, Satin, Shure, Stanton, Stax, Supex, Syrinx, Technics, Thorens, Trio, Ultimo, Westrak, Yamaha.

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ADC 1500

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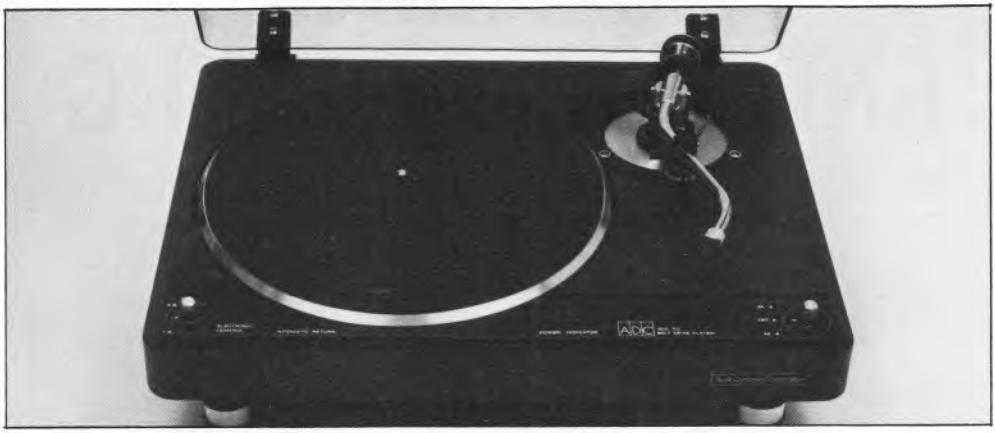


Features, facilities, setting up and use

Launched just too late for inclusion in the last edition of *Turntables and Tonearms,* the UK made *1500FG* sports a tonearm closely derived from the earlier Accutrack series, fitted with the ADC detachable magnesium die cast headshell. First impressions were of a rather 'plastic' and lightweight design, but as the evaluation progressed so the picture slowly improved. A cartridge was supplied ready fitted, namely an ADC *QLM 34 III* – a type recommended last year by *Choice,* and one which was fully compatible with the *1500*.

A belt drive design, the motor was a frequency generator (FG) type affording fine speed adjustment in addition to the standard 33⅓ and 45 rpm. A stroboscope was incorporated which is viewed through a small aperture in the plinth, but the image was confusing, being rather distorted and only just readable. A useful auto-return facility was also built in. The platter was of moderate mass, fitted with a hard rubber mat carrying fine circular ribs which gave rather poor disc contact.

The counterweight was of the rotary calibrated scale type, with a heavy sleeve section which is supposed to slide, allowing the balancing of high mass cartridges. In practice, the sleeve was locked by a set screw, only accessible after the decorative rubber trim ring had been removed. Finally, the springs were barely sufficient to hold the lively polystyrene lid open, and the hinges were sloppy in action. On the plus side, some thought had gone into the vibration isolation and the cylindrical anodized feet contained quite effective springs, providing a 6.5Hz lateral suspension resonance, although with little overall freedom. Movement was greater in the vertical mode, but with the main resonant frequency increased to 13Hz.

The instructions for cartridge alignment only applied to ADC models, and were in any case inaccurate; as supplied the cartridge was between 1° and 2° out, and required to be positioned fully back on the headshell fixing slots to give minimum tracing distortion. By implication, no further movement in this direction is possible for other cartridges which may need such adjustment (*ie* models with an increased stylus tip to fixing centre spacing).

Lab performance

Essentially the motor performance was good on all counts, taking into consideration the origin of the rumble result, which was mainly due to electric breakthrough rather than mechanical or main bearing noise. The speed characteristics and stability were fine with no dynamic wow, good torque and a rapid start up.

Arm effective mass was fairly high at 21g, though compatible with the supplied cartridge, the combination offering a near ideal 10.9Hz resonance of reasonable damping. The arm resonance characteristic was considered to be above average, and likewise the arm sound quality, which is an unusual finding at this price level, and one possibly due in part to the rigid headshell design. Lateral friction was satisfactory at 100mg in view of the 2g tracking cartridge fitted, although the bias levels were excessive at just about twice that required (a 1.5g setting is therefore suggested for 2–2.5g

tracking). Lead capacitance was high at 220pF, but once again was suitable for the *QLM,* provided that the amplifier adds no more than 100pF or so.

The sprung feet were moderately effective, and despite a below average rating for acoustic breakthrough the feedback margin in a listening set up was judged good. A trace of hum-related noise was audible at high sound levels but was not felt to be too obtrusive, and the player did exhibit a good resistance to shock excitation.

Sound quality

An average rating overall was achieved which is good for the price, especially as the included cartridge is a positive attribute rather than an afterthought or simply a sales convenience, as is so often the case.

Conclusion

While a bit flimsy in construction and possessing some weaknesses, namely a poor strobe, a suspect mat, and just satisfactory noise levels, the *1500FG* did offer an above average arm plus a good cartridge, auto-return, variable speeds and fairly effective feet. With an 'average' sound quality rating at a well below average price, it is clearly worth considering.

GENERAL DATA Integrated Turntable

Motor Section

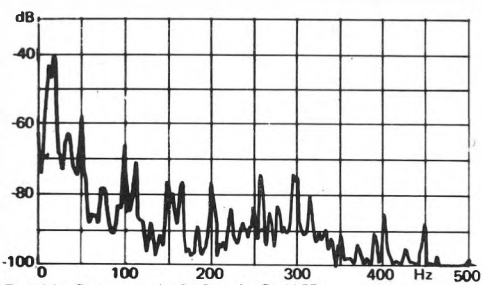
Type	auto-return, belt drive
Platter mass/damping	1.2kg/very good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.14%/<0.05%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	−0.15%/−0.2%
Start up time to audible stabilisation	1.0secs
Rumble: DIN B wtd L/R av (see spectrum)	67/68dB

Arm Section

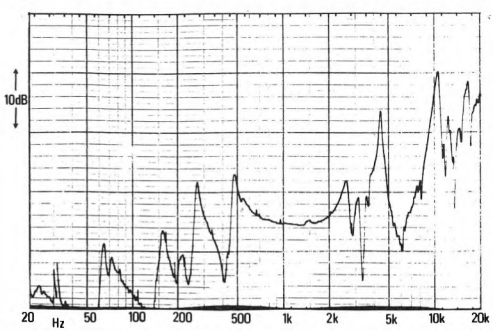
Approximate effective mass inc screws, excl cartridge	21g
Type/mass of headshell	universal detachable/9.5g
Geometric accuracy	good
Adjustments provided	overhang/lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	100mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	350mg/450mg
Downforce calibration error: 1g/2g	+0.05g/+0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/2.0secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	220pF/decoupled counterweight

System as a whole

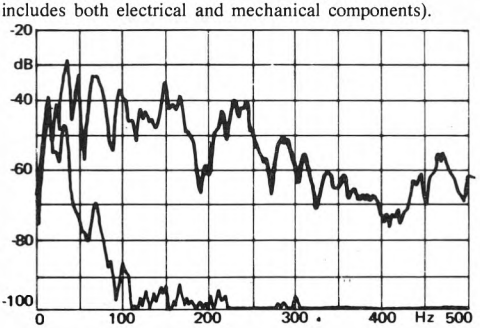
Size/clearance for lid rear	47(w) x 38(d) x 15.7(h)/3.7cm
Ease of use	good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	satisfactory/good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£75 (inc QLM 34)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



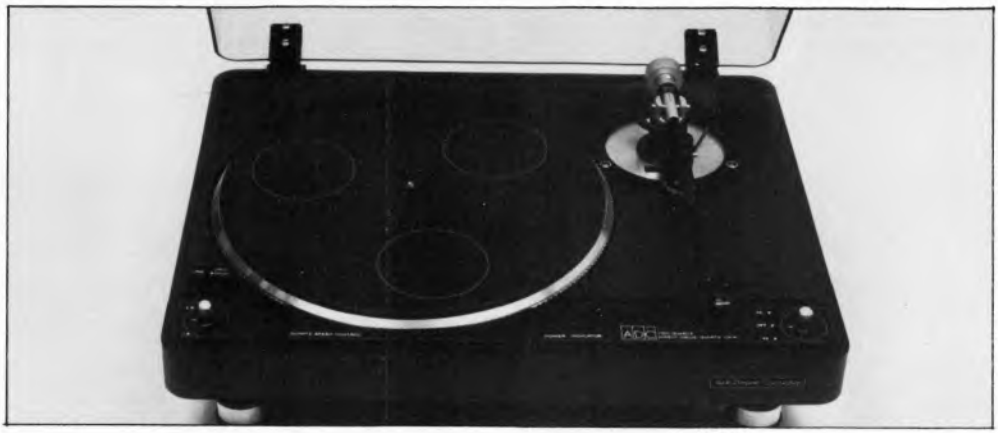
Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

ADC 1700

BSR., Powke Lane, Cradley Heath, Warley, West Midlands B64 5QH. Tel. 0384 65191



Features, facilities, setting up and use

As with the *1500,* the *1700* and *1600* are both supplied fitted with ADC cartridges. The *1600* (a non quartz lock version of the *1700*) is provided with a *QLM 36 III,* while the subject of this review, namely the *1700 DD,* comes with an *XLM III.* In all other respects including specified performance, the *1600* and *1700* are identical. An auto-return direct drive design, the *1700* was fitted with an aluminium tube version of the established *LMF2* low mass pickup arm, the latter made in Japan for ADC and fully compatible with the cartridge supplied as part of the package.

In common with the *1500,* the plastic double-skinned ABS moulded plinth was mounted on large sprung feet. The rather resonant polystyrene lid was hinged onto the plinth, and was thus acoustically coupled to the arm; perhaps in an effort to reduce feedback, the arm mount was mildly decoupled from the plinth on small rubber bushes. A good flat rubber mat was fitted, which offered good disc and platter damping. For the correct cartridge alignment (as supplied it was accurate), the *XLM* was mounted in the front of the headshell slots. This of course means that no further forward movement is available for other cartridges which might need further correction (for example, the Dynavector *20* series).

The motor was under quartz lock control, but this could be switched out to provide variable speed facilities, the latter a permanent feature of the *1600.* The stroboscope was much clearer than on the *1500,* although the same lid spring problem was again encountered, namely barely sufficient tension to keep the lid up. In context, neither the finish or 'feel' of the controls were up to the usual Japanese standard, although they did show a definite improvement over the old BSRs. The instruction manual was sparse and gave no information as regards cartridge alignment excepting for their own ADC models. The rumble results were a little poorer than specified, and a retest produced much the same results. Interestingly, the arm bearings on sample one were sloppy whereas on sample two they were much better adjusted; tight but not binding, thus indicating certain sample variations to be present here. We have since been told that the better arm bearing tolerances will be maintained.

Lab performance

Of fair platter mass, start up was fine at 1.8secs, with good weighted wow and flutter, although the linear wow figure was higher than average. Drift and torque were good, while speed stability was excellent as might be expected with the quartz lock reference switched on. Tests showed the presence of some dynamic wow (excessive speed overshoot on load variations), although this was not considered serious. The rumble figures were satisfactory and were mainly due to mechanical noise from the mains transformer; however, the rumble spectrum also showed some pole switching harmonics from the motor, these components being those which do not appear on the 50Hz vertical calibration marker lines.

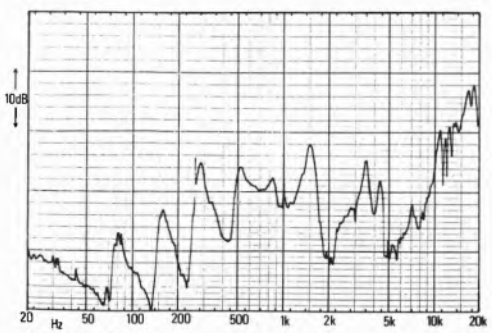
The arm resonance graph showed a marginally better than average trend, mainly due to the lack of

severe breaks and a generally even character, particularly in the final octaves. The effective mass was low despite the special detachable headshell, and should be fully compatible with medium-high compliance cartridges, but lateral friction was on the high side at 150mg. (This improved with the second sample to c.30mg, but was still poorer than the extravagant 5mg claimed in the specification.) Biasing was quite appropriate and lent no additional friction, and although lead capacitance was fairly high at 200pF, this is about right for the cartridge. For the best results, the additional amplifier contribution should be less than say 75pF.

With reasonable vibration isolation, the acoustic breakthrough (mainly lid induced) was poorer than average, and was also quite peaky. The feet helped to produce a fair feedback margin, and the above average arm was instrumental in achieving an overall 'average' rating for sound quality. Shock immunity was also good.

Conclusions

It is difficult to summarise the performance of the 1700 DD. The motor was not quite good enough, and some quality control problems are apparent, but the arm looks promising and the fitted cartridge was firmly recommended in last year's issue of *Cartridges and Headphones.*



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

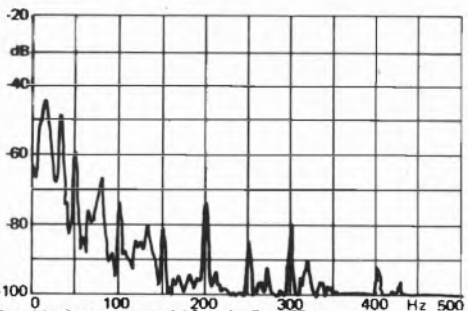
Type	semi-automatic quartz direct drive
Platter mass/damping	1.4kg/very good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.18%/0.08%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.8secs
Rumble: DIN B wtd L/R av (see spectrum)	66/71dB

Arm Section

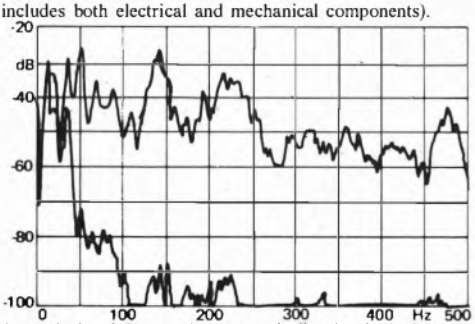
Approximate effective mass inc screws, excl cartridge	6g
Type/mass of headshell	special detachable/4.0g
Geometric accuracy	fairly good
Adjustments provided	overhang/lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	150mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	app 250mg/app 250mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.1secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	200pF/slight counterweight decoupling

System as a whole

Size/clearance for lid rear	47(w) x 38(d) x 15.7(h)/3.6cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£120 (inc XLMIII cart)



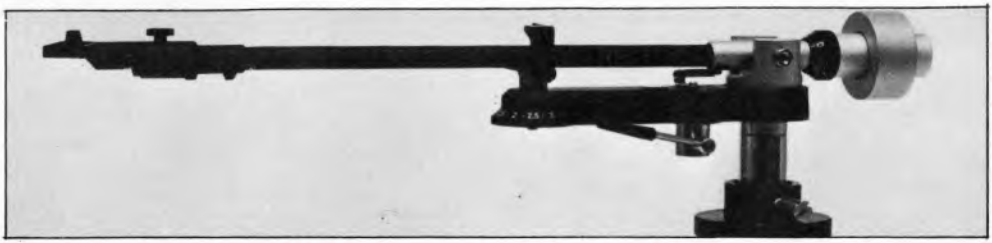
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

ADC ALT1

BSR, Powke Lane, Cradley Heath, Warley, West Midlands B64 5QH. Tel. 0384 65191



Features, facilities, setting up and use

The recent success of ADC's foray into the component tonearm business with the LMF-1 seems to have prompted the release of a less costly version, whereby the tapered carbon-fibre tube of the *LMF* has been replaced by aluminium and the end product labelled the *ALT-1*. This detachable headshell arm is also used in a similar form in the *1600* and *1700* turntables. The headshell remains a black carbon-fibre filled plastic moulding, which can also be found in comparable form on the two Rotel decks in this issue. The counterweight assembly is shorter than that on the *LMF-1*, and is of a rotating scale rather than the more complex calibrated dial type. The arm is supplied with a simplified sliding base compatible with SME fixing centres which made for easy setting up and alignment (the SME type base is an extra with the *LMF-1*).

Lab performance

Proving not to be as well adjusted as we would have liked, the horizontal bearing was rather slack and showed a moderate if not particularly low friction of 40mg. However biasing was fine, and downforce calibration very good. The resonance graph revealed an untidy characteristic, although as the modes were well-controlled the result was in fact above average. However, if this is compared with the new graph for the *LMF-1*, the latter's superior performance in this department is only too apparent, albeit at twice the price. Lead capacitance was 180pF, which is fairly high and may be worth bearing in mind with some cartridges.

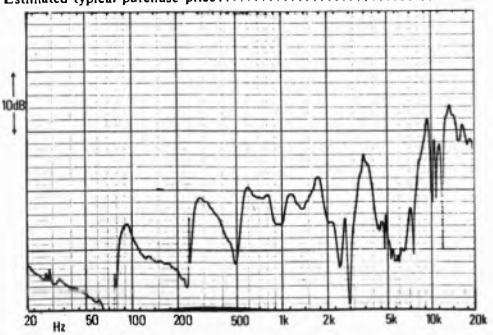
Sound quality

On a good turntable *(TD160)* the sound quality produced by this arm was judged as above average, despite some imprecision of stereo imaging.

Conclusion

The value is quite good, and the fact that there are few low mass arms around at this price level works to the *ALT-1's* advantage, since the more compliant cartridges should work well in this model.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	6g
Type/mass of headshell	special detachable/4.0g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang, height
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	40mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/225mg
Downforce calibration error: 1g/2g	<0.02g/<0.03g
Cue drift/8mm ascent/descent	negligible/0.4secs/1.5secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	180pF/some counterweight decoupling
Estimated typical purchase price	£36

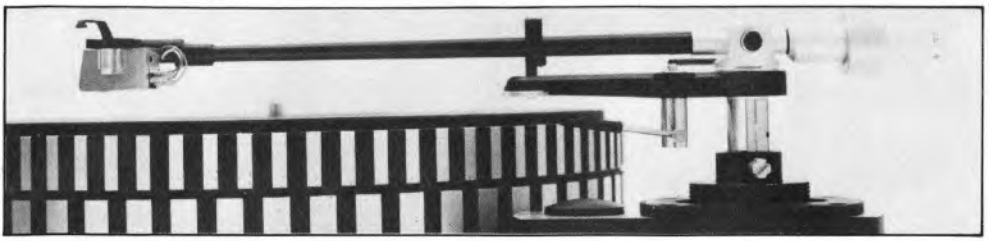


Arm resonances

RECOMMENDED

(revised & reprinted) **ADC LMF1 (LMF 2)**

ADC, BSR Ltd., Powke Lane, Cradley Heath, Warley, West Midlands, B64 5QH. 0384 65191



Physically, these two arms are quite similar, the only difference being the provision of a fixed cartridge platform on the *LMF1* as opposed to the unique detachable platform of the *LMF2*, the latter employing a knurled screw to firmly clamp the plug and socket section. While a normal hole fixing is standard, the optional *ASB1* accessory comprises a sliding base with SME-spaced mounting centre; the ensemble was very easy to set up for downforce and overhang. No provision was made for vertical tilt adjustment, but fortunately the platform alignment of both arms was good.

Carbon fibre has been skilfully employed for the tapered arm tubes, which proved highly rigid despite their low mass design; both finish and engineering were also to a high standard, with well adjusted precision bearings. However, a fairly large rear clearance was required to accommodate these arms, since the downforce knob extended some 7.5cm behind the pivots. This knob is only scaled to 1.6g, though it is of course possible to set any downforce by using auxiliary stylus scales. Bearing this in mind it is perhaps fortunate that the bias was somewhat excessive, which will assist the arms' use at higher than expected tracking weights.

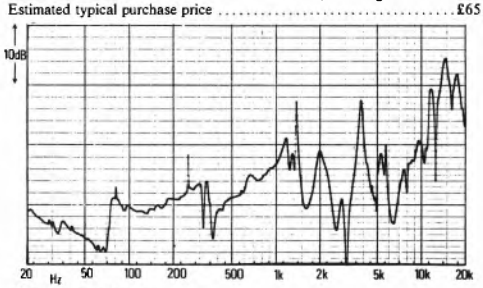
Friction was excellent in both planes with the bias in excess by approximately 30%, this allowing a correction of up to 2g downforce. Relative to the dialled settings, a commensurate 30% reduction is thus recommended when setting up.

Conversely, downforce on these samples was about 10% under, although this is still quite reasonable. Cue operation was fine, and while the effective mass for both models was very low thus making them eminently suitable for high compliance cartridges, low to medium models can also be used, with the addition of extra mass. Arm resonances were above average, particularly in the case of the fixed version, where the first mode appeared at 350Hz with good energy control above this point.

Both models gave a good account of themselves, but of the two the *LMF1* was noticeably better, so much so that it gains a recommendation. It exhibited a firm, extended, low frequency range, complemented by a neutral mid-band plus precise stereo imaging. The higher frequencies were a trifle subdued, imparting a slightly rich and warm quality that became apparent when comparing the arm with other models such as the Grace or the Mission.

The *LMF1* is undoubtedly a high performance arm at the price and is recommended. A conventional conterweight system (should not be too difficult to modify) would reduce the rear clearance required, allowing use with many turntables. The *LMF2* is less attractive but still does fairly well – the detachable head facility clearly somewhat penalises performance.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	4g(5.5g)
Type of headshell	Fixed (special detach.)
Headshell mass (inc screws)	N/A/(4g)
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/280mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/6secs
Downforce calibration error 1g/2g	–0.1g/–0.125g
Amount of damping	none
Arm resonances	good
Subjective sound quality	very good/above average
Motor recommended	TD160, note large rear clearance
Estimated typical purchase price	£65



Arm resonances

Aiwa AP2300

Consumer Information Dept., Aiwa Centre, 56–58 Brunswick Centre, Marchmont Street, London, WC1. Tel. 01-278 2081

Features, facilities, setting up and use

This compact turntable is similar to the *AP2200* reviewed in the last edition which is now nearing the end of production. This model suffered from a degree of music wow which has happily been eradicated from the new design. Built on a heavy plinth moulded in 'stone resin', the *AP2300* was constructed so that the lid hinged from its top surface and hence very little rear clearance was required when opening it. A remote start cable was also supplied, allowing synchronisation with Aiwa cassette decks when recording. An inexpensive cartridge came ready fitted, in the form of a 2g tracking spherical tipped model which was not set to the correct geometrical position; 52mm was the required amount of overhang, but on arrival it measured 54mm.

The feet were the usual rubber cone type and provided rather high suspension resonance frequencies at 22Hz lateral and 16Hz vertical, while the lid was formed from a rather 'live' grade of tinted polystyrene. Powered by an eight pole direct drive motor, auto return and fine speed adjustment were included, the latter monitored via the usual mains illuminated platter rim stroboscope. Of moderate mass, the cast alloy platter was quite well damped by a light mat of good disc contact area, while front positioning of the major controls allowed adjustment during play, even with the lid down. Cartridge compatibility parameters included the moderate 135pF of lead capacitance, with the medium-high effective mass suggesting optimum compliances in the 15cu range or less.

Lab performance

The left and right channel rumble figures showed some discrepancy, though this is not uncommon and is due to the arm/cartridge asymmetry resolving different rumble components, namely vertical and horizontal into different channels. The mean was −71dB DIN B, and although the spectrum was interesting, this is a pretty good overall result. Noting that static electrical components were present on the 50Hz marker intervals at 50, 100, 150, 300 and 400Hz, the other components were motor generated, with the worst at 17Hz and corresponding to the motor pole count at 33⅓rpm. Harmonics of 17Hz occurred further up the spectrum. Wow and flutter results were very good – better than for the *2200* – and particularly good as regards the wow content. Speed stability torque and start up time were all fine.

The arm effective mass worked out at 18g inclusive of fixing hardware, and while the geometric accuracy was fairly satisfactory as supplied, it could have been improved had a protractor been included. The finish was very good although the headshell fixing was not very rigid, and while the lateral friction was fairly high at 100mg, it was very good in the vertical plane. The bias however was not well adjusted: when set to 1.5g it gave 125mg at the centre, but barely worked at the rim, offering only 50mg here. Fortunately, perhaps, higher dial settings were OK. Downforce calibration and cue operation were fine, but the tonearm resonances were judged poor, with a severe mode at 55Hz (probably the counterweight) followed by a dramatic break in the headshell at a low 160Hz, the latter

nearly 40dB as regards peak-to-trough ratio. Further severe modes were also present at 480Hz, 1kHz and 3kHz.

The vibration rejection was poor – in fact possibly one of the worst measured, although the acoustic breakthrough graph is actually quite good. Unfortunately both these parameters need to be satisfactory in order to command a decent subjective result. Shock resistance was about average, but feedback margins, especially in the bass, were less satisfactory.

Subjective quality

Some transformer hum was audible from the deck in quiet surroundings. The player was found to reduce the clarity and focus of the stereo sound stage and to add a touch of boominess at low frequencies. Stereo depth was impaired and the frequency balance tended to brightness and appeared uneven; overall a below average rating was denoted.

Conclusion

This model was let down by two key factors, namely its ineffective insulator feet and the severe arm resonances. In addition, the bias should have been more effective and the lateral friction could have been reduced to advantage.

GENERAL DATA Integrated Turntable

Motor Section

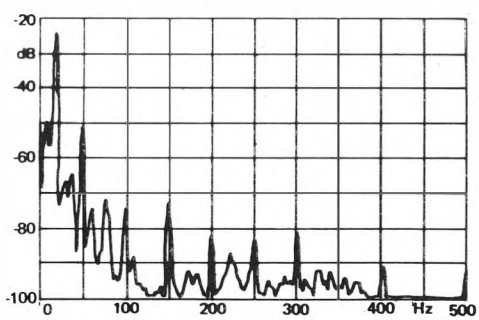
Type	auto-return, direct drive
Platter mass/damping	1.5kg/good
Finish and engineering	very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.06%/0.09%
Absolute speed error	−0.1%
Speed drift 1 hour/load variation	−0.25%/−0.3%
Start up time to audible stabilisation	2.0secs
Rumble: DIN B wtd L/R av (see spectrum)	74/68dB

Arm Section

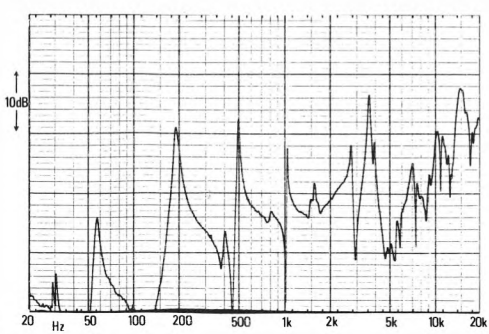
Approximate effective mass inc screws, excl cartridge	18g
Type/mass of headshell	universal detachable/11.5g
Geometric accuracy	fairly good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/fairly good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	100mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	<50mg/125mg
Downforce calibration error: 1g/2g	+0.05g/+0.05g
Cue drift/8mm ascent/descent	negligible/0.5secs/1.8secs
Arm resonances	poor
Subjective sound quality	below average
Lead capacitance/damping method	135pF/—

System as a whole

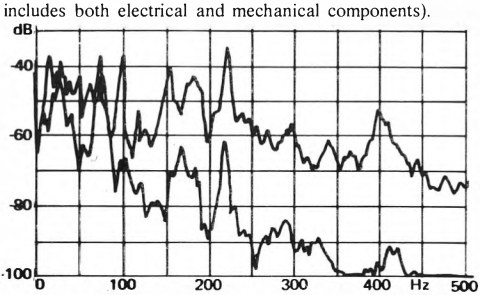
Size/clearance for lid rear	42.4(w) x 35.9(d) x 12.3(h)/1.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	poor/average
Estimated typical purchase price	£120



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Aiwa LP3000

Consumer Information Dept., Aiwa Centre, 56–58 Brunswick Centre, Marchmont Street, London, WC1. Tel. 01-278 2081

Features, facilities, setting up and use

Representing Aiwa's most elaborate turntable to date, this costly design is based on micro-processors and offers a wide range of operating facilities. While essentially highly automated, in fact it took some time to learn how to use it owing to the sheer complexity of the controls which number some 30 in all. Basic features comprised the parallel tracking tonearm (with zero lateral tracking error and no need for bias correction), driven by a separate motor via a lead screw arrangement. In all other respects the tonearm was conventional, though with a special detachable headshell. The connections here were however multiway, and coupled the record sensing assembly at the front of the headshell to the internal electronics. *Via* a microprocessor, a total of fifteen track sections may be played up to 24 times each in any desired order. In all, three motors were employed: one for arm tracking, one for cueing and a quartz-referenced direct drive one for the platter, which comprises a heavy chromed zinc die-casting, well damped by a good flat mat. The speeds were under synthesiser control allowing variation of up to ±6% in 0.1% steps, with both 33⅓ and 45 rpm independantly monitored by digital LED displays.

The heavy acrylic lid required only minimal extra rear clearance — an important fact in view of the otherwise large overall depth requirements. Substantially built, the whole assembly was supported on 'insulator' feet adjustable for height, but these were excessively stiff, and despite the suspended weight the plinth foot resonance was poorly defined at rather high frequencies of 15Hz in the lateral and 25Hz in the vertical modes. Ideally these resonances should be below that for the arm/cartridge — an unlikely event here in view of the highish effective arm mass. The space occupied by the sensor block in the headshell and the necessity for the sensor and record to be within closely prescribed limits meant that it was impossible to fit many cartridges to this model, and this is one aspect which the purchaser should investigate. For example, we had no trouble with the reference Mission *773* but found the Dynavector *10* and *20* series unsuitable.

Lab performance

The motor section was considered quite well engineered, and delivered good results for rumble, wow and flutter, speed accuracy, stability and torque. The motor start up time was unimportant owing to the far greater delay involved in the automatic arm cueing and tracking operation, and although some motor pole harmonics were present in the rumble spectrum, the latter was in fact dominated by static electrical components at 50, 100, 150 and 200Hz. Dynamic wow effects were negligible.

Arm effective mass was high at 25g, ideally requiring a lowish compliance cartridge of 15cu or preferably less. The parallel tracking and sensitive error-correction assured excellent

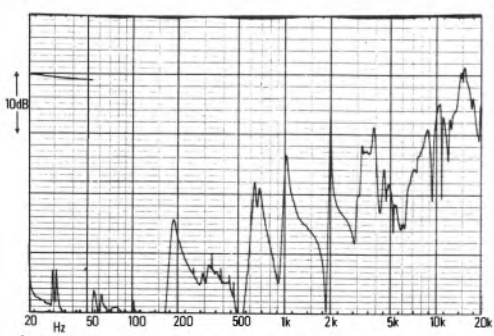
geometric alignment, while arm friction values were negligible and downforce accuracy satisfactory. The cue rates were fast, but not so much as to risk damage. The lead capacitance was quite high at 250pf, so the system needs to be carefully matched with the chosen cartridge. Although the picture improved somewhat above 5kHz, overall the arm resonances were pretty disappointing for a model in this price range, with numerous resonances possessing high peak-to-trough ratios. The massive lid and plinth contributed to a fine resistance to acoustic breakthrough, while shock resistance was also good, but these were to some extent compromised by the below average resistance to shelf-borne vibration, particularly from 10Hz to 100Hz.

Sound quality

An 'average' sound quality rating — a rather disappointing result at the price level — was confirmed for this model. The frequency balance was quite 'open' with fair upper treble, but the stereo depth was restrained, the midrange lacked clarity, and the bass registers were neither very firm nor deep.

Conclusion

The key to the judgment of this design lies in the importance a purchaser attaches to the myriad facilities it offers. We can add to an average sound quality rating such features as synthesised variable speeds, automatic operation, programmed track order, repeat and sensing, as well as a parallel tracking arm. If these are worth around £500 to you, then this may be the deck for your system.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

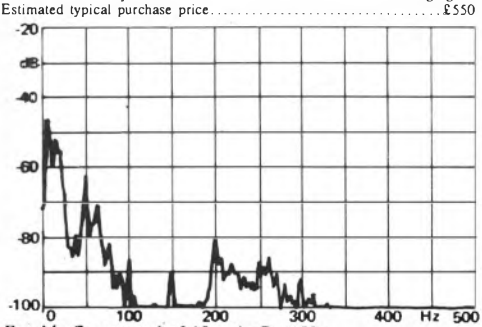
Type	quartz direct drive automatic, parallel tracking
Platter mass/damping	2.8kg/very good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	3 core/phonos + earth
Speed options	synthesised variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/<0.04%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	N/A
Rumble. DIN B wtd L/R av (see spectrum)	74/73dB

Arm Section

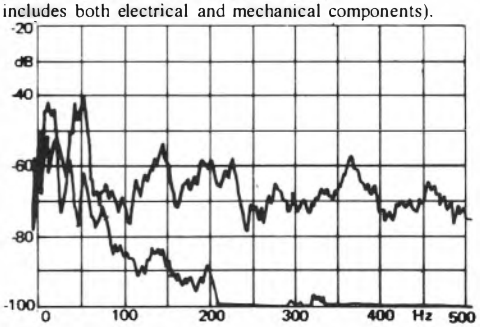
Approximate effective mass inc screws, excl cartridge	25g
Type/mass of headshell	special detachable/17.3g
Geometric accuracy	excellent
Adjustments provided	only height required
Finish and engineering	very good
Ease of assembly/setting up/use	both v. good/v. good when understood'
Friction: typical lateral/vertical	<15mg/<15mg
Bias compensation method	not required
Bias force: rim/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g/2g	−0.10g/−0.08g
Cue drift/8mm ascent/descent	negligible/1.5secs/0.3secs
Arm resonances	poor
Subjective sound quality	below average
Lead capacitance/damping method	250pF/—

System as a whole

Size/clearance for lid rear	48(w) x 44(d) x 15(h)/3cm
Ease of use	very good once understood
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	below average/good
Estimated typical purchase price	£550



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Akai AP-B10C

Akai (UK) Ltd., Unit 12, Silver Jubilee Way, The Haslemere Heathrow Estate, Parkway, Hounslow, Middx. Tel. 01-897 7171

Features, facilities, setting up and use

The *C* suffix to the model number refers to the fact that this inexpensive integrated turntable comes with a ready fitted cartridge. The latter, designated the *PC90,* was a modest spherical tipped model tracking at 2g, and possessing an appropriately low compliance to suit this particular player. It appeared to originate from Audio Technica and employed their "V" shaped magnet system. Serving to more or less replace the *AP100* of the previous issue, the *'10* represents an extensive redesign, and in contrast to its predecessor, is fitted with a lower mass arm with a special detachable plastic headshell. Manually operated, it has two fixed speeds selected by a front panel control, the plinth coming in either a black or a silver finish.

The light alloy platter was well damped by a multi-ribbed mat, being belt driven from a four pole synchronous/induction motor. Suspended on the usual rubber feet, the lateral plinth resonance was 10Hz, and the vertical 15Hz, both of which were rather close to that of the arm/cartridge. The lid was a resonant polystyrene type, being decoupled from neither the arm nor the plinth. The arm lead capacitance was fairly high at 190pF, while the effective mass was moderate at 13g and is thus suitable for cartridges in the 12–20cu range.

Lab performance

Despite a higher than average wow figure of 0.16%, the DIN weighted wow and flutter reading was fine at 0.06%, with good speed accuracy, ample torque, and a very fast start up time of approximately 0.7 seconds. Rumble was just satisfactory, averaging 65dB (exactly to spec), and checking revealed that the bulk represented coupling from the motor to the arm via the plinth, due to inadequate motor isolation. The intrinsic main bearing rumble was probably better than 73dB.

The arm showed very good geometric accuracy, with the square sides of the headshell facilitating final alignment. The vertical bearing was satisfactory although slight play was evident in the horizontal plane. Friction was satisfactorily low and biasing effective (if on the high side; to compensate, set the dial about 30% below the chosen tracking force). Downforce calibration was accurate and the cue operated well, although the descent rate was rather slow. Classed as average on arm resonances, the overall picture showed good control for a model in this price range; however the first break did occur at a low 180Hz.

Acoustic breakthrough was poor, a factor the *B10C* has in common with its predecessor, being notably severe at 60Hz and 210Hz, with a most uneven characteristic. The vibration sensitivity was also poor, showing the feet to be largely ineffective; it was thus no surprise to find a weak resistance to acoustic feedback on the listening test.

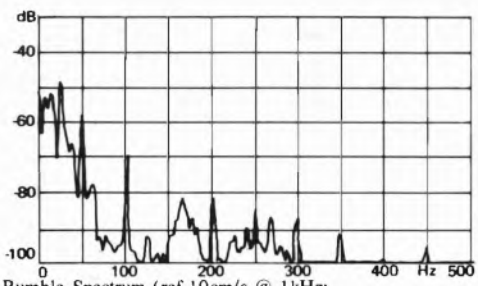
Sound quality

Rated as below average on sound quality, the *B10C* was saved from an even lower ranking by the 'average' arm quality. The sound was quite pleasant with a reasonably neutral frequency balance, but it was characterised by a lack of deep bass and upper bass emphasis, while stereo depth was impaired; overall, a mild general veiling of the sound was apparent. Mild motor rumble was just audible on quiet sections.

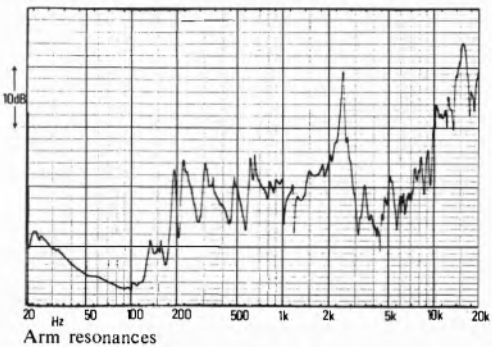
Conclusions

The *AP-B10C* offered just reasonable value at £55.00, including a modest cartridge. The rumble level could have been better while its poor isolation from external acoustic and vibratory energy was serious. On the plus side however, the arm quality was quite good all round, and it should prove compatible with many medium priced cartridges.

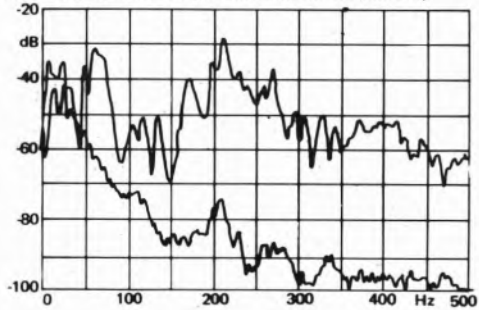
GENERAL DATA	Integrated Turntable
Motor Section	
Type	belt drive
Platter mass/damping	—/very good
Finish and engineering	very good/good
Type of mains lead/connecting leads	3 core/phono + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.16%/0.07%
Absolute speed error	<0.15%
Speed drift 1 hour/load variation	synchronous/—0.15%
Start up time to audible stabilisation	0.7secs
Rumble: DIN B wtd L/R av (see spectrum)	68/62dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	special detachable/6g
Geometric accuracy	very good
Adjustments provided	angle(lat), overhang, tilt
Finish and engineering	very good/fairly good
Ease of assembly/setting up/use	good/very good/good
Friction: typical lateral/vertical	50mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	250mg/300mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.2secs/3.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	190pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	44(w) x 35.5(d) x 13.5(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	very good/poor
Vibration sensitivity/shock resistance	poor/fair
Estimated typical purchase price	£55



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Akai AP-206C

Akai (UK) Ltd., Unit 12, Silver Jubilee Way, The Haslemere Heathrow Estate, Parkway, Hounslow, Middx. Tel. 01-897 7171

Features, facilities, setting up and use

This is the first direct drive deck from Akai to be reviewed in HFC, our sample coming complete with an Akai *PC100* cartridge (hence the *C* suffix), a 2g tracking spherical tipped model of low compliance, which was in fact quite advanced, employing a single point suspension rather than the usual foam bung. Auto-return arm operation is provided, and the arm differs from that on the *'10C* in using a normal 'universal' detachable headshell. The lead capacitance was very low at 75pF, almost one third that of its less expensive brother. A rotating scale counterweight was fitted, and the effective mass was on the high side at 17g, although compatible with the supplied Akai cartridge.

The fairly light cast-alloy platter was sufficiently damped by a ribbed mat, and the two fixed speeds of 33⅓ and 45rpm could also be varied via two independent controls, with speed reference provided by a mains illuminated platter rim strobe. The plinth was of reasonably solid wood composition, with the ubiquitous rubber feet, but by comparison with the *10C* its rather more substantial construction should result in better vibration and acoustic breakthrough graphs. The plinth resonances were measured at 16Hz and 22.5Hz, both of which are too high for comfort.

Lab performance

The wow and flutter performance was good, although marginally worse with DIN weighting than for the *10C*. Speed accuracy and drift were satisfactory but the motor did not generate much torque, slowing some 0.7% on the 3g dust bug loading. In view of the low platter mass, wow effects could be encountered on music. At least the motor was free of those particularly noticeable and extreme overshoot characteristics inherent in many older designs. Start up was slow considering the platter mass, but the weighted rumble measurement was fine at an average of 72dB. Unweighted, the rumble spectrum included a strong static electrical component at 50Hz, but all the others were mechanical in origin and motor generated. The output was thus not particularly 'clean', despite a good weighted figure (DIN B is centred on 300Hz).

The arm geometry was satisfactory, with reasonable alignment of the fitted cartridge, and was both well finished and engineered, although lateral bearing friction was a little high at 75mg. While the biasing was correct at the rim, it increased too

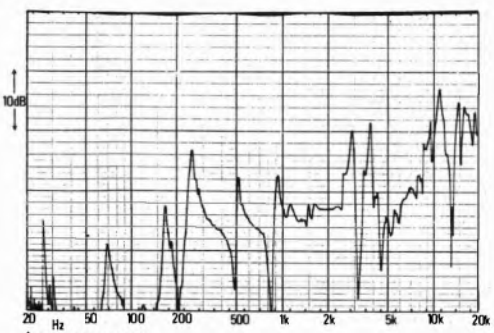
rapidly towards the record centre to give nearly double the required value. The downforce calibration also gave values about 10% too low. The arm resonances were judged to be poorer than average as a break appeared as early as 70Hz, the headshell resonance proved severe at 200Hz or so, and several strong modes also occurred at higher frequencies. Acoustic breakthrough was rated as 'average', showing a noticeably less peaky character than for the *10C*, while the vibration isolation also indicated some improvement. On the listening tests the feedback margin was judged to be average.

Sound quality

Ranked a little below average on overall sound quality, it was clear that the plinth improvements were offset by the less favourable sound quality of the arm. As with the *10C*, the frequency balance was quite reasonable, tending neither to brightness or dimness, but transients were softened and lost focus particularly in respect of the depth of stereo image. A mild change in bass quality was also apparent, but in fact this deterioration is only absent from those models which possess exceptional vibration isolation. There was a suspicion of pitch wavering on loud passages, but I doubt that many users would detect this except by direct comparison with a better unit on highly critical program.

Conclusion

While this direct drive model was relatively inexpensive, the arm was not particularly good, and was fairly high in mass. The low motor torque was also a cause for some concern and most other parameters were in the 'average' class.



Arm resonances

GENERAL DATA — Integrated Turntable

Motor Section

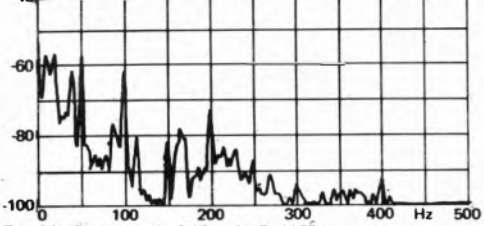
Type	direct drive auto return
Platter mass/damping	1.3kg/fairly good
Finish and engineering	very good/good
Type of mains lead/connecting leads	—/phonos + earth
Speed options	variable 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.09%/<0.04%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	−0.3%/−0.7%
Start up time to audible stabilisation	3.0secs
Rumble: DIN B wtd L/R av (see spectrum)	73/71dB

Arm Section

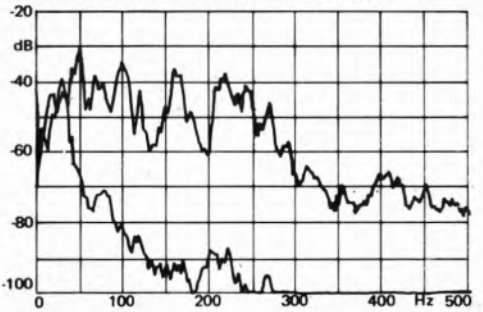
Approximate effective mass inc screws, excl cartridge	17.0g
Type/mass of headshell	universal detachable/9.0g
Geometric accuracy	fairly good
Acjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/fairly good/good
Friction: typical lateral/vertical	75mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/350mg
Downforce calibration error: 1g/2g	−0.1g/−0.15g
Cue drift/8mm ascent/descent	negligible/1.0secs/2.5secs
Arm resonances	below average
Subjective sound quality	average
Lead capacitance/damping method	75pF/—

System as a whole

Size/clearance for lid rear	44(w) x 35(d) x 15.8(h)/7.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/average
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£88



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

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Ariston RD11S

RECOMMENDED

Ariston Acoustics Ltd., 1 Society Street, Maybole, Ayrshire KA19 7BH.
Tel. 0655 82424

Ariston's troubled history at last appears to be stabilising with this, the latest version of the *RD11*. The resemblance to the *Sondek* is close – not surprising in view of their intertwined ancestry. However separate development has occurred for some years now, with the notable external difference between the two decks being the small circular arm mount of the Ariston as opposed to the full depth arm board of the Linn.

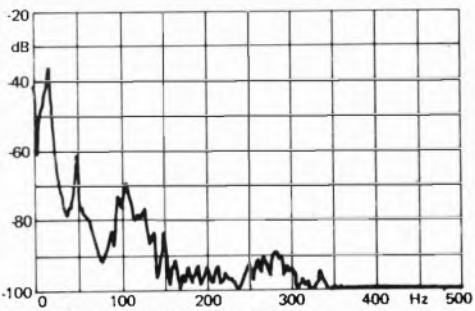
Equipped with a steel sub-chassis suspended on coil springs, the *RD11* platter was a massive two section die casting, weighing 5.5kg, this inclusive of the hard flat rubber mat. This combination was well damped and a square section ground neoprene cord was used to drive the centre platter hub from a 24 pole low power synchronous motor. Two pulley diameters were provided, but the speed change is manual and inconvenient, requiring the removal of the outer platter. A non-resonant acrylic lid was fitted which gave above average arm clearance: it would for example accommodate the ADC *LMF1*. The sub-chassis resonance was dominant at a low 4.8Hz, although a secondary rocking mode at 9.5Hz was also present, suggesting that the sub-chassis was not fully dynamically balanced.

Torque was good and the speed accurate, but the heavy platter extended the start up time to a long 6.5 seconds. Wow and flutter was good, with both load stability and rumble fine, the latter averaging 73dB and showing signs of improvement with running in. The deck did however prove awkward to set up, and required care in appropriately dressing the arm leads to ensure proper operation of the sub-chassis suspension. This done, very good acoustic breakthrough curves resulted, with quite excellent vibration isolation (using SME III). Excellent feedback immunity was also shown, with a fairly good impact shock resistance.

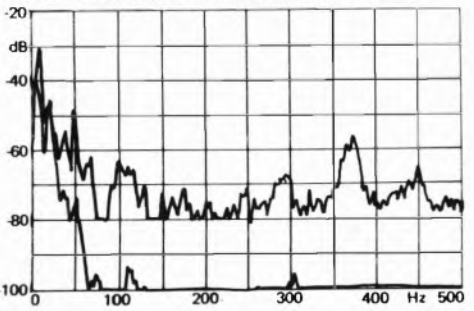
Partly dependent of course on the chosen arm, this turntable is in the top class. In our system the supplied mat was favoured, and the general standard appeared indistinguishable from the handful of other devices in this high ranking category.

Highly competent in all vital respects, this model may be confidently recommended.

GENERAL DATA	Motor Unit
Type	isolated subchassis, belt drive
Platter mass/damping	5.5kg/very good
Finish and engineering	both very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	manual change, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.16%/0.06%
Absolute speed error	+0.05%
Speed drift 1 hour/load variation	synchronous/−0.1%
Start up time to audible stabilisation	6.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75/72dB
Size/clearance for lid rear	45(w) x 36(d) x 14(h)/5.5cm
Ease of use	fairly 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/good
Estimated typical purchase price	£250



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

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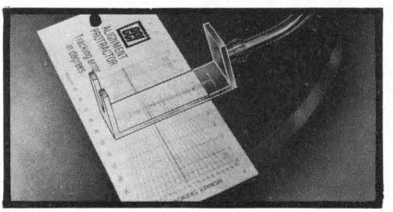
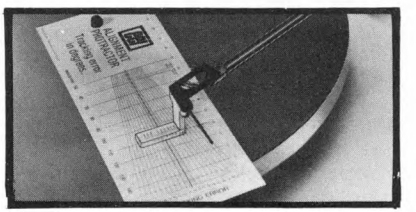


THE IEC PLUG-IN GAUGE MEASURING TRACKING ERROR – NOTE, THIS GAUGE HAS A SECOND SCALE TO ACCURATELY SET THE CARTRIDGE IN THE HEADSHELL.



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NEW ZEALAND

Audio Linear TD4001

Wilmex Ltd., Compton House, New Malden, Surrey KT3 4DE. Tel. 01-949 2545

The unusual *TD4001* bore such a close resemblance to a Michell product at first sight that one was convinced that they must be the manufacturers; in fact the deck is made in Belgium. It used the familiar Michell old-type aluminium plate platter with chromed weights in the surface, these providing only small rubber pad contact points for disc support. The platter was in fact quite heavy at 2.1kg, on a 6mm diameter bearing. The unit offers two speeds, control selected, and is powered *via* a precision neoprene cord belt. No provision had been made for small 45rpm discs, only the centre boss is available for support. A 15mm thick dark tinted acrylic panel formed the plinth/chassis and carried the arm fixing (cut for SME but suitable for others with the appropriate blanking plates), as well as the platter bearing.

The platter and disc were not well damped due to the absence of a conventional mat, nor were the wow and flutter readings very good, either as separate or combined measurements. With 0.15% regarded as the 'hi-fi threshold', the importers were contacted. They informed us that a belt problem was responsible for the deterioration, and Audio Linear were dealing with it, but we did not receive a substitute belt during the production of this review.

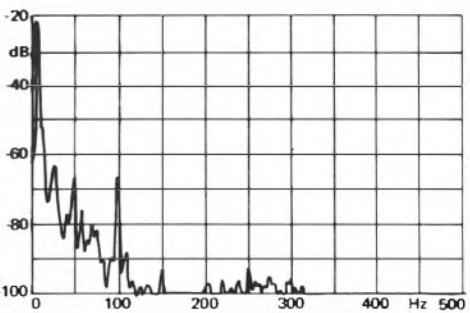
The weighted rumble was fine at 74dB and the spectrogram gave some idea of its origins. The curve was excellent above 100Hz, the 100Hz line itself an electrical component, but the 50Hz line represents belt-coupled motor vibration, while the strong component at 8Hz (well outside the DIN B weighting) was identified as the motor/belt resonance, the latter also associated with the high wow and flutter.

Acoustic breakthrough was average with peaks at 100Hz and 250Hz, but vibration was much better isolated. Shock resistance and feedback were above average, with the suspension resonances fairly low at 5.8Hz lateral and 10Hz vertical.

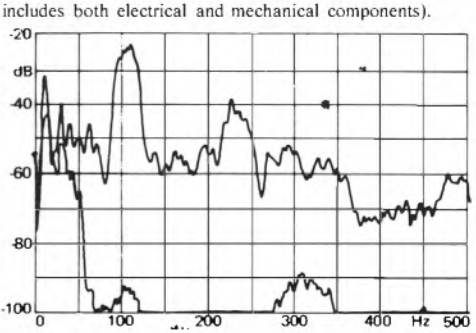
Assuming that the wow problem is solved, an 'average' sound quality rating applies. The bass was promising, but in our view the reproduction was mainly constrained by the minimal disc contact and damping levels provided.

Although the *4001* has certain attractive features, the minimal contact platter and as yet unresolved wow problem must prevent recommendation at this time.

GENERAL DATA	Motor Unit on plinth
Type	belt drive
Platter mass/damping	2.8kg/fair
Finish and engineering	very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.2%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.26%/0.15%
Absolute speed error	+0.7%
Speed drift 1 hour/load variation	synchronous/−0.15%
Start up time to audible stabilisation	4.0secs
Rumble: DIN B wtd L/R av (see spectrum)	74/74dB
Size/clearance for lid rear	45(w) x 37(d) x 15(h)/7.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/above average
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£122



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Audio Technica AT1005

Audio Technica UK, Hunslett Trading Estate, Low Road, Leeds. Tel. 0532 771441

Features, facilities, setting up and use

This particular arm was almost discontinued after having been on sale for nearly a decade but due to a resurgence of demand, it is still in production. The overall standard of engineering and finish was excellent, despite the modest price. It sports a 'universal' detachable headshell to an Audio Technica perforated design, and a rest pillar was provided but no lift/lower cue device; this must be effected manually via the headshell finger lift.

The offset counterweight ensured that the arm was dynamically balanced, aiding shock resistance, while standard gimbal ball race bearings were used, the latter excellently adjusted and free of both friction and looseness. Downforce was set via a sliding rider weight on the main arm tube. Moving mass proved high at 19g and is thus best suited to low compliance cartridges, with the low 75pF lead capacitance permitting 'padding' to suit any compatible cartridge. It should be noted however that the arm is fairly deep and will not suit some of the smaller turntables.

Lab performance

The geometrical accuracy was very good when set up as instructed. Frictions were very low and the biasing was effective, although a little on the high side and tending to an inverse ratio from rim to centre (in general, the rim value should be less than that pertaining at the centre). Downforce calibration was quite accurate.

Unfortunately in view of the other aspects of its performance the arm resonances were judged to be quite serious. Several breaks of notable severity were present, namely at 150, 700 and 600Hz, with further modes at 2.1kHz, 3.5kHz and 4.2kHz.

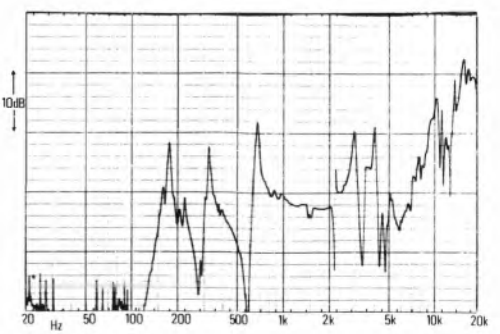
Sound quality

For a component arm fitted to a good turntable, the average sound quality rating was disappointing. The sound was a trifle brash and 'loud' with some edginess in the treble and a hardness on piano, while stereo information was also reduced.

Conclusion

The excellent constructional quality of this arm was not sufficient to make up for its ageing design, particularly with regard to arm resonances.

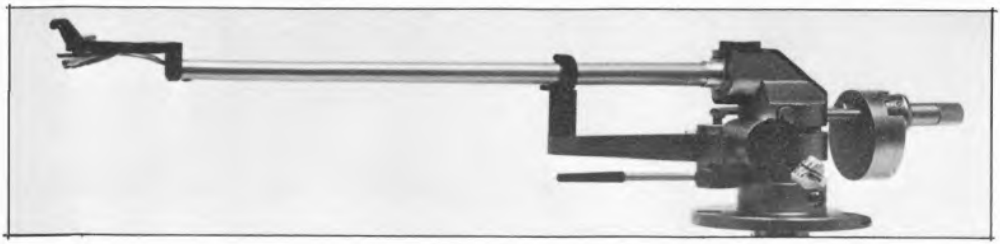
GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	19g
Type/mass of headshell	universal detachable/8.5g
Geometric accuracy	very good
Adjustments provided	height, lateral angle, overhang
Finish and engineering	very good
Ease of assembly/setting up/use	good/very good/fairly good
Friction: typical lateral/vertical	<20mg/15mg
Bias compensation method	thread and weight
Bias force: rim/centre (set to 1.5g elliptical)	275mg/235mg
Downforce calibration error: 1g/2g	−0.07g/−0.15g
Cue drift/8mm ascent/descent	N/A/N/A/N/A
Arm resonances	below average
Subjective sound quality	average
Lead capacitance/damping method	75pF/—
Estimated typical purchase price	£35



Arm resonances

Audio Technica AT1100/Signet XK50

Audio Technica UK, Hunslett Trading Estate, Low Road, Leeds. Tel. 0532 771441



Features, facilities, setting up and use

This interesting arm represents a development of the *AT1010* reviewed in the last issue but which is no longer on sale in the UK. The latter was of medium to high effective mass and employed a universal detachable headshell; for the new model, the mass is much reduced, and the arm uses an integral arm/shell carrier fixed by a locking mechanism at the massive bearing housing. A covered fluid well subsonic damper (similar to that on the SME) was incorporated, a feature carried over from the *'1010.*

The light headshell structure was very rigid, machined from an aluminium alloy block, with biasing applied via a low friction thread and pivoted leader weight. The massive pillar fitted in a 'oval' base to achieve a rigid three point contact when secured, while the bearings were of good quality although some slight play was evident in the horizontal plane on our sample.

Designated as a *DTS* model, the vertical pivot line was set below the stylus point so that variations in forward drag with groove modulation were resolved as stable or slightly increased downforce. (Conversely, of course, where the stylus is below the pivot line, increased drag results in a decrease in downforce, the resolved vertical component reducing the tracking ability — an unfortunate feature of several arms.)

Lab performance

Effective mass proved quite low at 9g, which will be suitable for almost all cartridges, with additional mass where required. Lead capacitance was also low at 95pf. The geometry was fine, the finish excellent and engineering very good apart from the slight bearing slackness. Frictions were low and the biasing close to ideal, with downforce calibration accurate and cue rates just right. As recommended, the damping was excessive, but it could be adjusted by removal or dilution of the fluid. The resonance characteristics were above average although not as good as was hoped, with the 75Hz mode traced to the counterweight and the arm tube itself notably rigid to 450Hz. Overall the control was quite good, and the trackability certainly above average.

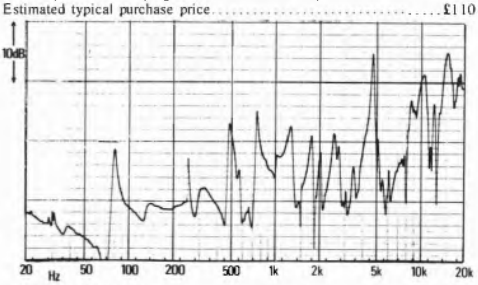
Sound quality

Obviously dependant on the deck used, when fitted to the Ariston for example, the combination delivered a well above average sound quality, so a rating of 'good' was just considered appropriate. The treble was marginally 'splashy' with good stereo precision and only slight depth loss, while the bass was quite good, if slightly coloured.

Conclusion

Competition is fierce at this price level, but this is undoubtedly a good arm. Certainly Audio Technica's best yet, it clearly merits consideration.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	8g
Type/mass of headshell	special detachable arm tube/N/A
Geometric accuracy	very good
Adjustments provided	height/overhang
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/very good/very good
Friction: typical lateral/vertical	<20mg/<10mg
Bias compensation method	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	225mg/225mg
Downforce calibration error: 1g/2g	<0.02g/<0.03g
Cue drift/8mm ascent/descent	negligible/0.6secs/0.8secs
Arm resonances	above average
Subjective sound quality	good
Lead capacitance/damping method	95pF/variable via fluid well
Estimated typical purchase price	£110

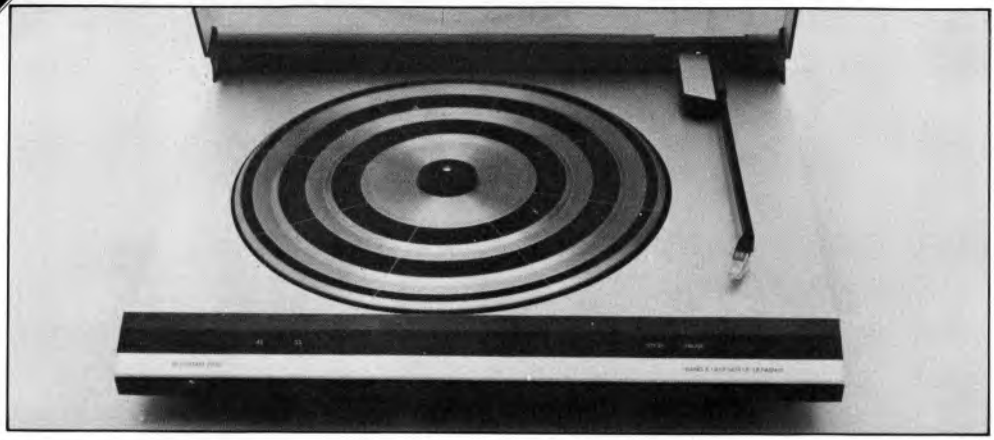


Arm resonances

RECOMMENDED

Bang & Olufsen 2200

Bang & Olufsen U.K. Ltd., Eastbrook Road, Gloucester GL4 7DE 0452 21591



Features, facilities, setting up and use

There is inevitably some confusion concerning the B & O range of turntables, which are basically all variations on a theme. Internally they derive from one design, but externally the facilities offered can vary, for example, as regards the type of cartridge fitted, the styling or control arrangement.

The *2200* is based on a well-designed floating sub-chassis; it is belt driven and uses a very low mass magnesium die-cast pickup arm. This is used with an integral B&O cartridge, a feature that is in fact common to the older *1102* and *1902* decks recommended in the last edition of *Choice,* and the soon-to-be-released *1500.* It thus follows that all the models in the range exhibit certain basic similarities of performance. The *2200* reviewed here is a fully automatic unit with accessible (with lid down) front-mounted controls and a disc weight detector system. The latter automatically engages 45rpm for singles, with an override included for 45rpm LPs. A new design of *MMC20E* cartridge tracking at 1.5g comes ready fitted in the arm, making for trouble-free assembly, and the unit also proved easy to operate, with an extremely rapid starting cycle. The review sample was in fact an early version with highish lateral arm friction, but B&O anticipate that the fine values measured for the *1900* in the last edition of *Choice* will also become the *2200* production norm.

Both subjective and arm resonance data was recorded as a system, that is with the supplied cartridge, and hence these results are not wholly comparable with the other models, where the standard test cartridge was employed.

Lab performance

The motor section gave very good results for both wow and rumble, and demonstrated fine speed accuracy, stability and torque. Vibration resistance was excellent but the feedback margins were less favourable, and while the acoustic breakthrough curve was fine below 300Hz, it worsened rapidly from 400 to 600Hz, both effects attributable to the light platter and the poorly damped record contact area. However, this problem can be ameliorated by a worthwhile 6dB if the lid is closed when playing a record.

It must be remembered that the arm resonance curve is not directly comparable with the other review models, since the excitation was generated by B&O's own cartridge. Nevertheless, relevant information was provided up to 2kHz; eg: the first mild break at 300Hz with fair energy control thereafter. Biasing was found to be set too high, at double the required value, and B&O should improve this alignment in future production. However the other facilities were all fine, with the geometrical alignment of the fitted cartridge measuring well. At 4g or less, effective mass was very low, and matched perfectly the supplied cartridge, thus providing a stable 12Hz subsonic resonance.

Sound quality

A touch of rumble could be heard, indicating a 'good' rather than a 'very good' rating, but both the wow and hum levels were fine. The bass

RECOMMENDED

register proved both firm and extended, although the midrange was a trifle veiled with some depth loss, and a mild coarseness plus added brilliance was also apparent.

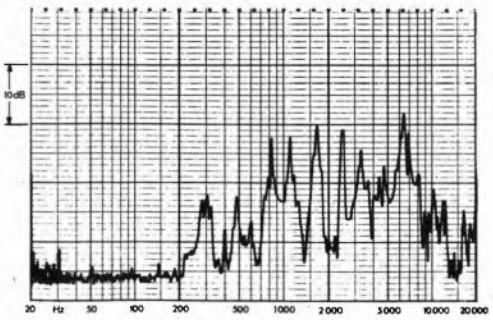
Conclusions

As reported in the previous issue concerning the related *1902,* a significant proportion of the B&O's strength lies in the skilled subchassis suspension and integrated arm/cartridge design. This combination serves to lift the sound quality of the system to into the 'good' category, although this is to some degree based on a preliminary assessment of the cartridge quality, whose properties will be more fully examined in the forthcoming edition of *Cartridges & Headphones.* This aside, while the rating is an achievement considering the price level it also assumes that the minor sample faults discovered, namely incorrect friction and bias settings, will be rectified in subsequent production.

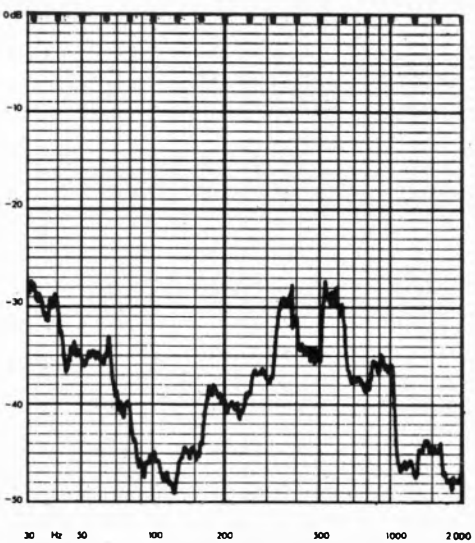
Update

The cartridges mentioned above proved very competent performers in our subsequent reviews. The *2200* will continue to be available for some months, but is due to be replaced by the *2402*. The major change is a new arm type, already used in the *1700* (replacing the *1500*). Examination of an early prototype indicated some cause for concern in respect of arm and bearing rigidity; we understand that this is being dealt with, so while we must advise some caution at present, we hope very much that the intelligent performance balance of the *2200* will be maintained.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic belt drive
Platter mass/damping	0.8kg/adequate
Finish and engineering	good
Type of mains/connecting leads	two core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.06%/0.1%
Speed accuracy/drift/variation under load	–0.1%/<0.05%/–0.02%
Start up time to audible stabilisation	2.7secs
Rumble (av DIN B wtd L/R)	73/70dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	4g est.
Type of headshell	N/A fitted cartridge
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	downforce
Finish and engineering	good
Ease of assembly/setting up	excellent
Friction lateral/vertical (typical)	≏ 100-150mg/50mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/250mg/310mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/1sec
Downforce calibration error 1g/2g	–0.05g/–0.075g
Amount of damping	little (friction)
System as a whole	
Size/rear clearance for lid	44(w) x 36.7(d) x 8.5(h)cm/none required
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	good/fairly good
Vibration or shock sensitivity	excellent
Ease of use	excellent
Estimated typical purchase price	£160



Arm resonances



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

BIC SP75

C. E. Hammond & Co. Ltd., 105–109 Oyster Lane, Byfleet, Surrey KT14 7LA.
Tel. 09323 51051

Features, facilities, setting up and use

The *SP75* is the first BIC model to be assessed by *Choice*, and is manufactured in the US by the British Industries Corporation, whose name derives from their earlier role as the US Garrard agent. A fully automatic belt drive model, the motor was run from a stablised supply and offered fine variation in addition to the two (33⅓ and 45) rpm speeds. Beneath the attached ribbed rubber mat the moderate mass alloy platter was of a skeleton form, and showed a strong resonant mode, namely that of the heavy rim on the thin radial 'spokes.' The light plastic plinth was suspended on spring feet whose resulting resonance was rather high at 18Hz, and provided little isolation. In fact the internal construction showed design provision for a sprung subchassis, but this was bolted up solid.

The gimbal type tonearm had a fixed headshell and exhibited significant play in both bearings. Possessing 'medium' effective mass, its capacitance was fairly high at 185pf, and this may need to be taken into consideration when choosing a cartridge (though the supplied model should be fine). The visual appearance was quite good overall but in fact the controls did not work particularly smoothly — certainly not up to Japanese standards — while the lid was of a rather live resonant variety.

Lab performance

Wow and flutter was satisfactory, although the linear wow figure was on the high side. The speed accuracy (set with the strobe) was good, and the high torque ensured minimal slowing under load, as well as a pretty rapid start up. Drift was satisfactory but the rumble results were not good enough at a typical 58dB, the spectrum containing a static electrical component at 50Hz, with the rest mechanically generated; in fact, the 130Hz 'line' was undoubtedly a motor vibration signal, a harmonic of the rotational speed.

The arm was quite well aligned and proved easy to set up and use. Friction levels were very low and the biasing effective if on the low side; increasing the dial settings by 30% would be about right. Downforce calibration was reasonable and the cue worked well, but the resonance graph showed a well below average characteristic. A resonance appeared as low as 75Hz, probably due to the counterweight, while a severe arm mode was present at 350Hz, which

displaced the mean level by 15dB. Further resonances also occurred in the upper midband.

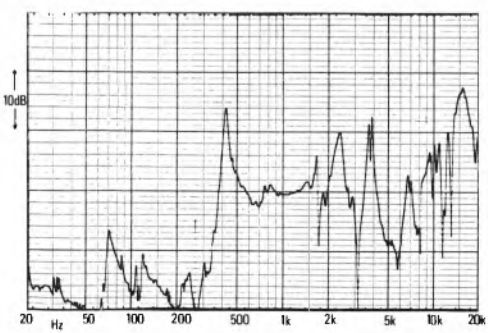
On acoustic breakthrough the *SP75* was judged below average, although it was at least even in balance spectrally. The turntable demonstrated an above average immunity to impact shock, but the vibration isolation was poor, which can be linked to the poor result for acoustic feedback which appeared poorest in the bass region.

Sound quality

Overall the player was ranked below average, and although in context it was not a bad deck, unfortunately the standard it set was significantly bettered by other models in the same price range. Some rumble was audible and the arm lent a 'thinned,' almost 'nasal' quality to the midrange, while the low frequencies were suppressed and the stereo field not particularly well defined.

Conclusion

A recommendation is not possible in view of the as yet unresolved rumble problem, but as we were going to press, we heard that the price of the *SP75* at around £150 will include a Sonus *Black* cartridge. However, our feelings were that even if the price of deck and cartridge were 'separated,' the *SP75* still falls short of several other models in the £125 price range.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

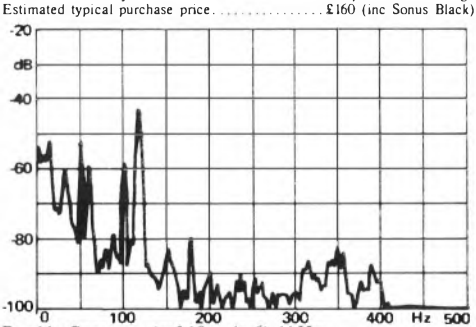
Type	fully automatic stabilised supply belt drive
Platter mass/damping	1.5kg/poor
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.11%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.22%/<0.05%
Absolute speed error	variable/<0.1%
Speed drift 1 hour/load variation	+0.3%/−0.15%
Start up time to audible stabilisation	1.5secs
Rumble: DIN B wtd L/R av (see spectrum)	56/61dB

Arm Section

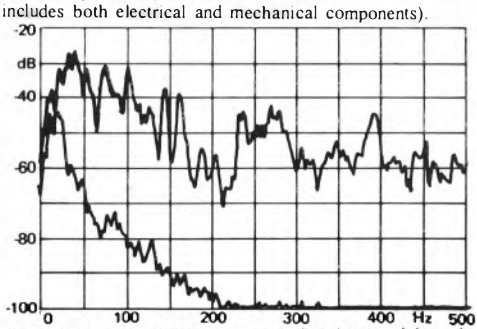
Approximate effective mass inc screws, excl cartridge	12g
Type/mass of headshell	fixed/N/A
Geometric accuracy	good
Adjustments provided	overhang/some lateral angle
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	<20mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/125mg
Downforce calibration error: 1g/2g	−0.15g/+0.15g
Cue drift/8mm ascent/descent	negligible/1.0sec/1.0sec
Arm resonances	poor
Subjective sound quality	below average
Lead capacitance/damping method	185pF/—

System as a whole

Size/clearance for lid rear	47.5(w) x 37.6(d) x 15(h)/4.3cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/poor
Vibration sensitivity/shock resistance	poor/above average
Estimated typical purchase price	£160 (inc Sonus Black)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

BIC SP85

C. E. Hammond & Co. Ltd., 105–109 Oyster Lane, Byfleet, Surrey KT14 7LA.
Tel. 09323 51051

Features, facilities, setting up and use

Bearing a superficial similarity to the *SP75,* the *'85* was in fact quite different as regards its motor control circuitry, with the simple stabiliser of the *'75* replaced by a microprocessor-controlled system actuated from a sealed 'touch pad' array. A digital readout of speed was given, which may be finely tuned by entering the appropriate code on the buttons. However, despite this sophistication the 'program' and cue controls were both rather rough in action, while the digital speed display on our sample flashed periodically; we were unsure whether this was correct. A stop watch function was also included in the digital display system, but in the absence of any directive from the manufacturer, we could only guess at the reason behind its inclusion. Requiring assembly before use, we could not make the unit operate until a plastic sleeve section was removed from the platter spindle – a point not covered by the instructions.

Unlike the *'75,* the tonearm in this model was provided with a detachable tube with a spanner locking collar near the pivots, the headshell proving to be a good design, and well fixed to the carrier tube. However, the arm bearings showed significant looseness in both planes, while the centre spindle which was of less than perfect finish was marginally on the small side, which tended to worsen the wow and flutter. The light plinth with its resonant lid was supported on similar feet to the *'75,* giving a high 18Hz resonance, well above the arm/cartridge range. The platter, as with the *'75,* was not well damped.

Lab performance

In common with the *'75* the rumble levels at a typical 58dB DIN B gave rise to concern. Inspection of the rumble spectrogram showed mainly motor components, for example at 77Hz, 155Hz etc, and the static electrical contribution should be considered separately, these noted at 50, 150 and 250Hz. The combined weighted wow and flutter was satisfactory although the wow reading alone was on the high side. The speed was highly accurate with the opto-electric servo control maintaining speed on load and offering good stability over a long period of time. Conversely, a touch of wow overshoot was present, and the start up time at 3.8 seconds was slow for the platter mass involved.

The tonearm showed a moderate effective mass of 12g, suited to medium compliance cartridges, together with a highish 180pF of lead capacitance. The geometry was good and included all the required adjustments, some of these by headshell rake and tilt, while the removable arm carrier aided setting up and cartridge installation. Bearing

frictions were quite low with the bias nicely judged and just a trifle low, while downforce calibration was reasonable and cue operation fine. The arm resonances differed from those for the *'75* and were somewhat better although still below average with the 250Hz break less severe and the overall picture more tidy; however the 2–10kHz resonance group let the side down.

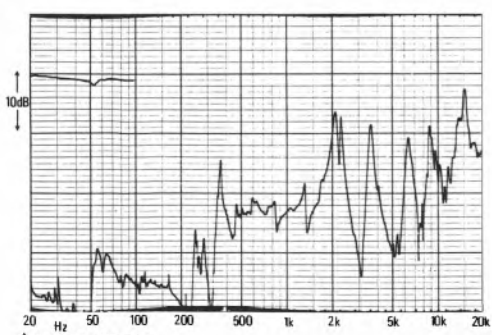
Similar to the *'75*, the acoustic breakthrough pattern was of below average quality, while the poor vibration rejection spectrum was similarly paralleled, the common lid, plinth and foot construction being to blame here. The hum level was just satisfactory, and although shock resistance was above average, the feedback margin was poor.

Subjective quality

For reasons not fully understood but believed to be due to arm differences, the speed control system, and possibly the higher electrical noise level, the *SP85* found even less favour than did the *'75*, being clearly below average. It tended to sound 'loud' – a significant indicator of a 'coloured' quality – while the bass region lacked definition and tended to boominess in the 40Hz range. In other respects however the two BIC models were similar, and mild motor rumble was also apparent on the *85*.

Conclusion

It is possible that both the BIC decks were faulty, but even if the obvious problems, notably the rumble, were cured, the basic design of the *'85* was such that a significant improvement in sound quality would be unlikely to result. Despite the extra facilities offered by the *'85*, the value was no better than for the *'75*, again despite the inclusion of the Sonus *Black* cartridge.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

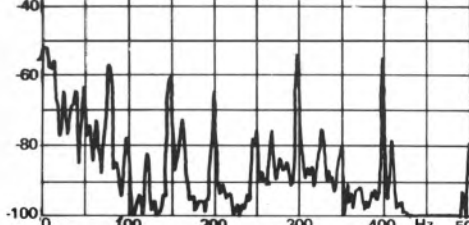
Type	fully automatic servo control belt drive
Platter mass/damping	1.5kg/poor
Finish and engineering	fairly good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.22%/0.08%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	+0.15%/<0.05%
Start up time to audible stabilisation	3.8secs
Rumble: DIN B wtd L/R av (see spectrum)	56/61 dB

Arm Section

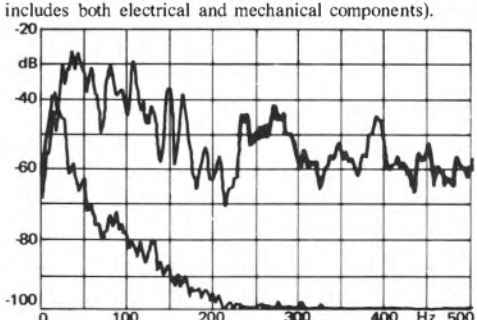
Approximate effective mass inc screws, excl cartridge	12g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	good
Adjustments provided	tilt/overhang/some lateral angle/height
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	30mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/150mg
Downforce calibration error: 1g/2g	−0.15g/<0.05g
Cue drift/8mm ascent/descent	negligible/variable 1sec/1sec
Arm resonances	below average
Subjective sound quality	below average
Lead capacitance/damping method	180pF/—

System as a whole

Size/clearance for lid rear	47.6(w) x 37.5(d) x 15(h)/4.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	satisfactory/poor
Vibration sensitivity/shock resistance	poor/above average
Estimated typical purchase price	£200 (inc Sonus Black)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Connoisseur BD2A

Hacker Connoisseur, Shadsworth, Blackburn, Lancs BB1 2PT. Tel. 0254 53525

Features, facilities, setting up and use

A model bearing this type number was reviewed in the last issue but since then sufficient changes have been made to warrant a reappraisal, notably to the lid assembly, the plinth structure, and most important of all, the feet suspension system, whereby the awkward torsion bar which proved easy to misalign has been replaced by a rubber and coil spring damper arrangement. The least expensive of the Connoisseur models (with the exception of the *BD1* chassis and kit unit), this deck may also be obtained without the auto-stop, the model number then dropping the *A* suffix. A belt drive unit, the synchronous motor was coupled to the undersize platter *via* a long rubber cord, the motor itself flexibly suspended to reduce vibration coupling to the plinth and arm; however, as with the last model the plinth resonances were still too high at 11Hz lateral and 21Hz vertical.

Criticised in the last issue on grounds of inferior finish, this time round the standard was a little better, although the vinyl plinth covering was showing signs of peeling, and glue contamination was evident on the tinted lid around the hinge support fixings. A stylus gauge of sufficient accuracy was supplied. Upon inspection, play was apparent in the arm bearings, and the plastic headshell did not fit very firmly into the special arm socket. The arrangement for bias compensation, comprising a gravity lever, could not be set to suit tracking forces below 1.5g, and was also uncalibrated. The control gimbal bearing design which facilitated biasing correction also had the effect of producing a vertical tilt in the headshell mounting plane which was dependant on the bearing angle. Consequently the geometry was not constant over disc warps, but conversely, this feature could be exploited to provide effective tilt adjustment *via* pillar height.

Lab performance

The moderate mass platter was quite well damped by a soft rubber ribbed mat, although the whole surface of an LP disc was not supported. While wow and flutter was adequate at a weighted 0.19%, it was worse than for last year's sample; on the plus side, the torque was high with a rapid start and good speed accuracy. The DIN weighted rumble averaged 68dB which is quite satisfactory and is unlikely to prove audible except under the most taxing conditions. The steel chassis helped to produce quite low levels of electrical noise, and the rumble spectrum was entirely composed of mechanical running noise components: Those at 50, 100 and 200Hz were mains frequency vibrations from the motor frame, while others were proportional to the rotational frequency, and the 150Hz-300Hz range did contain more rumble than usual.

Clearer low frequency resonance traces were obtained for the arm as compared with our last examination, allowing a more accurate estimate to be made of the arm effective mass at 13g — a medium value. Load capacitance measured 140pf, and arm bearing friction could have been lower, with the 80mg lateral value high enough to cause errors in the bias compensation. The latter

was reasonable, although the variation ratio was in the inverse direction. Using the applied stylus scale, downforce accuracy was reasonable. Rated as average on arm resonances, the arm was not very rigid with a strong break at 200Hz, but conversely the overall picture showed quite good tube damping, which is a help.

On acoustic breakthrough the graph was pretty average but fortunately free of serious peaks. The vibration isolation was about 'average' thanks to the new feet, the deck also proving quite resistant to external impact shock as well as to feedback in the test location.

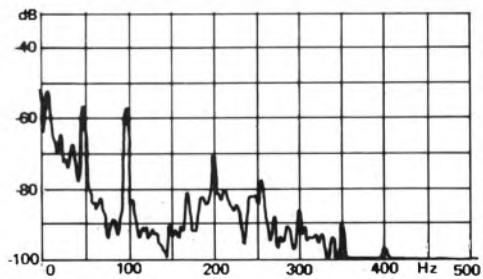
Sound quality

Quite favourably received despite the lab assessed problems, the *BD2A* was rated above average on sound quality which is rather promising at the price. Compared with other models costing around the same, the bass register was cleaner and the sound balance more even, with better detail, while the treble was quite sweet if a little vague.

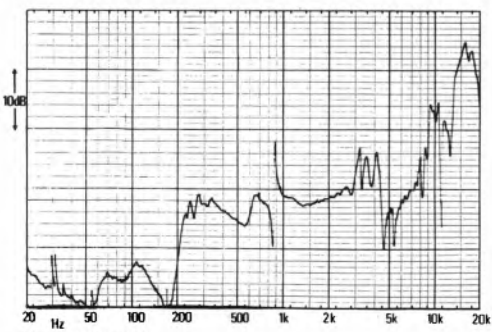
Conclusion

We still have some reservations concerning quality control and finish on this model, but feel that with attention to detail on the part of the manufacturers, a good value rating should be possible, at least with respect of sound quality *vs* price.

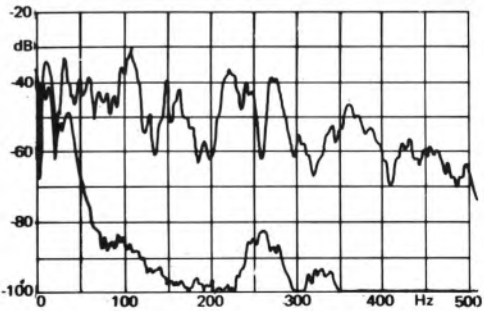
GENERAL DATA	Integrated Turntable
Motor Section	
Type	belt drive, auto switch off
Platter mass/damping	1.3kg/good
Finish and engineering	fair/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.19%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.23%/0.1%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	synchronous/−0.15%
Start up time to audible stabilisation	1.3secs
Rumble: DIN B wtd L/R av (see spectrum)	66/71dB
Arm Section	
Approximate effective mass inc screws, excl cart	13g
Type/mass of headshell	special detachable plastic shell/8.5g
Geometric accuracy	fairly good
Adjustments provided	height/overhang
Finish and engineering	fairly good/fair
Ease of assembly/setting up/use	good/fairly good/good
Friction: typical lateral/vertical	80mg/40mg
Bias compensation method	gravity lever set minimum
Bias force: rim/centre (set to 1.5g elliptical)	approx 200mg/approx 175mg
Downforce calibration error: 1g/2g	0.08g/0.12g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.2secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	140pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	45.7(w) x 39(d) x 16.1(h)/6.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	above average/very good
Estimated typical purchase price	£70



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Connoisseur BD102 (BD101+SAU2)

Hacker Connoisseur, Shadsworth, Blackburn, Lancs BB1 2PT. Tel. 0254 53525

Features, facilities, setting up and use

The *102* is a *BD101* with an integral arm, in this case the *SAU2*, which was also fitted to the *BD2A*. In the last issue we encountered problems with the *101* and Connoisseur outlined the extensive design revisions that have taken place, these including the fitting of the new spring feet described in connection with the *BD2A*. The original model possessed a motor which was positioned rather near to the cartridge, thus producing electrical hum problems. Although this has now been moved to the opposite deck corner, the rumble spectrogram did not in fact show the expected improvement in the hum periodic component, and what was worse still, the overall rumble reading was actually poorer.

Fitted with a full size platter and rubber mat, an integral inner drum (accessible *via* a plate in the platter) carries the rubber belt drive. As with the *BD2A*, the motor was a synchronous type offering two fixed speeds selected via a rotary control, but in this case the rigid steel plate chassis of the *BD2* is not employed, and as a result the deck showed different acoustic breakthrough properties. The lid, of rather resonant plastic, was not very well finished, particularly around the rim, while the friction stays were untidy, and the controls were not pleasant to operate. Finally, on our sample the serial number tag scraped on the undersurface of the platter and had to be removed.

Lab performance

Wow and flutter was fine with a good balance of unweighted separate wow and flutter contributions. The platter ran 0.2% slow which would not be particularly important if the torque were sufficient to maintain speed under load, but in fact the dust bug added 0.4%, giving a total of -0.6%. The only 'fair' weighted rumble figure has been noted, this averaging 66dB, the spectrogram showing significant energy in the 200-300Hz range, together with mechanical hum and other contributions.

The same *SAU2* arm is used here as on the *BD2A*, so the results of this sample will only be briefly covered, to note that the biasing and friction were similar to the *'2A*, but cue rates were faster.

The acoustic breakthrough just made the average grade and showed some peakiness, notably at 90 and 230Hz, but conversely the vibration breakthrough was rather better and rated

as above average. Shock and feedback vibration were also quite good, while the plinth resonances were fairly low at 7Hz lateral and 12Hz vertical.

Sound quality

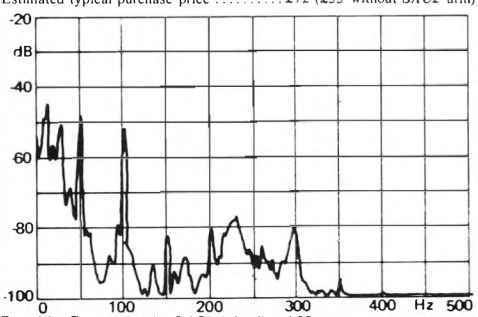
Essentially similar to the *BD2A*, the motor rumble was a trifle more obtrusive indicating an average rating.

Conclusion

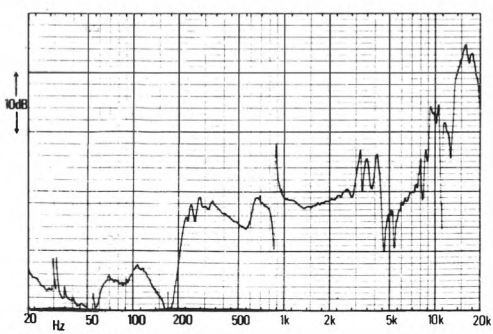
As with many turntables in this report the plinth suspension resonances overlapped or even appeared above the likely range for the arm/cartridge combination. Excitation of the plinth mode from external shock and bass feedback is thus guaranteed to disturb the tracking cartridge by common excitation of its own resonance mode.

While the sound quality of the *BD102 (SAU2)* was reasonable, we continued to be disturbed by the quality control, finish and feel of the product. This is in fact the third consecutive issue where complaints of this nature have been laid at the door of this manufacturer.

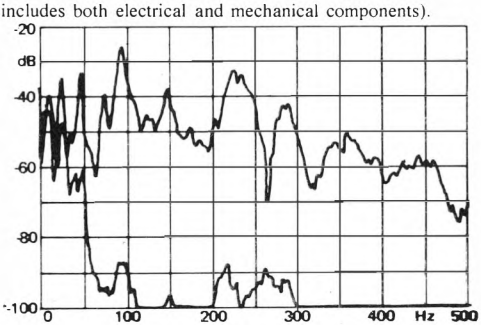
GENERAL DATA	Integrated Turntable
Motor Section	
Type	belt drive, auto switch off
Platter mass/damping	fair/fairly good
Finish and engineering	fair only/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.11%/0.06%
Absolute speed error	−0.2%
Speed drift 1 hour/load variation	synchronous/−0.4%
Start up time to audible stabilisation	2.5secs
Rumble: DIN B wtd L/R av (see spectrum)	65/66dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	special detachable/9g
Geometric accuracy	fair
Adjustments provided	overhang/lateral angle/height
Finish and engineering	fairly good/fair
Ease of assembly/setting up/use	good/fairly good/good
Friction: typical lateral/vertical	<75mg/<50mg
Bias compensation method	force lever set to minimum
Bias force: rim/centre (set to 1.5g elliptical)	approx 200mg/approx 175mg
Downforce calibration error: 1g/2g	approx 0.1g/0.1g
Cue drift/8mm ascent/descent	negligible/0.5secs/0.9secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	140pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	45.8(w) x 36.2(d) x 16.1(h)/5.9cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	adequate/good
Vibration sensitivity/shock resistance	above average/very good
Estimated typical purchase price	£72 (£55 without *SAU2* arm)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Connoisseur BD103 (SAU4)

Hacker Connoisseur, Shadsworth, Blackburn, Lancs BB1 2PT. Tel. 0254 53525

Features, facilities, setting up and use

The *BD103* represents Connoisseur's top line model, fitted with the same new spring feet noted in the *BD2A* review, as well as the more expensive Connoisseur *SAU4* arm. The latter is a unipivot type employing the same headshell fixing and counterweight as the *SAU2*, but qualifying for a slightly lighter and more rigid headshell in perforated aluminium (this is an optional extra on the *SAU2*). Superficially the resemblance to the *102* is close, but the motor in the *103* was a direct current type run from a separate power supply, the latter of disappointingly poor finish and appearance. The speed control system provided $33\frac{1}{3}$, 45 and 78rpm as well as fine variation, but with a fairly diffuse reflection stroboscope supplying the reference, *via* a mains illuminated neon lamp.

The controls were mounted on a small panel and were not at all well engineered; in particular the speed selector was rough in action. An inspection beneath the chassis revealed a microswitch array, but the tolerance of the Connoisseur built connecting levers was just not good enough to provide a confident action. The feet gave a pair of resonances at the same frequencies as the *BD2A*, namely 7Hz horizontal and 12Hz vertical, these rather too close for comfort to the likely arm/cartridge value.

A small bubble spirit level was provided on the arm boss to aid alignment, and Connoisseur's own type of multiple arc protractor was not felt to be as effective as the traditional parallel line type. Neither bias nor downforce were calibrated on the *SAU4*, but a simple balance was supplied and the instructions proved quite accurate for an estimated bias correction at the test 1.5g value. Interestingly enough, while the effective mass of the arm was barely lower than for the *SAU2*, the lead capacitance was considerably higher at 250pf, and will require considerations of compatibility with certain cartridges.

Lab performance

The wow and flutter was satisfactory if not inspiring. However the speed control servo was clearly not optimised, for although the flutter was fine, the combined weighted reading was dominated by fairly high pure wow of 0.28%. Start-up was fine at 2 seconds, but the deck ran slightly fast off-load with the speed drift at 0.5% being greater than usual and the speed variation under the dust bug worrying at +/–1%. This load was in fact taking the motor into a torque region where it was beginning to 'hunt.' The rumble figures were fine. with a very low mains related

content, and the 50Hz line representing electrical induction *via* the cartridge and cables, but little else proving of significance.

The arm finish and fit of the parts was disappointing, but in fact it operated well with very low friction levels and appropriate bias compensation, although the cue action was rather slow at 5 seconds ascent and 3 seconds descent. Judged average on arm resonances, the headshell coupling was not very rigid, this mode evident at 180Hz (the 50Hz break is the rubber-decoupled counterweight.) Further resonances occurred, although of a reasonably tidy nature.

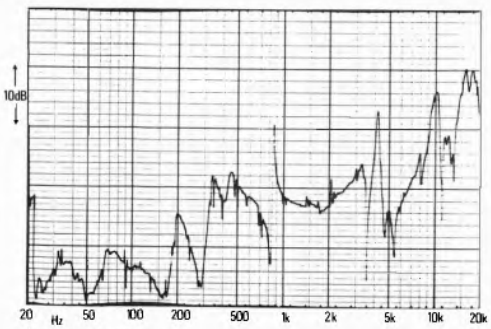
On acoustic breakthrough the unit was felt to be a little above average, but was poorer than the *102* on vibration, recording a just 'average' rating, probably due to variations in the effectiveness of the rubber isolating feet. Shock and feedback resistance were fine.

Sound quality

Scoring a little above average, overall the *BD103* was felt to offer a more accurate sound quality with respect to the arm contribution than the *BD102*. Rumble noise was entirely absent, and at the 1.6g test cartridge downforce, tracking was stable and wow not really significant except on the most critical of passages.

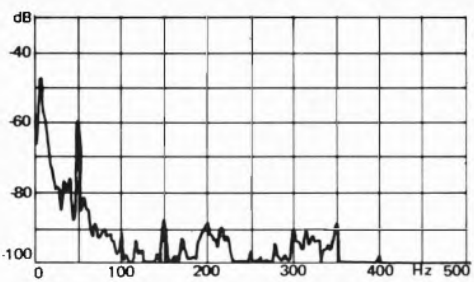
Conclusion

The wow problems we encountered were probably atypical, being absent from our previous review model, and this versatile deck was certainly not without merit; however it clearly still suffered from certain quality and finish problems which are difficult to ignore at this price level.

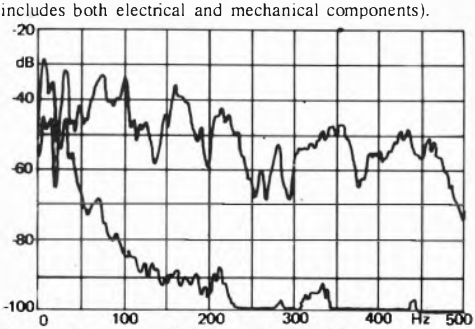


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	belt drive, auto switch off
Platter mass/damping	1.9kg/fairly good
Finish and engineering	fair/fairly good
Type of mains lead/connecting leads	2 core pwr unit with built-in connector /phonos + earth
Speed options	variable, 33⅓, 45, 78rpm
Wow and flutter (DIN peak wtd sigma 2)	0.13%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.28%/<0.05%
Absolute speed error	approx 0.3%
Speed drift 1 hour/load variation	approx 0.5%/±1%
Start up time to audible stabilisation	2secs
Rumble: DIN B wtd L/R av (see spectrum)	74/75dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	12g
Type/mass of headshell	special detachable metal shell/8g
Geometric accuracy	good
Adjustments provided	height/overhang/lateral angle
Finish and engineering	fair/fair
Ease of assembly/setting up/use	fairly good/fair
Friction: typical lateral/vertical	<15mg/<15mg
Bias compensation method	thread and weight — no pulley
Bias force: rim/centre (set to 1.5g elliptical)	150mg/170mg
Downforce calibration error: 1g/2g	−0.1g/−0.05g
Cue drift/8mm ascent/descent	negligible/5secs/3secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	250pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	45.8(w) x 39(d) x 16.2(h)/6.0cm
Ease of use	only fair
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	excellent/good
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£100



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

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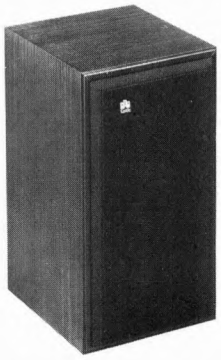
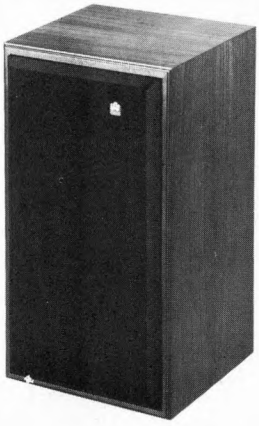
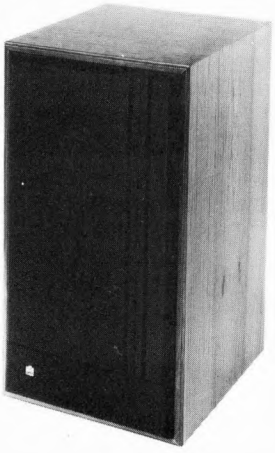


Richmond II
Efficient, two-way speaker system.
For use with amplifier power ranging between 8–30 watts per channel
Incorporating 3.5–20 kHz treble unit and a 15 cm 55–3500 Hz bass/mid-range unit



Kendal II
Efficient, two-way speaker system.
For use with amplifier power ranging between 8–40 watts per channel.
Incorporating 3.5–20 kHz treble unit and a 20cm 48–3500 Hz bass/ mid-range unit.



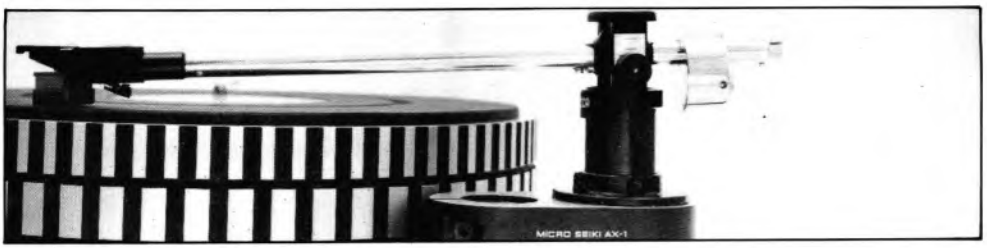
Conway II
Floor standing, three-way system.
For use with medium power amplifiers between 25–100 watts per channel.
Incorporating 4–2.2 kHz treble unit, 750–4000 Hz mid-range unit and heavy duty 21cm 35–750 Hz bass unit.

Castle Acoustics Limited

Shortbank Road,
Skipton, North Yorkshire
Tel: Skipton (0756) 5333

(revised & reprinted) **Decca International**

Decca, Decca Special Products, Ingate Place, Queenstown Road, London SW8 3NT.01-622 6677



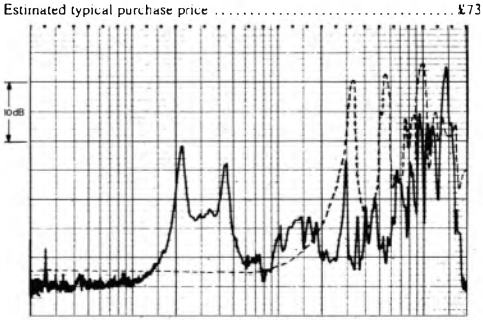
Compared with the standard set by most of the models in this survey, the finish and engineering of this fairly expensive arm were definitely below par. Extensive use has been made of a black plastic which marks easily and visibly distorts under normal adjustment; for example, the arm pillar fixing ring when under tension from the locking grubscrews. While high rigidity is usually to be preferred at the pivot, the Decca offered a damped magnetically-suspended plunger arrangement under the unipivot mount, with significant play in both horizontal and vertical planes. In addition the downforce and lateral balance adjusters were none too secure, and in use could rattle. The special plastic headshell comes from Connoisseur, using their unique socket arrangement, and carries a spirit bubble to aid levelling. An effective magnetic bias compensator was incorporated, but unfortunately could not be adjusted to the lowest settings when used with low profile turntable platters such as the Michell *Focus*.

Lead-out wire torque compromised the friction measurements, but despite this problem the values were acceptably low, and the magnetic bias system ensured that no further friction was added. Downforce calibration was just over 10% low and biasing 60% high, but fortunately in the correct ratio. Full geometrical adjustment were possible to a good standard of accuracy, but the arm resonance graph showed a fairly serious pair of resonances at 220 and 440Hz, with an energy loss beyond 15kHz. However, these two regions apart, the behaviour was quite good, with only moderate amplitude peak-to-trough resonances. Despite damping, the subsonic resonance had a double mode with the fundamental suppressed and only detectable on the crosstalk response (indicative of a unipivot rocking mode.)

Due to the upper subsonic resonance, the output was 3dB high at 20Hz with the test cartridge, as compared with the 1-2dB typical of the other arms. This perceived during the listening tests as a 'heavy' quality to the frequency balance. However, an overall good sound quality rating was attained, the sound appearing quite rich and pleasant, although slightly muddled in the bass and with a touch of mid forwardness giving a 'loudness' effect. Some loss of stereo focus was also noted.

This arm was found to work well with the Decca 'Gold' cartridge, the almost clinical sharpness of the latter balancing the arm's 'rich' qualities and resulting in a very good combination. Irrespective of this, however, its sound quality rating would in any case have ensured that this model merits consideration.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	12.0g
Type of headshell	special detachable/(Conoisseur)
Headshell mass (inc screws)	9.5g
Geometric accuracy	good
Facilities for adjustment	height, tilt, overhang, damping
Finish and engineering	fairly good
Ease of assembly/setting up	fairly good
Ease of use	fair
Friction lateral/vertical (typical)	60mg (bias)/45mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/200mg/300mg
Cueing: drift/8mm ascent/8mm descent	no cue fitted
Downforce calibration error 1g/2g	–0.125%/–0.25%
Amount of damping	moderate
Arm resonances	average
Subjective sound quality	good
Motor recommended	N/A
Estimated typical purchase price	£73



Arm resonances (compared to cartridge resonances, dotted).

Denon DP2500

Denon, Eumig (UK) Ltd., 14 Priestley Way,
London NW2 7TN. 01-450 8070

Features, facilities, setting up and use

Based on the latest Denon *DP2000* quartz lock direct drive motor unit, the *DP2500* represents the complete unit, while a further version is also available with plinth but without arm, designated the *DP2550*. Both the motor and the arm on the *'2500* were superbly engineered and finished, the motor being an outstanding example of a linear torque ac drive, using magnetic pulse error detection with excellent servo characteristics, an internally generated flicker free strobe, plus electromagnetic braking for speed change and stop. The first sample, which was an ex-dem unit possessed a faulty main bearing and incorrect 45rpm speed; the second model suppled was fine, and gave the majority of the results recorded below. In common with many other decks, the anti vibration isolation feet were not particularly effective, the typical plinth resonance was unfortunately on the wrong side of the arm/cartridge resonance at 12Hz. The arm incorporated Denon's own vibration absorber, consisting of a rubber damped flexible tube joint between the arm section tube and pivot section (see also *DA307, DA309*), and the platter was well damped by a sensible mat with good record contact. It should be noted that the manufacturer's *A* suffix does not denote any extra facilities, but is merely a means of differentiating between plastic veneer finishes; light ash where the *A* suffix applies, and walnut where it does not.

Lab performance

Both rumble and wow and flutter results were beyond reproach, while torque was also excellent and no overshoot was present. Quartz lock ensured near perfect speed accuracy. Very good hum levels were noted although vibration resistance was only adequate, but the heavy construction and good quality lid gave a 'good' feedback margin, agreeing with the fairly good curve for acoustic breakthrough, the latter showing some weakness in the 50-80Hz range.

Despite the tube decoupling no subsonic damping was detectable on the arm, while the light magnesium headshell helped to keep the effective mass at an estimated 9.5g. Arm resonances were non too promising, with the graph showing a damped mode at 20Hz, a severe one at 600Hz, and fairly serious additional resonances thereafter. A rapid energy fall also occurred above 10kHz, (note that for this graph the cramped scale places the 20kHz point at 10kHz.) Geometry, biasing, downforce and friction were all judged as very good, and cue operation fine.

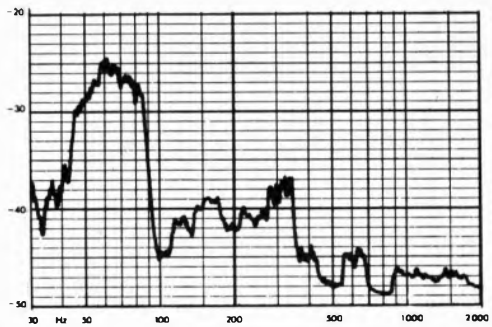
Subjective quality

As might be expected from the lab results, neither wow nor rumble effects were audible. Overall the sound quality was rated as 'average' which is rather disappointing considering the high price level. A degree of upper bass emphasis was noted, probably related to the high level in the breakthrough graph, together with an attendant suppression of low bass. The midband was mildly coloured with a veiling of depth and detail, though at higher frequencies the balance moved to the bright side. Stereo imaging was vague, which we

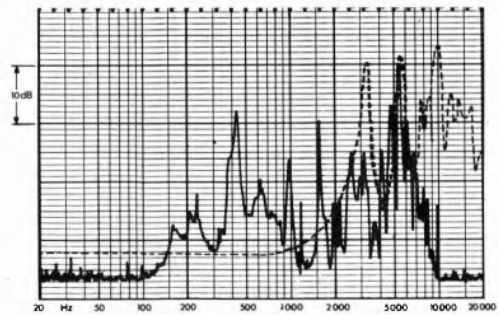
feel is attributable to the flexible joints provided for the arm pillar and tube. It is likely that the motor section alone, partnered by a suitable arm and mounted on a structural wall shelf, would perform rather better subjectively.

Conclusions

Considering the price bracket no recommendation can be made; while this is an excellently engineered product, insufficient attention has been paid to questions of vibration feedback and arm coloration. Used optimally however the motor unit (*DP2550*) merits recommendation.



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).



Due to 45 rpm sample error frequency scale is compressed, 20kHz → 10kHz and *pro rata*.
Arm resonances (compared to cartridge resonances, dotted).

GENERAL DATA Integrated Player, components available separately

Motor Section

Type	manual, quartz direct drive
Platter mass/damping	1.55kg/very good
Finish and engineering	excellent
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.06%/ 0.07%
Speed accuracy/drift/variation under load	quartz/quartz/0%
Start up time to audible stabilisation	1.3secs
Rumble (av DIN B wtd L/R)	75/76dB

Arm Section

Approximate effective moving mass (excl cart, inc screws)	9.5g
Type of headshell	universal detachable
Headshell mass (inc screws)	7g
Geometric accuracy	very good
Facilities for adjustment	height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	40mg/ 10mg
Bias comp: type/force rim/centre (1.5 ell set)	spring/190mg/150mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/3.5secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none

System as a whole

Size/rear clearance for lid	48.6(w) x 40.3(d) x 17.6(h)cm/4cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£250 (2550 motor £220)

Denon DA307 & DA309 tonearms

These two arms are very similar to each other, and share the unusual feature of a 'lossy' decoupling 'vibration absorber' between the arm tube and bearings like the arm fitted to the *DP2500*. While this system may be of some benefit under 'difficult' operating conditions, with our listening tests results were less encouraging, with a degree of vagueness and lack of precision noted, though the £120 *307* was considered better than the £110 *309*.

Both arms fall into the 'medium mass' category, the *307* at 10g and the *309* at 13g, which is quite modest for models possessing universal detachable headshells. Furthermore both possess an unusually large total pillar height, which may prove difficult to accommodate.

RECOMMENDED

Dual 506

Dual, Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont St. Peter SL9 9EW. 02813 88447

Features, facilities, setting up and use

The new Dual *506* has one notable difference when compared with its predeccesor, namely the inclusion of a *ULM* (Ultra Low Mass) cartridge assembly. In fact, the arm has been redesigned to accommodate a special clip-in version of the new Ortofon type miniaturised models, that fitted to the *506* being the *ULM45E*, which is a good quality 1.5g downforce model, with an elliptical tip and weighing a miniscule 2.3g. If required, the supplied cartridge can be removed and a small bracket fitted to the arm to accept another type. Of course doing so means that some of the benefits of the integrated low mass design are lost, but even so the effective arm mass still turned out to be quite low, so the arm is thus potentially suitable for fairly high compliance cartridges.

In the Dual tradition, the *506* was built on a steel plate chassis resting on damped coil springs, being thus mechanically isolated from the lid and plinth. A manually operated belt drive model, the motor in the *506* was a constant speed synchronous type, with fine variable speeds afforded by a clever variable diameter motor pulley, and a rim stroboscope providing a speed reference. (A fully automatic version is also available at a slightly higher cost, designated the *522*.)

The platter was quite light and was fitted with a thin mat which afforded only moderate damping; disc support was small due to two ring contact points only. The first sample we tested gave marginal results for the DIN rumble, and although I was sceptical when the importers suggested that the counterweight (a resonator assembly) might be responsible, in fact this was fully confirmed when a new counterweight was fitted, resulting in an effective improvement of the rumble reading. It transpired that the motor produced a significant vibration component at 100Hz which was partially cancelled in the arm by means of an anti resonance in the counterweight at the same frequency, and our first counterweight was simply mistuned. Theoretically the addition of a resonant structure to a tonearm is not the best way to solve a rumble problem, and I suspect that Dual will soon cure the rumble at source.

Lab performance

While some weave was evident at the rim of the rotating platter, the main bearing was of good engineering quality, and fine wow and flutter results were recorded. The speed was accurate and stable and gave acceptable slowing under dust bug loading, with start up fairly rapid at 2 seconds. The rumble problem has already been noted, with the original result averaging 62dB DIN B, improving to nearly 70dB with the second sample.

Arm mass was low at 7g with the lead capacitance at 175pf, but presumably with the supplied cartridge the usual 400pf Ortofon loading is required, so the matching amplifier needs some consideration, and a little additional capacitance may be required. On the whole the arm was above average, being well engineered although the bearings were a little slack. Friction was satisfactory, biasing very good and geometry

RECOMMENDED

and alignment fine. Numerous resonant modes were displayed, but most were well controlled with the main beam mode at 320Hz being the most serious. The mis-tuned counterweight of the first sample was visible at 70Hz, but this was the only feature to alter on fitting the new counterweight, and an average rating for resonances was the result.

While the suspension springs were possibly overdamped, the chassis resonance was quite low at 7Hz, mainly in the lateral plane, and well spaced below the supplied arm/cartridge resonance. In consequence the acoustic breakthrough results were good although the vibration isolation was just average. Feedback and shock resistance were however considered better than average.

Sound quality

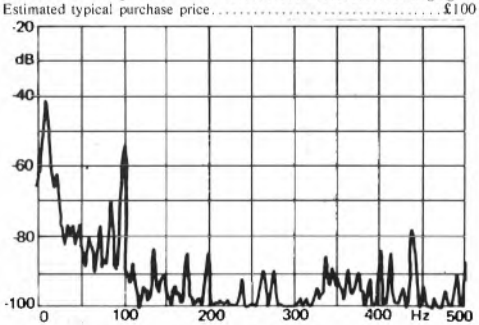
Ranked above average, the *506* sounded pleasant in the treble registers and was quite neutral, with reasonably good bass and fairly good stereo image position and depth.

Conclusion

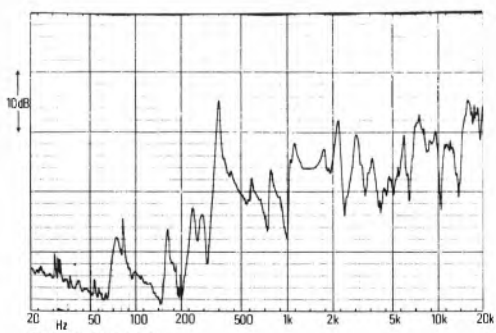
Despite the rumble problems first encountered, no rumble was in fact audible with the second sample, and the general quality, taking into account the inclusion of an accurately fitted compatible cartridge worth probably £15.00 or so, means that the *506* is worthy of recommendation.

GENERAL DATA — Integrated Turntable

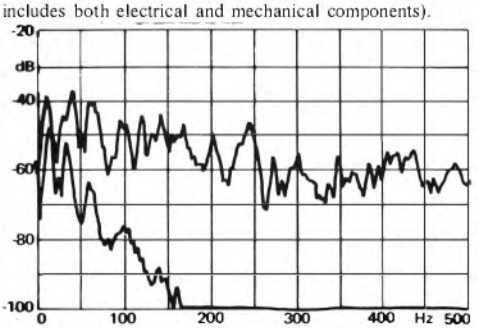
Motor Section	
Type	manual belt drive
Platter mass/damping	1.1kg/fair
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.09%/0.065%
Absolute speed error	variable, +0.1%
Speed drift 1 hour/load variation	synchronous/−0.4%
Start up time to audible stabilisation	2.0secs
Rumble: DIN B wtd L/R av(see spectrum)	(2nd sample 69/70) 59/64dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	7.0g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	both very good/very good
Friction: typical lateral/vertical	50mg/<10mg
Bias compensation method	spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	195mg/250mg
Downforce calibration error: 1g/2g	−0.1g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.6secs/0.9secs
Arm resonances	average
Subjective sound quality	above average
Lead capacitance/damping method	175pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	42(w) x 36.5(d) x 15(h)/5.0cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£100



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

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Hayden Laboratories Ltd.

Hayden House, Churchfield Road, Chalfont St. Peter, Bucks SL9 9EW. Telephone: Gerrards Cross (STD 02813) 88447

HAYDEN

Dual 606

Dual, Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont St. Peter SL9 9EW. 02813 88447

Features, facilities, setting up and use

The *606* represents another *ULM* model, and was fitted with an almost identical arm to that of the *506*, but in this case the fitted cartridge was an Ortofon *ULM 55E*. The latter possessed a comparable specification to the *45E*, but with fractionally lower output at 0.7mV/cm/sec, and a slightly reduced IM distortion at a 1.5g downforce of 0.8% (as compared with 1% for the *45E*.) This manual direct drive model was fitted with a moderate mass pressed platter of poorer than average edge-weave and centration, although the steel chassis/deck plate gave a reasonably low suspension resonance of 6Hz on its damped coil springs. Once again, with this technique lid-borne feedback was not coupled to the arm, thereby reducing acoustic breakthrough. Not quartz locked, the motor offered two speeds plus fine variable control with the usual mains illuminated strobe reference, and as with the *506*, an automatic version is also available at a slightly higher price (*626*).

The effective mass of the arm read 7g, but this was taken in conjunction with the test cartridge and mounting plate, and it is estimated that the entire effective mass with ULM fitted is barely greater, thereby endowing the system with good stability and a sensibly high subsonic resonance, together with the attendant benefits of the highish compliance cartridge supplied.

Lab performance

A good wow and flutter result was recorded despite a higher than average wow only figure. Speed accuracy and stability were fine, with the slowing under load negligible despite the moderate torque output, the latter offering a 3.5 second start up. A trace of wow overshoot was detected but was not considered to be subjectively significant, while the weighted rumble reading was quite acceptable at an average 72dB. Part of this was due to static electrical induced breakthrough in the test cartridge output, although other motor components were also present — for example at 36, 72 and 140Hz, with the 60Hz line probably representing a resonance effect traceable to the tonearm.

The arm itself proved well adjusted and aligned, with low pivot frictions, and the biasing was effective, adding no additional friction; however, on our sample it did give rim/centre values in the

inverse ratio, although of about the right sort of magnitude. Downforce calibration was fairly accurate and cue drift negligible, with sensible rates. Despite the 60Hz counterweight mode, the tidy and relatively continuous nature of the arm resonance curve merited an above average rating, and with the supplied cartridge the excitation of those resonances will in fact be less, due to its lower mechanical resistance by comparison with the lab test model (a Dynavector *10X*).

Judged good on acoustic breakthrough, the *606* improved on the *506* vibration isolation by achieving an above average rating, some 10dB better, for example, at 100Hz. Both feedback and impact shock resistance were well above average.

Sound quality

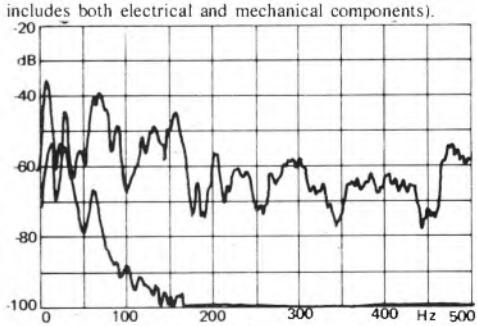
Despite our misgivings concerning the quality of the platter mat, the *606* rated above average, and sounded quite similar to the *506*, but offered marginal improvement in stereo focus and bass clarity, although these differences were in fact small. We wondered whether a simple counterweight rather than the *506* resonator type would have effected a further improvement?

Conclusion

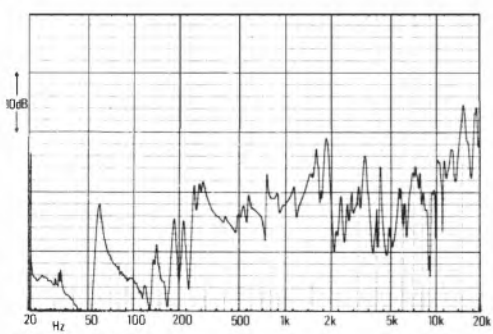
In many respects this turntable was above average, which finding largely justifies its price. The inclusion of a modern and fully compatible cartridge was an attractive feature, and if the sound of this component meets with your approval, then the *606* is well worth considering (this recommendation of course also holds true for its automatic *626* brother.)

GENERAL DATA	Integrated Turntable
Motor Section	
Type	direct drive
Platter mass/damping	1.40kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.06%
Absolute speed error	+0.15%
Speed drift 1 hour/load variation	<0.15%/−0.05%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	71/73dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	7g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	20mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	250mg/175mg
Downforce calibration error: 1g/2g	−0.1g/−0.15g
Cue drift/8mm ascent/descent	negligible/1.8secs/0.8secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	175pF/acoustic weight in c/w
System as a whole	
Size/clearance for lid rear	42.5(w) x 37(d) x 15.5(h)/5cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/above average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£145

Rumble Spectrum (ref 10cm/s @ 1kHz: includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Dual 731Q

Dual, Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont St. Peter SL9 9EW. 02813 88447

Features, facilities, setting up and use

A top line model from Dual, the *731Q* was a quartz locked direct drive deck fitted with an upmarket *ULM* cartridge, in this case a *60E*. Rated at a lg downforce, a high compliance stylus assembly (c.35cu) was fitted with an elliptical diamond. The arm was more massive by comparison with that on the *506/606* models, and when equipped with the accessory brackets needed for cartridges other than the model supplied, it gave a fairly high effective mass of c.17g. However a significant saving was shown by using Dual's special adaptation of the *60E* cartridge, this giving a total effective mass of about 8g including cartridge, which is quite compatible with the stylus compliance (resonance at c. 8Hz.). The arm was fitted with a tuneable subsonic anti-resonator, intended to damp the arm/cartridge subsonic resonance, but in fact using our test record for lateral modulation, we found it to have very little effect on the subsonic resonance amplitude.

The *731Q* was fully automatic in operation, although speed change was of course manual. The platter had strobe edge markings illuminated by an accurate internally referenced lamp, while the quartz lock on the two fixed speeds may be disengaged to allow fine speed control. An LED indicator panel showed the speed deviation and this and the other 'soft touch' controls were built into the angled front of the plinth, allowing full operation with the lid closed. A steel chassis/deck plate was employed mounted on coil spring isolators, with a 6.5Hz or so resonance — favourably below that of the arm/cartridge figure.

Lab performance

Excellent wow and flutter results were obtained with fine speed accuracy and stability. The quartz lock assured negligible speed loss under load, while the high torque resulted in a rapid 1.5 second start up. At typically 76dB DIN B weighted, the rumble results were also very good, the spectrogram revealing electrical components at 50 & 150Hz, but with the remainder motor generated, as at 45, 110 and 200Hz.

Clearly optimised for the special *ULM* cartridge, the arm's effective mass was suprisingly high at 17g when fitted with a 'standard' mounting; there was substantial lead capacitance of 180 pf. The arm was well engineered with firm bearings, and was accurately aligned in geometric terms, but it only provided adjustments for overhang and lateral

angle; at this price level one might have expected more.

The headshell assembly was not very rigid, particularly as regards torsion, the arm resonance curve confirming the latter judgement, being noticeably poorer than for the cheaper Duals. A vertical counterweight mode was present at 45Hz with the 200Hz flexure severe and serving to break the energy trend rather strongly. The output was also rather peaky at 2kHz, with the overall rating just 'average'. On the other hand, the arm did show excellently low friction, good bias correction and quite accurate downforce, the latter reading a little low. Acoustic vibration was well above average at 'good', with hum levels fine and the feedback and impact shock resistance both good.

Sound quality

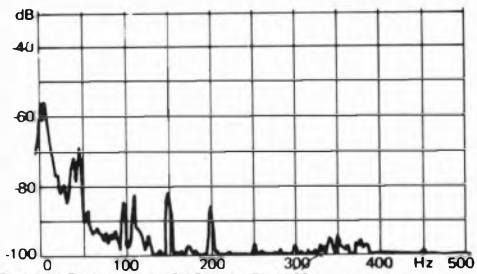
Rated a little above average, this result was a trifle disappointing considering the price level. It was felt that the main weakness concerned the arm coloration, as otherwise the turntable did well, providing a reasonably extended firm bass, stable tracking and quite precise stereo imaging.

Conclusion

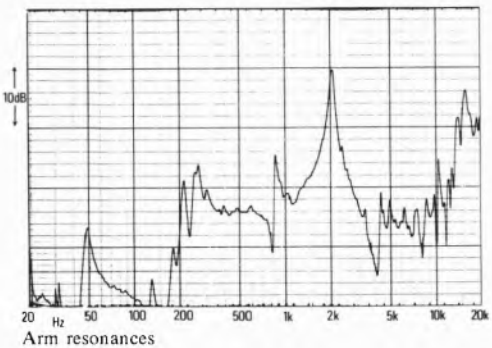
The performance was quite good in many respects, with the arm capable of extracting the best from the cartridge in trackability terms and sounding less coloured when used with the supplied cartridge; if the latter suits your ears then the *731Q* is worth considering, albeit at rather a high price.

GENERAL DATA	Integrated Turntable
Motor Section	
Type	automatic quartz direct drive
Platter mass/damping	1.45kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable and 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.045%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/<0.04%
Absolute speed error	locked <0.05, variable −0.2%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75/77dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	17g*
Type/mass of headshell	special detachable slide carrier/N/A
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/excellent
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/225mg
Downforce calibration error: 1g/2g	−0.1g/−0.05g
Cue drift/8mm ascent/descent	negligible/variable, min 1secs/1.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	180pF/resistive cambric weight
System as a whole	
Size/clearance for lid rear	42.4(w) x 38.5(d) x 14.8(h)/5.0cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£260

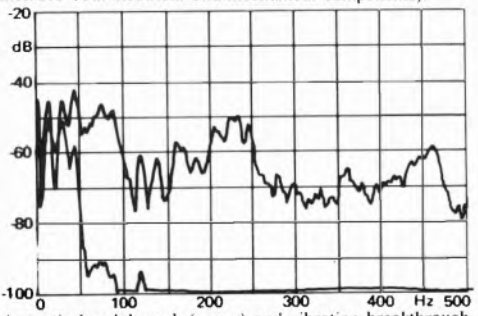
*with Ortofon low mass system, this reduces to 10g approx



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).

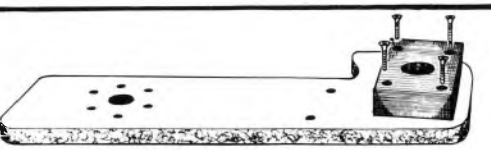


Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

KJ and the Turntable Revolution



The TD160 has been available for some considerable time and has established an enviable reputation with hi-fi enthusiasts. Many modifications have been suggested which purport to improve the basic performance and more than a few retailers offer versions which incorporate them. In our opinion, very few provide any real improvement in the turntable's performance and some actually detract from it.

It is essential that there should be the most rigid coupling possible between the record and the pickup arm. In other words, we want a situation where if the record moves by even the smallest amount in any plane, the pickup arm will move by exactly the same amount in exactly the same plane. Only then can we be sure that the forces generated by the interaction between the pickup and the record groove are being properly resolved. The standard TD160 can be greatly improved here. Not only is the sub-chassis extremely flexible, but the method of fixing the pickup arm to it lacks rigidity. The arm mounting platform is a flimsy plastics moulding held in position on the sub-chassis by three self-tapping screws. This, then is the area to which we give most attention in the KJ modification.

Our answer is to provide a custom-made stiffener for the sub-chassis and fix it into place with a liberal number of machine screws and load-spreading threaded bushes. Epoxy resin is applied to the stiffener around the bearing for extra rigidity and a new arm platform in laminated wood is securely attached by more machine screws and threaded bushes.

The modified Thorens comes complete with 'Platter Pad' and alignment protractor. Three choices of pickup mounting boards are available to suit Hadcock, Mayware, Mission and SME arms. Why not call in and listen for yourself.

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Dunlop Systemdek

Dunlop System Transcription Ltd., PO Box 9, Troon, Scotland. Tel. 0563 29777

RECOMMENDED

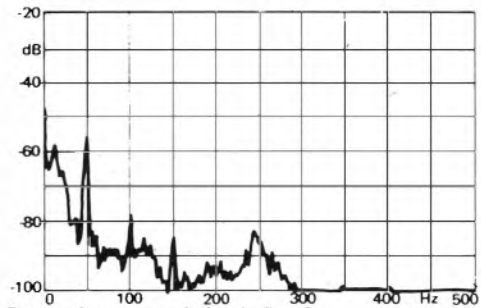
The brainchild of Peter Dunlop, this uncomplicated turntable offered two fixed speeds *via* a precision belt drive, with speed change done by hand, shifting the belt from one pulley step to the other after removing the platter. This clumsy system is also used in the Ariston and STD; I can see no good reason why the usual mechanical speed change was not incorporated. The design incorporated a rigid alloy girder reinforced subchassis whose main struts continued beneath the arm mounting thus providing effective coupling of the platter and subchassis mass to the arm pillar. The subchassis itself was softly suspended on coil springs whose adjustment was critical. A special spanner facilitates such settings from above the turntable, but it needs time or practice (or perhaps both).

The main bearing was of fine quality incorporating a form of oilfeed to the top section via a special spiral groove cut in the spindle, and very good tolerances are claimed under running conditions. The massive platter was a 4.8kg fully machined casting with an integral dense mat made of beige lambswool felt, the plinth being finished in brown 'suede' *Nextel*.

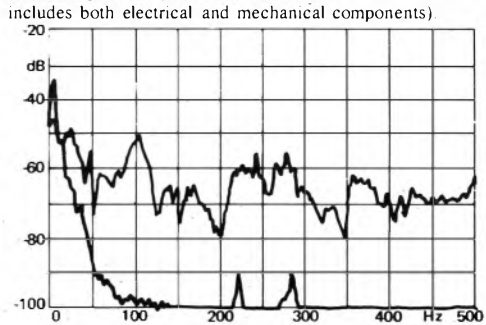
The general sound engineering quality was highly rated. Wow and flutter was very good, but the linear wow content was higher than we would have liked at 0.25%; however it is suspected that this component was connected with the subchassis resonance, and it did not contribute greatly to the weighted result. The subchassis resonance was in fact superbly low at 3.8Hz vertical and c.3Hz lateral, even if this does inevitably increase arm handling sensitivity. Speed accuracy was fine with negligible slowing under load and a reasonable start up was attained, despite the heavy platter. Measuring 75dB, the rumble was also very good, though some motor noise rather than platter components were evident on the spectrogram, in addition to the known electrical contributions at 50, 100 and 150Hz. The acoustic breakthrough was very good — some 20-30dB better than average — if slightly peaky at 100Hz. Vibration isolation was excellent as was the feedback resistance.

The sound quality was undoubtedly in the very good category, although this will of course ultimately be dependant on the choice of accompanying arm. Little can be said except that the low frequency clarity and depth were quite exceptional, while the good separation of chassis and cartridge resonance gave fine stability with clear, well-focused stereo imaging.

GENERAL DATA	Motor Unit
Motor Section	
Type	belt drive, manual
Platter mass/damping	4.8kg/fairly good
Finish and engineering	very good/excellent
Type of mains lead/connecting leads	3 core/N/A
Speed options	manual belt change, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.25%/0.09%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	synchronous/—0.15%
Start up time to audible stabilisation	4.0secs
Rumble: DIN B wtd L/R av (see spectrum)	73/76dB
Size/clearance for lid rear	46(w) x 36.5(d) x 15(h)/4cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£260



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components)



Acoustic breakthrough (upper) and vibration breakthrough

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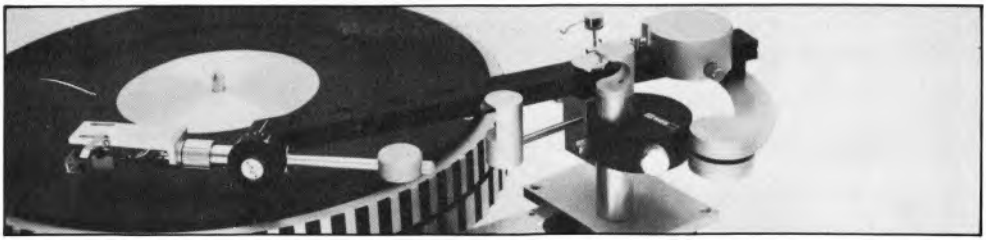
(revised & reprinted) **Dynavector DV505**

Dynavector, Condor Electronics Ltd., 100 Coombe Lane, London SW20 0AY. 01-947 9511



This extraordinary arm was so heavily engineered that it was found to weigh c.1.8kg; as such it can be placed directly on a solid plinth type turntable without any further need for fixing! The manufacturer's instructions were none too clear considering the arm's complexity; a number of features unique to this model were claimed, including the elimination of the subsonic arm cartridge resonance. Unfortunately this was not found to be the case, as the resonant subweight inside the main arm and the electromagnetic eddy-current dampers only acted in the lateral plane; in the vertical plane the arm was in fact undamped. A very high lateral effective mass was attained by the main arm section carrying the sub-arm (is this really desirable?), while the latter was rather lower in mass at an estimated 17g. The heavy loading on the main arm tube inevitably resulted in high lateral friction, greater than the claimed 50mg; in addition, the simple thread and weight bias compensator served to increase friction in the lateral plane, as the guide wire was of small diameter with no pulley. Downforce was supplied by a spring which was strongly angle dependant, making measurement difficult.

Lateral friction was rather poor at 150mg, with the biasing not only incorrect in value and imparting extra friction, but also being higher at the rim than the centre! The shortness of the sub-arm means that warp wow will be greater than for ordinary arm tubes, but in fact this is unlikely to prove significant in subjective terms. An arm resonance graph was taken, with the accelerometer at the 1/3 from pivot position on the sub-arm, but due to this model's unique design, the curve is not fully compatible with the others in this report. High peak-to-trough ratios are visible on a number of resonances, with an unusually low mode at 24Hz, while the first sub-arm break appeared at 300Hz with an uneven energy distribution holding at higher frequencies. Lateral effective mass was so high as to place the subsonic resonance below 4Hz using the test cartridge.

We were disappointed by the overall sound quality of this arm, more particularly when its high price is taken into account. The following characterisations may seem severe, but again they must be put in the context of the superior performance attained by other lower priced tonearms, critisims made included brittleness, midrange hardening and emphasis with a 'loud' effect, plus apparent coloration in the ambient sound field. The stereo positioning was vague and the central image widened, but in contrast the low frequency performance was quite good.

Rated as only 'average' on sound quality, this performance taken in conjunction with certain measured characteristics, preclude recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	complex
Type of headshell	Universal detachable
Headshell mass (inc screws)	12.5g
Geometric accuracy	Very good
Facilities for adjustment	damping, mass, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	good
Friction lateral/vertical (typical)	150mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	t & w 220mg/120mg
Cueing: drift/8mm ascent/8mm descent	No cue fitted
Downforce calibration error 1g/2g	Depends on adjustment:
Amount of damping	little
Arm resonances	average
Subjective sound quality	average
Motor recommended	probably solid plinth type
Estimated typical purchase price	£250

Arm resonances (compared to cartridge resonances, dotted).

Eagle 7500

Eagle, Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU. 01-902 8832

Features, facilities, setting up and use

The *D7500* is a neat auto return player which in all other respects bears a remarkable resemblance to the manual Audiotronic *ATT100M,* both models marketed by the same parent organisation. Of simple construction, with an unsprung fabricated plinth standing on rubber feet, the light platter was powered via a synchronous induction motor, and in contrast to the *AT100M,* a proper signal earth lead was present with the phono connectors. The lid, while well-finished, was also of rather resonant construction, and its direct attachment to the plinth unfortunately ensured that its stored energy was effectively coupled through to the arm pillar, and thence to the cartridge. The soundly engineered tonearm accepted the usual universal headshell, in this case a perforated light alloy model weighing 9g inclusive of fixing screws. No subsonic resonance damping was provided — not really surprising at this price level. The suggested method of cartridge alignment was by overhang measurement, which not only proved awkward but also resulted in a 2° error; an accessory protractor should be used instead.

Lab performance

Running an acceptable 0.6% fast, the torque was high, imparting an excellent loading stability and a rapid 0.6sec start up. Wow and flutter was satisfactory, but the rumble DIN B weighted figure was barely adequate, and reflected the high level of motor vibration. Acoustic breakthrough was poorer than average, as was vibration immunity, feedback and hum induction.

The arm resonances were notably severe and were definitely indicative of serious vibrational modes. Lateral friction was only fair at 100mg, although countered by good readings for downforce bias compensation and satisfactory cue operation. Unusually for such a low cost player, a height adjustment was also included.

Sound quality

In view of their many similarities, it is perhaps not surprising to find that the sound quality of the Eagle was described as being fairly similar to that of the related *AT100M,* the *D7500* receiving a 'poor' rating which does not compare well with the achievements of other players at this price level. Rumble was clearly audible in the reproduction and should be improved or preferably eliminated.

Conclusions

In its present form, the *D7500* does not merit a recommendation.

GENERAL DATA Integrated Player

Motor Section

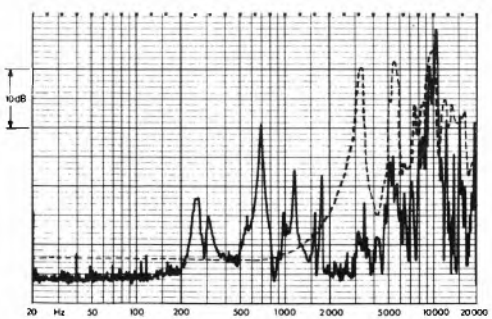
Type	auto return belt drive
Platter mass/damping	0.75kg/very good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.11%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.11%
Speed accuracy/drift/variation under load	+0.60%/synchronous/–0.05%
Start up time to audible stabilisation	0.6secs
Rumble (av DIN B wtd L/R)	50/52dB

Arm Section

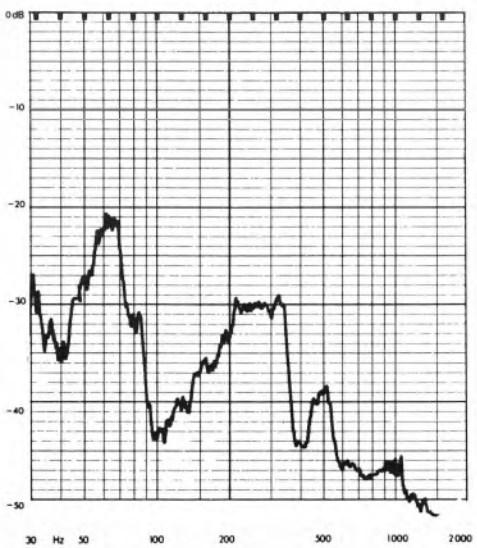
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	9g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	average
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	100mg/ <10mg
Bias comp: type/force nm/centre (1.5g ell set)	thread & weight/ 160mg/175mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/1.5secs
Downforce calibration error 1g/2g	+0.025g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.9(w) x 36.0(d) x 14.3(h)cm/4.0cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	poor
Hum level/Acoustic feedback	poor/poor
Vibration or shock sensitivity	poor
Ease of use	very good
Estimated typical purchase price	£75



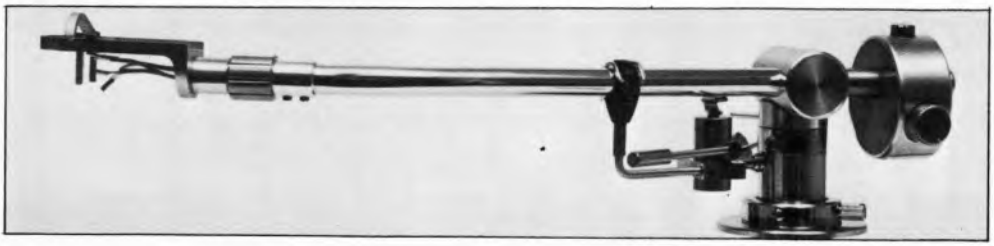
Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Fidelity Research FR-12S

Wilmex Ltd., Compton House, New Malden, Surrey KT3 4DE. Tel. 01-949 2545



Features, facilities, setting up and use

Loosely speaking, of all the arms in Fidelity Research's new range, this is the one that is probably nearest to the long established but now discontinued *FR54* reviewed in the previous issue. Arrangements for bias and the like were a trifle primitive for the older model, but these details have since been considerably refined on the new series. Workmanship and finish were both excellent, although perhaps this is no more than one would expect at this price level? A detachable headshell of the universal type was fitted (incidentally machined out of a solid block), with an improved clamp arrangement comprising four splines which firmly grip the headshell plug when properly connected. A locking device was present on the counterweight for use after it had been correctly set, and the latter employed a convenient rack and pinion system for downforce adjustment. The bearings were free of play, with the whole structure relatively rigid, and despite the manufacturer's claim of 12g, effective mass was quite high at 22g, necessitating the use of a low compliance cartridge, although the low arm lead capacitance provides flexibility as regards electrical matching.

Lab performance

With the headshell weight at 12g, the geometrical alignment was very good, although the absence of lateral cartridge adjustment in the headshell meant that the pillar to platter spindle dimension was critical and must be accurately set. Pivot frictions were excellent and the bias compensation effective, adding negligible extra friction, although it was in the inverse ratio from rim to centre. Downforce calibration was pretty accurate and cue operation fine.

Rated as average on arm resonances, the graph showed several quite sharp modes. The 100Hz resonance was probably the counterweight, but the 250Hz one was almost certainly the first break in the headshell/tube system, other modes being present at higher frequencies.

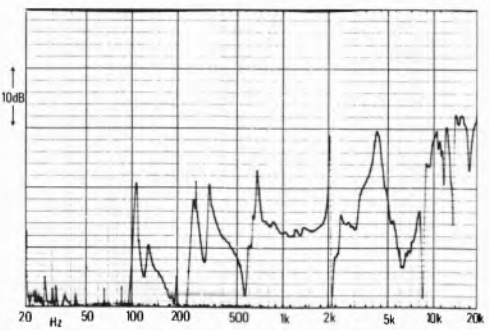
Sound quality

Despite the resonances noted above, on a high class turntable the sound quality was rated above average, with the bass clean and frontal stereo imaging precisely detailed. The more distant detail however showed some veiling, and the ambience of some recordings was also mildly curtailed.

Conclusion

This very well engineered arm was just too expensive with respect to its sound quality to achieve a clear recommendation.

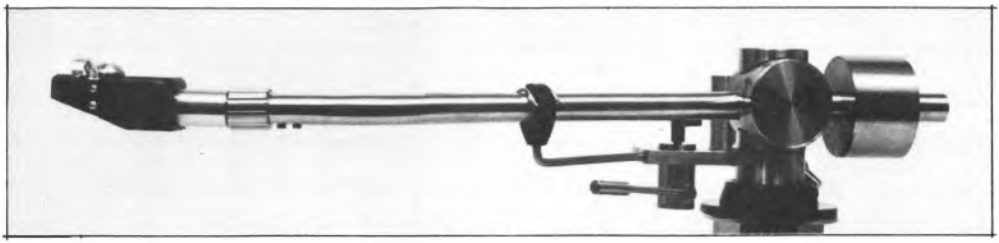
GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	22g
Type/mass of headshell	universal detachable/12g
Geometric accuracy	very good
Adjustments provided	height/overhang
Finish and engineering	excellent/excellent
Ease of assembly/setting up/use	good/good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	approx 250mg/180mg
Downforce calibration error: 1g/2g	−0.08g/−0.1g
Cue drift/8mm ascent/descent	negligible/0.5secs/1.5secs
Arm resonances	average
Subjective sound quality	above average
Lead capacitance/damping method	80pF/—
Estimated typical purchase price	£180



Arm resonances

Fidelity Research FR-64S

Fidelity Research, Wilmex Ltd., Compton House, New Malden, Surrey KT3 4DE. 01-940 2545



Features, facilities, setting up and use

The *S* suffix for this arm as well as for the preceeding *FR12s* refers to the use of pure silver for the internal conductors, but the benefits of this extra feature are as yet unproven. About 30% up in price on the *'12s*, the *64'* was a massively built arm with a 35g effective mass, and is intended for use with low compliance cartridges. The headshell alone weighed in at 20g!

A superbly crafted design, it employed a lateral balance weight for dynamic stability and for some resistance to poor levelling, but a strange effect was noted where the bias lever bearing appeared to possess a deliberate viscous damping component, which marginally damped the arm subsonic resonance.

Lab performance

Despite the overall high mass, the frictions were excellently low, and the arm was well aligned geometrically. The biasing gave values close to the ideal though without the optimum rim/centre differential, and while the downforce contribution was accurate, the cue descent could have been a little faster.

Believed due in part to the high inertia of this design, the resonance graph was judged well above average, for although resonant modes were clearly present, the energy characteristic showed a good uniform overall trend. In fact, the behaviour is so complex as to make it impossible to assign specific features to the various resonances.

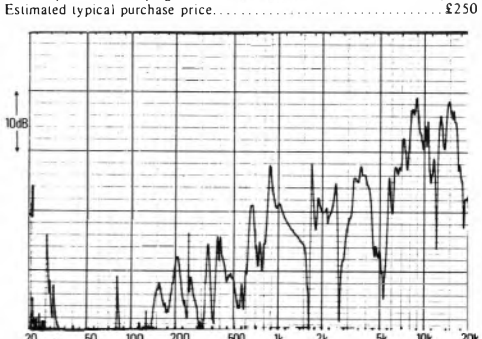
Sound quality

Rated as 'good', the stereo presentation and depth were fine with clear transients, a neutral midband, and clean extended bass, but a hint of a splashy quality was apparent in the treble however.

Conclusion

Undoubtedly a fine arm in many respects, the price precludes a value recommendation although it is entirely possible that some cartridges which we have not tried here may work particularly well with this arm, such as some high energy low compliance moving-coil models.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	35g
Type/mass of headshell	universal detachable/20.5g
Geometric accuracy	very good
Adjustments provided	height/overhang/lateral angle
Finish and engineering	very good/excellent
Ease of assembly/setting up/use	good/very good/good
Friction: typical lateral/vertical	20mg/15mg
Bias compensation method	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	175mg/175mg
Downforce calibration error: 1g/2g	−0.05g/−0.08g
Cue drift/8mm ascent/descent	negligible/0.6secs/3secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	80pF/—
Estimated typical purchase price	£250



Arm resonances

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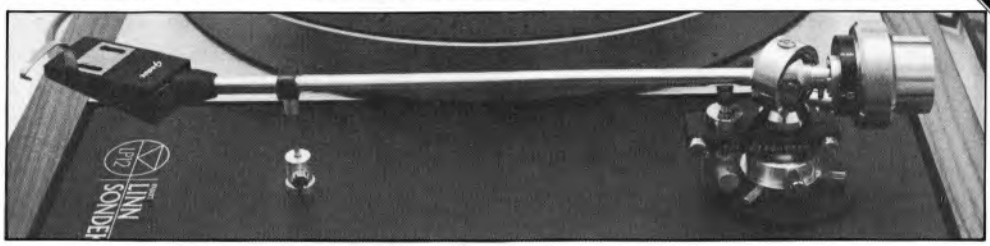
(revised & reprinted) **Grace G707**

Grace, Linn Products Ltd., 235 Drakemire Drive, Glasgow G45 9SZ. 041 634 3860

RECOMMENDED



This retested arm is a rigid yet low mass design with a fixed plastic headshell (adjustable for tilt) and employs a straight chromed alloy tube with secure gimbal bearings free of play. Essentially little decoupling was provided on the rotating counterweight assembly, while a pivoted weighted lever applied bias compensation via a thread, the arrangement offering reasonably low friction.

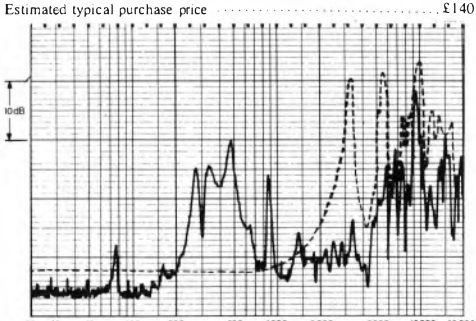
The instructions supplied were rather poor, with minimal guidance on alignment, and we felt that only a relatively experienced user could be expected to set up the arm correctly, using the information supplied. It is perhaps fortunate that the arm is distributed by Linn Products, and is in fact often fitted to their *LP12* turntable, their dealers being relied upon to provide a valuable setting up service as part of their sales package.

Low friction values were recorded but the supplied bias system set to 1.5g gave values virtually double that required for normal elliptical styli. However the ratio of rim-to-centre values was correct. Set up with a protractor, the geometrical accuracy was very good, with tilt, height and overhang provided. Cue operation was satisfactory and downforce calibration accurate. Effective mass was low at 6g and suitable for medium to high compliance cartridges, and extra weights may be necessary for low mass, low compliance model (otherwise moderate bass lift in the 20-40Hz region may occur.) A better than average characteristic was apparent from the arm resonance graph despite the anomalies in the 280-500Hz range and the related harmonic spike at 850Hz. Above this range the characteristic was commendably even with fair control and maintained energy to the 20kHz limit. A minor resonance appeared at 80Hz — too low for a bending mode and possibly due to the stiff counterweight elastic 'liner'.

In agreement with the previous issue a 'very good' rating was established using either a *LP12* or an ATR deck. The bass register was considered tight extended and powerful, with accurate placement while stereo was detailed with good depth and precision. The arm presented an interesting contrast to the SME *III*, which we felt to be on the rich side of neutrality, the *G707* conversely sounding slightly on the bright and coarse side of this balance. These facts are of considerable importance at this high quality level, when chosing a matching cartridge.

On the basis of sound quality alone, this arm would merit a recommendation. Fortunately the high price is justifiable on the grounds of its overall performance, both subjective and objective.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	6g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	20mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	weighted lever & thread 240mg/290mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2secs/2.5secs
Downforce calibration error 1g/2g	-0.025g/-0.05g
Amount of damping	none
Arm resonances	above average
Subjective sound quality	very good
Motor recommended	TD160,LP12 etc.
Estimated typical purchase price	£140



Arm resonances (compared to cartridge resonances, dotted).

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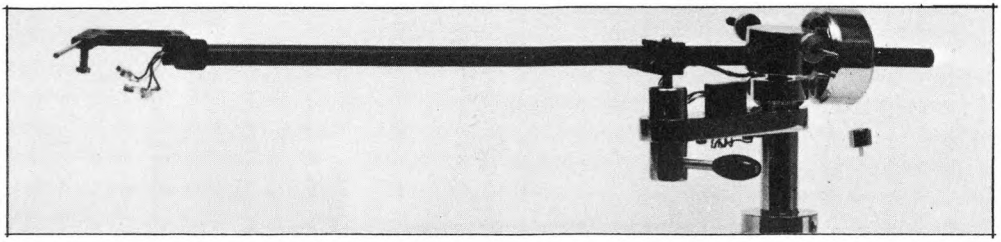
Hadcock GH228D

Hadcock, G. F. C. Hadcock, Audio Division, The Old Vicarage, Doveridge, Derby DE6 5NN. 088 93 2452



Several versions of this arm were supplied for review, and updates and modifications continued unabated during its preparation! Essentially, however, the fixed arm model of the previous issue still continues with some amendments, while a more costly version utilising a plug and socket assembly on the pillar section is now also available, this allowing the complete removal of a balanced arm top assembly (notwithstanding the problem of damping fluid spill from the unipivot housing).

Attracting criticism in the last two issues of *Choice*, the pivot pin finish was at last to a standard offering sensibly low bearing frictions, and while the general standard of engineering had certainly been improved, attention to detail is still required. For example, a pulley had been fitted to our first sample's bias compensation mechanism, but it was so eccentric that the bias actually worked better with the pulley removed; however, a satisfactory version was supplied at a later date.

To summarise, this low mass arm employed a rigid cast headshell on a selected alloy tube, with the latest counterweight — a simplified decoupled sliding affair — possessing crudely inaccurate filed markings for downforce, rendering a stylus force gauge an essential accessory. The new gold-plated plugs were far too tight a fit in the small pillar fixing nut, and the arm proved both time consuming and complicated to set up and fit.

Lab performance

Of moderate lead capacitance, the Hadcock was low in effective mass at 5.5g and is thus highly versatile. The geometrical accuracy was very good, and the biasing effective if slightly low (new sample). Downforce calibration was however hopeless (the use of a gauge is suggested anyway by Hadcock), and while arm cue rates were satisfactory, some drift did occur, and the cue geometry is itself rather unusual. Bearing friction was satisfactorily low, if still not as low as claimed. The Hadcock scored well as regards resonances, these proving its main strength, as right up to upper mid frequencies the graph showed an even, controlled character, marred only by a couple of sharper modes at 2.5kHz and 6.0kHz.

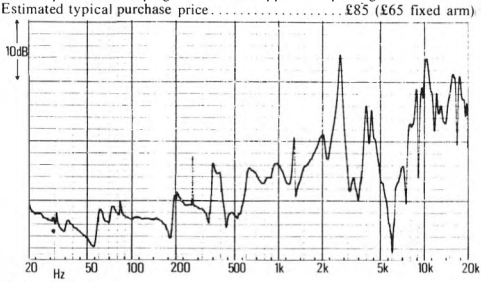
Sound quality

Rated as 'good', the Hadcock produced a clean, clear and neutral sound with good bass and satisfying stereo imaging. Just a trace of tizziness was present in the upper frequency ranges, but this was not serious.

Conclusion

As usual the fine sound quality versus price ensures recommendation, but engineering quality reservations still remain, and much skill is needed for setting up and use.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	5.5g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	very good
Adjustments provided	overhang, tilt, height
Finish and engineering	both fairly good
Ease of assembly/setting up/use	good/fair/fairly good
Friction: typical lateral/vertical	approx. 30mg/<10mg
Bias compensation method	pulley weighted thread
Bias force: rim/centre (set to 1.5g elliptical)	125mg/140mg
Downforce calibration error: 1g/2g	approx ±0.2g/±0.2g
Cue drift/8mm ascent/descent	fair/0.8secs/2.5secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	approx 135pF/slight via fluid well
Estimated typical purchase price	£85 (£65 fixed arm)

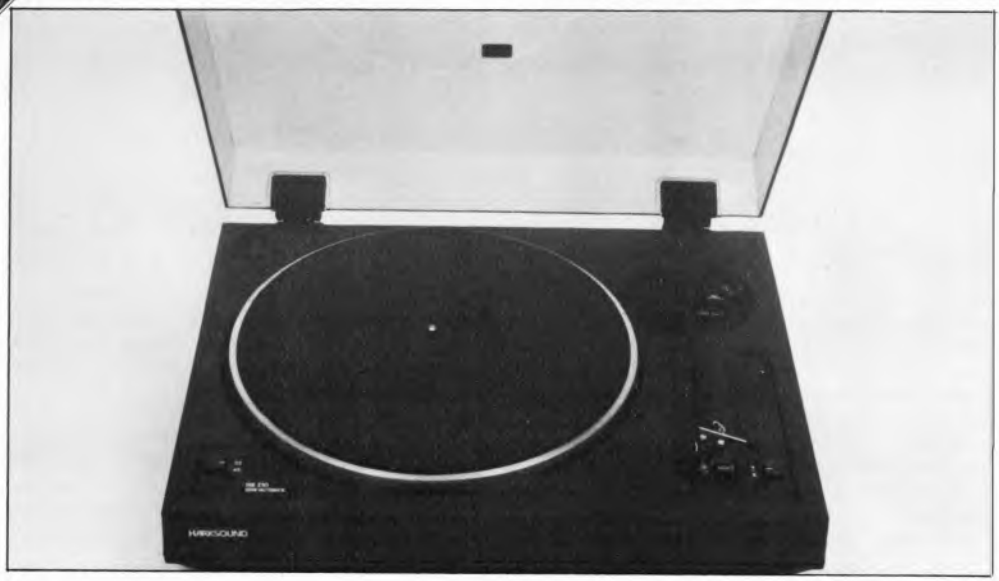


Arm resonances

RECOMMENDED

Harksound HS210

Uher Ltd., 24 Market Place, London, NW11, Tel. 01-455 1771



Features, facilities, setting up and use

This turntable is produced in Japan by C.E.C. for their Harksound brand, this line represented in the previous issue under the Visonik label. An inexpensive belt drive model with an automatic arm return at end of side, the unit came equipped with an Ortofon cartridge from their new low mass series, in this case a *LMB 70*, a 1.5-2.0g downforce spherical-tipped model. A powerful four-pole synchronous motor was employed, with two speeds available via a front panel control. A form of decoupled subchassis was inbuilt whose resonances at 10Hz lateral, and less seriously 16Hz vertical, overlapped those of the arm/cartridge range; nonetheless this suspension was a worthwhile inclusion, as the breakthrough graphs were better than average for a model in this price range. The mat was rather uneven when unpacked, and although it flattened reasonably with use, it failed to damp the light platter particularly well, the latter weighing 0.8kg including the mat.

Overall the engineering was fair enough at the price, but some platter weave was apparent when rotating, and the arm bearings were none too tight. The arm was not a particularly rigid structure, being of moderate mass (11g) and low lead capacitance (80pF). It was provided with a special detachable headshell moulded in carbon fibre-loaded plastic, and while in general the instructions were good, those pertaining to the cartridge alignment were none too helpful, and the paper protractor supplied was too flimsy.

Lab performance

Wow and flutter levels were quite good with good speed accuracy, a rapid start up, and minimal slowing under load. At an average 72dB DIN B the weighted rumble was low, 50 & 150Hz modes on the spectrogram being of an electrical static nature, and the rest 'true' mechanical rumble effects: for example, the series at 25Hz intervals was clearly related to the motor rotational period.

Of medium effective mass, the arm was well aligned geometrically and proved easy to use. Bearing frictions were adequate, but best suited to 1.5-2.0g minimum downforce, and thus compatible with the cartridge supplied. The bias compensation was quite accurate and worked well, but downforce calibration was on the low side, although not excessively so, and the cue operation was fine. It rated as just 'average' for resonances, being well behaved up to 200Hz where the first flexural mode was rather severe, serving to displace the sections by 15dB; reasonable control was shown thereafter.

RECOMMENDED

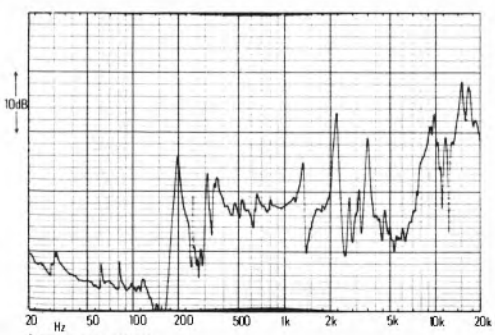
Considered to be above average as regards acoustic breakthrough, the 350-400Hz range was poorer than the rest with the marginal platter mat damping the probable cause. The average vibration isolation was reasonable for the price, although a heavier mat would help matters here, and while hum levels were good and shock resistance average, the acoustic feedback margin was less so, the problem first appearing in the bass. Midband feedback alone was quite good.

Sound quality

Ranked somewhat below average, the *HS210* showed a degree of arm coloration in the lower midrange although the overall effect was not unpleasant. The balance tended to 'lightness' with a significant loss in bass depth, while the transient quality of the upper bass lacked definition and clarity. Stereo presentation was reasonably good however, with less veiling of detail than is often encountered at this price level.

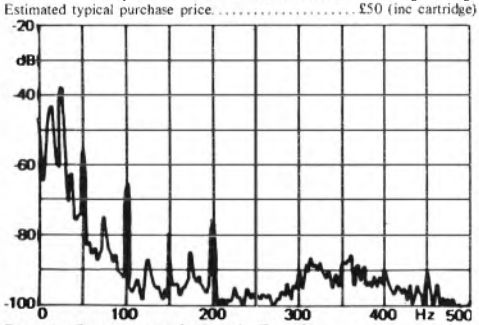
Conclusion

Considering the inclusion of a reasonable and compatible cartridge, the performance was quite creditable for the price. The *HS210* had no serious defects, being well aligned and producing negligible wow and rumble, and in addition, it included an auto-arm return. Furthermore, a firmer shelf support than our standard test coffee table gave an improvement in both bass quality and feedback. The deck clearly gains a recommendation, and enters the lower ranks of the high fidelity group, a cut above other similarly priced music centre equipment.

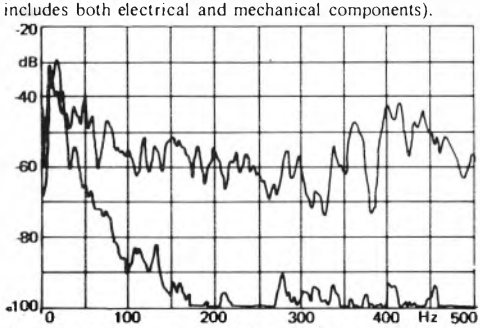


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	0.8kg/fair
Finish and engineering	fairly good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/0.08%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	mains synchronous/−0.15%
Start up time to audible stabilisation	<1sec
Rumble: DIN B wtd L/R av (see spectrum)	70/74dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	11g
Type/mass of headshell	special detachable/6g
Geometric accuracy	very good
Adjustments provided	overhang/lateral angle
Finish and engineering	good/fairly good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	50mg/75mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/175mg
Downforce calibration error: 1g/2g	<0.1g/<0.1g
Cue drift/8mm ascent/descent	negligible/0.5secs/2.0secs
Arm resonances	average
Subjective sound quality	below average
Lead capacitance/damping method	80pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	45(w) x 36.4(d) x 13.7(h)/3.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£50 (inc cartridge)



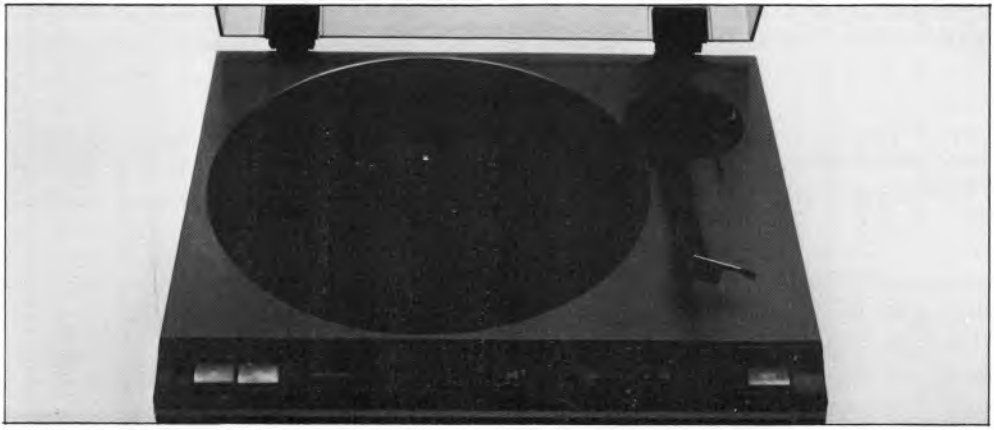
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Harksound HS510

Uher Ltd., 24 Market Place, London, NW11, Tel. 01-455 1771



Features, facilities, setting up and use

An upmarket version of the *210*, the same moderate mass tonearm was fitted, but with a more costly cartridge, in this case an Ortofon *LM20* low mass model with an elliptical tip, this being a recent version derived from the *VMS20E II*. The *HS510* was described as 'semi automatic' which in our terms meant that an auto-return and stop mechanism were inbuilt. A two speed direct drive design, a single slide control offered fine speed variation with the mains illuminated stroboscope recessed in the turntable rim. Platter mass was moderate at 1.5kg (although almost twice that of the *210*), but the mat was rather light, affording only fair damping, and furthermore it had become distorted during transit.

As with the *210*, a spring floating subchassis was incorporated, the increased mass of the *510* endowing it with a fairly low 10Hz main resonance, even though the lateral freedom was rather restricted. This chassis resonance was in fact potentially coincident with that of the arm/cartridge, which is not a good thing. Most of the controls were brought out onto a front angled plinth section, allowing operation with the lid closed. Similar levels of arm bearing play were observed for this model as for the *210*, and the headshell was not particularly rigid in its fixing, despite the screw locking arrangement.

Lab performance

A very good DIN weighted wow and flutter figure was recorded and a fair proportion of the linear wow reading was due to our sample of the mat not being level. A motor with apparently only first order servo control was fitted, as some wow-overshoot was detected under variable loadings; however slowing under load was satisfactory despite the just adequate torque. Start up was a slow 3.2 seconds, particularly considering the low platter mass.
mass.

Rumble was fine at an average of 73dB weighted DIN B, although the spectrogram showed some interesting features, notably that this direct drive motor was not as 'clean' as the 20-pole 30-slot specification might imply. The noise spectrum was all motor generated proving comparatively strong in the 250-300 Hz range; note however that the bottom line was 100dB below the DIN reference level of 10cm/sec 1kHz, so while noisier than average, the result was still satisfactory.

As with the *210* the effective mass was 11g, and the lead capacitance a low 80pF. On track record, Ortofons seem to prefer 400pF or so and additional capacitance would therefore be worth adding to the system if the matching amplifier value were low. The arm bearings were rather slack, and despite this the lateral friction was quite high at 85mg. Representing a considerable proportion of the required bias correction (which was itself on the low side for the rim value), this degree of friction will tend to degrade the tracking stability at the highest modulation levels. Downforce calibration was about 10% low, while cue operation was to the required standard, and not unexpectedly the arm resonances showed a very similar trend to that for the *HS210*.

However the increased subchassis mass of this

model endowed it with an improved vibration and acoustic breakthrough resistance, both these still being rated as above average. Nevertheless, bass feedback was still a residual problem on the listening test location, and only improved with rigid shelf mounting. Resistance to impact shock was about average.

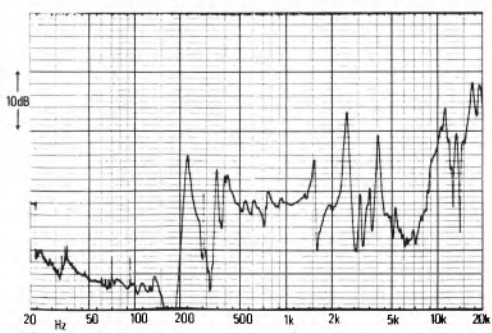
Sound quality

True to the occasionally unpredictable nature of turntable compromises and performance combinations, this model was judged to be marginally below the *210* as regards its sound quality, although it proved difficult to pin down the precise reasons why. Any combination of factors such as dynamic wow, inferior bias/friction, a poor mat or rumble level and even *in situ* incipient feedback could be responsible (the supplied cartridge was not used in this assessment.)

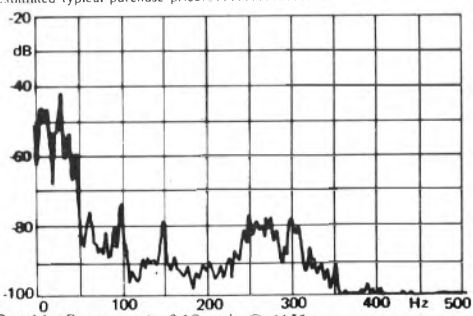
Conclusion

The below average sound quality was a clear barrier to recommendation at this price level although the value is not too bad in view of the good quality cartridge that forms part of the package. However, the differences in arm performance between the *210* and *510* gave cause for concern as regards quality control.

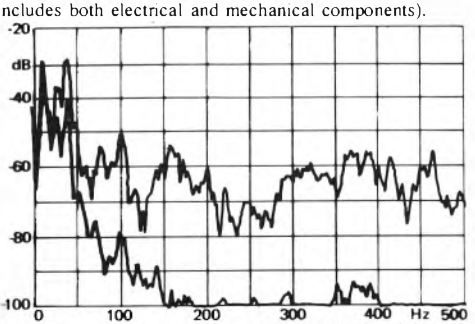
GENERAL DATA	Integrated Turntable
Motor Section	
Type	semi-automatic, direct drive
Platter mass/damping	1.5kg/fair
Finish and engineering	fairly good/fairly good
Type of mains lead/connecting leads	2 core/2 phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.12%/0.07%
Absolute speed error	variable <0.2%
Speed drift 1 hour/load variation	+0.2%/−0.2%
Start up time to audible stabilisation	3.2secs
Rumble: DIN B wtd L/R av (see spectrum)	71/74dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	11g
Type/mass of headshell	special detachable/6g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	good/fairly good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	85mg/35mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/250mg
Downforce calibration error: 1g/2g	<0.1g/<0.1g
Cue drift/8mm ascent/descent	negligible/0.8secs/2.0secs
Arm resonances	average
Subjective sound quality	below average
Lead capacitance/damping method	50pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	45.0(w) x 39.5(d) x 13.7(h)/3.7cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	very good/below average
Vibration sensitivity/shock resistance	above average/average
Estimated typical purchase price	£105



Arm resonances



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Hitachi HT324

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use

Representing Hitachi's economy model, the *HT324* nonetheless sported an automatic arm return. A belt driven design, it came fitted with a modest *MT30* cartridge which was correctly aligned (see *HT354* for data). Some play was evident on the lateral arm bearing, and although the arm seemed to be the same as that fitted to the *354*, in this case the cable capacitance was considerably lower at an average 155pF. Effective mass was however identical at 17g necessitating the use of a low compliance cartridge. The brief instructions included an alignment procedure using the clumsy overhang method, which means that the stylus tip distance to the headshell back will require measurement. Not only is this geometrically critical, it also cannot account for the change in geometry as the stylus settles under its chosen downforce.

The lightweight lid was of the resonant type and the platter was also light at 0.8kg, inclusive of mat, but the latter did provide good platter and record damping. The controls were brought out onto the front edge of the plinth allowing operation with the lid closed, with the usual isolator feet endowing the plinth with suspended subsonic resonances at 10Hz lateral and 16Hz vertical, these too high for comfort.

Lab performance

Excellent wow and flutter results were obtained, perversely much better than for the two more costly direct drive Hitachis! The deck ran slightly fast but showed great torque with a rapid speed start up and only minor slowing under load. The rumble reading was quite good at typically 68/69dB, the spectrogram showing static electrical components at 50, 100 and 200Hz, with the rest being mechanical in origin.

The arm provided reasonable friction levels and satisfactory bias compensation, but the latter was in inverse ratio and also added further lateral friction. Cueing was fine but the arm resonances were classed below average, for as with the *HT354*, a strong break in response occurred at 150Hz or so, displacing the curve sections by 20dB. Another break was present at 3kHz although the 250Hz to 1.5kHz range was in fact nicely controlled.

On acoustic breakthrough and resonances the unit proved surprisingly good, this due to the even nature of the breakthrough pattern. Vibration isolation was not exceptional although probably

RECOMMENDED

above average, while both hum induction and impact shock resistance were considered good, and the resistance to acoustic feedback definitely above average.

Sound quality

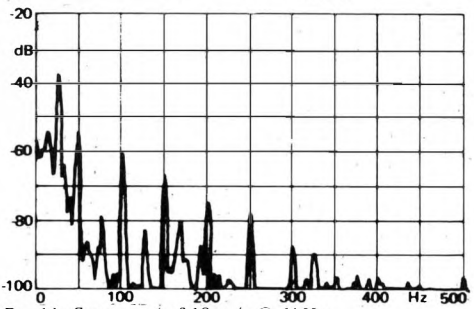
Just attaining an average ranking, the sound was quite pleasant offering reasonable detail and fairly good bass if rather light in character, with average stereo imaging.

Conclusion

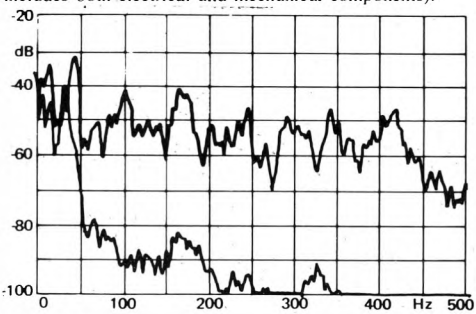
This deck earns a recommendation, the inclusion of a fitted cartridge acting as an additional bonus; the latter might not be taken too seriously by hi-fi enthusiasts, but it nonetheless offered a quite reasonable performance, being fully compatible with the player.

GENERAL DATA — Integrated Turntable

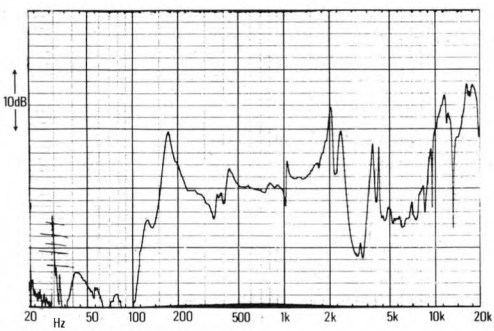
Motor Section	
Type	auto return, synchronous belt drive
Platter mass/damping	0.8kg/good
Finish and engineering	excellent/good
Type of mains lead/connecting leads	3 core/2 phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.06%/<0.04%
Absolute speed error	+0.35%
Speed drift 1 hour/load variation	synchronous/−0.2%
Start up time to audible stabilisation	0.5secs
Rumble: DIN B wtd L/R av (see spectrum)	68/69dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	17g
Type/mass of headshell	universal detachable/7g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	excellent/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	50mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	250mg/175mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.8secs/1.3secs
Arm resonances	below average
Subjective sound quality	below average
Lead capacitance/damping method	155pF/—
System as a whole	
Size/clearance for lid rear	43.5(w) x 37.5(d) x 13.0(h)/4.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£65



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Hitachi HT354

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use

A mid priced design, the *HT354* was similar in many respects to the *324,* for it carried the same arm and again the front controls were positioned outside the lid area. Known as a 'semi automatic', auto arm return at end of side was provided. The specification did claim much improved rumble and wow figures by comparison with the *324*, these resulting from the use of a Hitachi built 'unitorque' direct drive motor. A Hitachi *MT30* cartridge was fitted, which is an inexpensive 2g tracking Audio Technica type with a spherical tip. The brief instructions included the clumsy overhang method for cartridge alignment, but were otherwise OK.

The arm was not particularly well adjusted and showed looseness in the lateral plane; in addition, the plastic headshell was rather flexible. Arm lead capacitance was quite high at 220pF, as was effective mass, necessitating the use of a lowish compliance cartridge and some care in electrical matching.

With so called anti-resonance feet, the light plinth assembly gave poorly isolated resonances at 10Hz lateral, 16Hz vertical, these overlapping the arm/cartridge resonance, and as is so often the case proving of little value for upper range isolation. In addition, the resonant lid was also coupled to the plinth and is likely to play a significant part in the acoustic breakthrough results. Two speeds were provided plus fine variable adjustment, with the usual platter rim stroboscope for mains frequency speed reference.

Lab performance

The weighted wow and flutter was satisfactory, though poorer than the 0.03%rms (NAB weighting) specification would imply. Speed accuracy was fine, drift and load tolerance satisfactory, and start up time average. No significant wow overshoot was detected. Averaging 70dB, the rumble just met the spec, with a number of static electrical components present in the rumble spectrogram at specifically 50, 150, 250 and 400Hz, the remainder attributable to the motor noise.

The arm proved to be quite well aligned and easy to set up. Bearing friction was satisfactory although the bias compensation was found to introduce some additional friction; the compensation values were reasonable but in the inverse ratio from rim to centre. Downforce calibration was very good, and the cueing also worked well. Rated below average on arm resonances, a severe mode appeared at a low 125Hz, with a 20dB energy displacement on

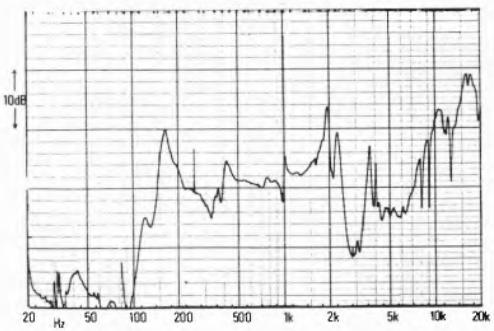
the curve, but at higher frequencies the picture was more favourable. A surprisingly good result was obtained for airborne acoustic breakthrough, and the spectrum was quite even in character. Vibration sensitivity was also above average as were shock resistance and feedback.

Sound quality

Proving difficult to entirely remove audible hum from the system if using a more advanced lower output cartridge than that supplied, the sound quality was in any case a little below average. Some coloration was evident both in the bass (possibly plinth derived) and in the midrange, the latter attributable to the arm, while some loss of detail and depth was also apparent in the stereo image.

Conclusion

In general the *HT354* was quite average, which on the positive side at least denotes the absence of any major faults. Taking into consideration the fitted cartridge, the price is not unreasonable.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

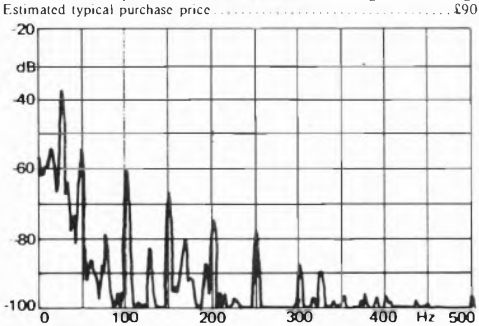
Type	direct drive, auto return
Platter mass/damping	0.8kg/good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	3 core/2 phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.12%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/0.08%
Absolute speed error	variable <0.2%
Speed drift 1 hour/load variation	+0.25%/−0.3%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	68/72dB

Arm Section

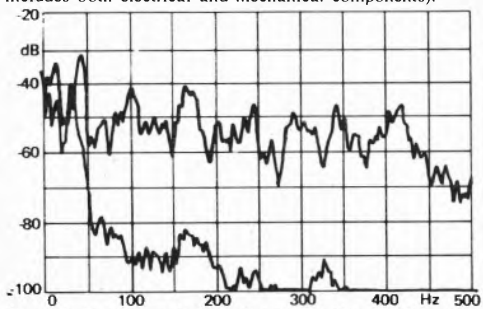
Approximate effective mass inc screws, excl cartridge	17g
Type/mass of headshell	universal detachable/7g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	excellent/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	45mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/150mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.0sec/1.3secs
Arm resonances	below average
Subjective sound quality	below average
Lead capacitance/damping method	225pF/—

System as a whole

Size/clearance for lid rear	43.4(w) x 37.4(d) x 13.0(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	satisfactory/above average
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£90



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Hitachi HT660

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use

This top-of-the-line quartz-lock direct drive turntable possessed an interesting arm feature, whereby the complete arm/pillar assembly could be raised or lowered to provide cartridge rake adjustment, an unusual feature within the confines of an automatic mechanism. Employing the usual detachable universal headshell, the effective mass was fairly high at 18g and is therefore suited to low compliance cartridges; the lead capacitance of 155pF was about average. The first sample demonstrated excessive arm, lateral friction at about 0.3g, which was much improved with the second sample, but still on the high side at 100mg.

The substantial platter was well damped by a sensible mat and the motor section well engineered and finished. Two fixed speeds were provided, both of which were quartz referenced, with smooth acting micro-switch buttons on the forward section of the plinth clear of the lid to control the mechanisms. The lid, though of a resonant variety, was at least of a quite substantial thickness. The resonances of the foot/plinth system were widely displaced at 6.3Hz lateral and 16Hz vertical, thus clever cartridge selection can keep these well clear of the arm/cartridge range.

Lab performance

A good rating for combined wow and flutter was obtained though the linear wow was a little high at 0.15% considering the price level. As expected, the speed error was negligible under all conditions of drift and loading, while start up was a typical 3 seconds. A trace of mild wow overshoot was detected in the lab although at the measured level it is unlikely to be audible. A better result was anticipated for rumble than the nonetheless good 72dB recorded; the 50Hz component on the spectrogram was of an electrical nature, but the others were motor generated.

Essentially well aligned, finished and engineered, the arm downforce calibration was accurate, cue operation commendable and vertical friction fine. It did however possess some play in the bearings and gave poor readings for lateral friction, and it was impossible to read the bias levels on the first sample as the friction exceeded the bias. The second deck's biasing was still poor, only just beginning to operate at the 1.5g dial setting.

Rated as average for arm resonances in the audible range, the rising energy trend was reasonably uniform if distorted by resonances at 150, 220, 500, 900 and 4500Hz. The breakthrough

graphs showed a clear dominant resonance region for the system centred on 250Hz, which imbalance denoted a just average rating for acoustic sensitivity, though the vibration isolation still warranted an above average judgment. Hum levels were good and so was acoustic feedback at the listening location, while impact shock resistance was also above average.

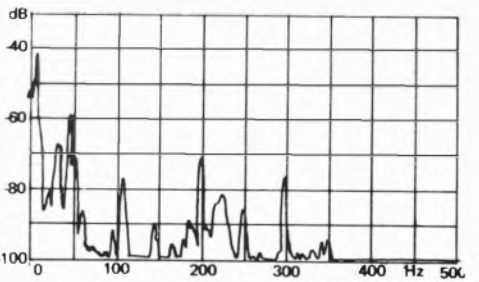
Sound quality

Classed as 'average', the frequency balance was a trifle thin with some depth ambience loss. The bass lacked definition with softened transients and a restriction in the lower registers, while the high treble range sounded a little ragged with more sibilance than usual on voice.

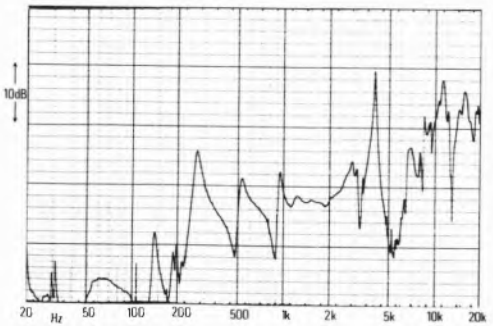
Conclusion

Overall this model proved unexceptional, with a below par arm performance in terms of friction and bias which requires the manufacturers attention. In any case the modest sound quality precludes recommendation at this price level.

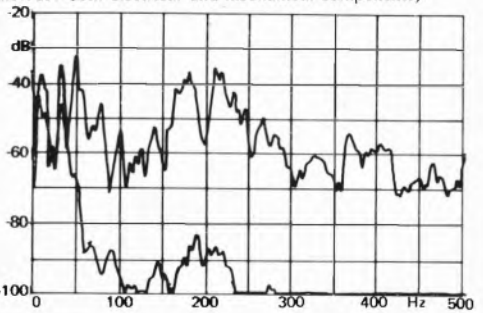
GENERAL DATA	Integrated Turntable
Motor Section	
Type	fully automatic direct drive quartz
Platter mass/damping	2.0kg/good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	3 core/2 phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/0.07%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	3.0secs
Rumble: DIN B wtd L/R av (see spectrum)	71/73dB
Arm Section	
Approximate effective mass (no screws, excl cartridge	18g
Type/mass of headshell	universal detachable/9.5g
Geometric accuracy	very good
Adjustments provided	lateral angle, height, overhang
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	(100 2nd sample) 300mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	not measurable/not measurable
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.0sec/1.0sec
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	155pF/slightly decoupled c/wt
System as a whole	
Size/clearance for lid rear	45.4(w) x 39.1(d) x 14.0(h)/4.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£200



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

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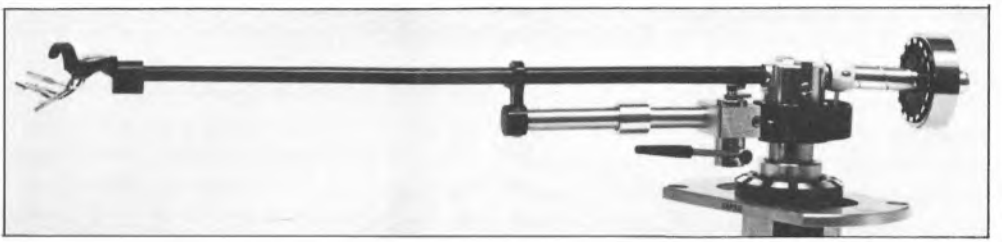


Features, facilities, setting up and use

First released in 1976, the original *Black Widow* arm was made from carbon fibre, later reverting to aluminium alloy for the main tube. The latest version employs graphite fibres for tube reinforcement; in this instance the intrinsic Young's modulus for the fibres is higher still than the exceptional value for the carbon fibre alone, but of course a reinforcing fibre is no guarantee of high rigidity. In fact, while this low mass arm was promisingly stiff in the bending mode, little account had apparently been taken of torsional stiffness which was quite poor.

Of Japenese manufacture, the *Black Widow* was beautifully finished and incorporated several important features, notably a knife edge vertical bearing with a horizontal precision ball race. Viscous subsonic damping was provided via a fluid well similar to the SME, and a SME type bedplate was also included, allowing easy geometrical adjustment, this essential in view of the fixed headshell mounting holes. The rest and cue system were integrated with the pillar and the decoupled counterweight was of the convenient rotating scale type.

Lab performance

Including mounting hardware the effective mass was undoubtedly low at 4.25g, as was the capacitance at 65pF, allowing full flexibility as regards electrical matching. Geometry was excellent with a sensible supplied protractor, likewise friction was in the top class with bias highly effective if on the high side; a 30% reduction in dialled value is suitable. Downforce was excellent and the optional damping effective. Additional mass might be worth adding with some low compliance cartridge types, *eg* moving-coils. Arm resonances were classed as average with the counterweight resonance placed at 65Hz, and the marked torsional mode at 180Hz. A severe break was evident at 900Hz, with several more thereafter.

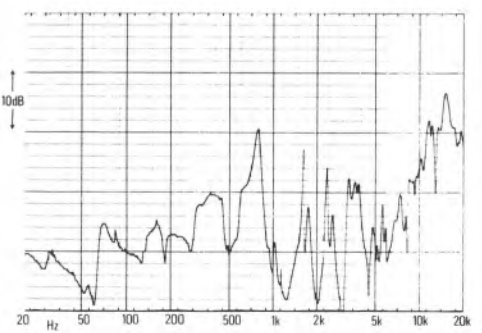
Sound quality

Despite the unfavourable resonances, the sound quality was judged above average, although the midband did sound 'constrained' with a less than even treble range. However, stereo presentation was quite good, albeit with some loss of depth and ambience.

Conclusion

The high engineering quality of this arm helped to lift the sound quality, but the audible range resonance behaviour was not good enough at this elevated price level to merit recommendation.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	4.25g
Type/mass of headshell	fixed/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, overhang, height, damping
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	internal mechanism
Bias force: rim/centre (set to 1.5g elliptical)	250mg/350mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.5secs
Arm resonances	average
Subjective sound quality	above average
Lead capacitance/damping method	65pF/option via silicone fluid well
Estimated typical purchase price	£120



Arm resonances

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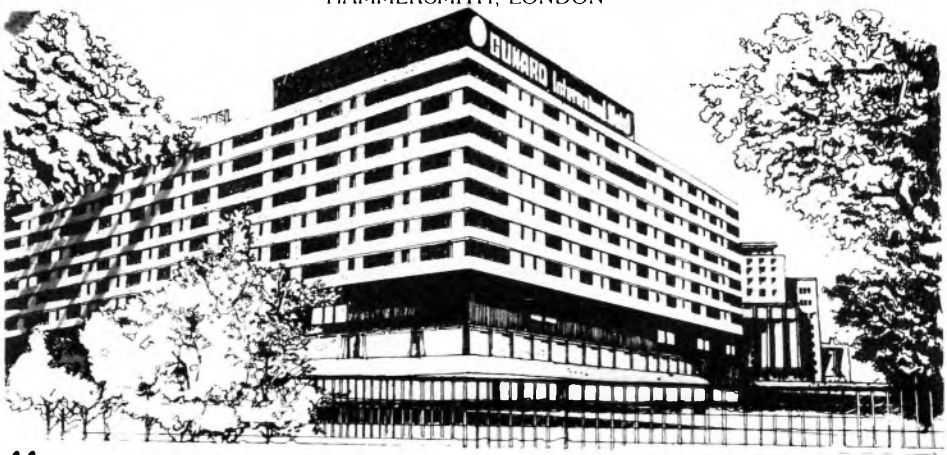

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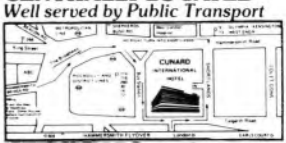

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JBE series III

Janorhurst Ltd., Century House, Shortmead Street, Biggleswade, Beds. 0767 314252

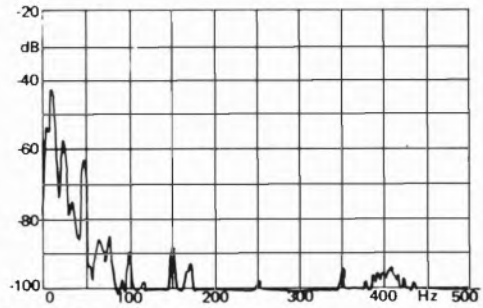
The original version of this deck was reviewed in the last issue, and in general received favourable comment. However, a minor reservation was expressed concerning the level of wow overshoot experienced with the Matsushita *MKL S1T* motor employed, the provisional recommendation thus dependent on an undertaking from JBE that an improved motor would be fitted to future production – at least by press date. In good faith JBE did install a more costly motor (*MKL B III*) as soon as possible, but unfortunately the picture was in fact little changed from the original as regards the level of dynamic wow, even though the other figures were slightly improved. Briefly the *Series III* is a direct drive motor on a massive slate plinth fitted with an attractive fabricated acrylic lid, and mounted on 'Microsorber' feet.

The platter was reasonable at 1.9kg, with an average start up time of 3.5 seconds. Finish was very good with bearing tolerance and centration both fine, as was wow and flutter at 0.08%, DIN weighted. Speed drift was satisfactorily low, but slowing under load was on the high side at 0.3%, with recovery inducing some dynamic wow. At typically 78db rumble was excellent, the spectrogram essentially made up of electrical contributions at 50Hz with some negligible pole noise at other frequencies. Rated as good for acoustic breakthrough, the level improved significantly with increasing frequency. The isolation feet however proved quite ineffective, and the vibration breakthrough was classed as relatively poor, but impact shock was well resisted as was feedback on the listening test. The plinth resonance occurred at 9Hz lateral and 20Hz vertical.

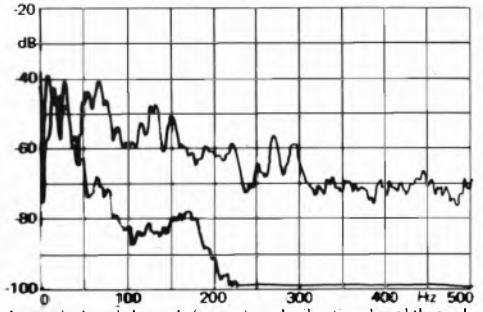
Rated above average the *Series III* showed a slightly muted bass quality with reduced deep bass. However the midrange was clear and detailed, allowing a good stereo presentation, and although on occasion very mild wow was detectable by comparison with a more stable alternative; this was only apparent with critical programme.

While aspects of this model were indeed favourable, at this price level the mild wow problem cannot be ignored, and as such recommendation must be withheld until this problem is finally and satisfactorily resolved. In all fairness, JBE are well aware of the problem, and are endeavouring to put things right as soon as possible.

GENERAL DATA	Motor unit
Type	manual direct drive
Platter mass/damping	1.9kg/very good
Finish and engineering	very good
Type of mains lead/connecting leads	3 core/power unit/N/A
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.11%/0.08%
Absolute speed error	variable
Speed drift 1 hour/load variation	+0.15%/−0.3%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	77/79dB
Size/clearance for lid rear	43.4(w) x 34.3(d) x 15.5(h)/8.4cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/above average
Vibration sensitivity/shock resistance	poor/above average
Estimated typical purchase price	£220



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

JVC LA11

JVC, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621

Features, facilities, setting up and use

The JVC turntable line is an extensive one numbering nine models in all, with the *JL-A11* representing the only belt drive deck, retailing at a modest £77.00 or so. The unit was an auto-return model, fitted with a JVC *Z1-S* cartridge (a spherical-tipped version of the *Z1*). Downforce was specified at 1.5–2.0g, with the compliance at 25cu, the latter rather high considering the not inconsiderable effective mass of the arm. With cartridge and mounting, total moving mass was close to 25g, resulting in a low cartridge/arm resonance of 6.8Hz, which means that compatibility with the supplied cartridge was none too good. The arm capacitance was quite high at 250pF and some looseness was observed in the arm bearings, although this is probably understandable considering the price level.

The instructions were quite good except for the section pertaining to cartridge alignment. The supplied *Z1-S* was in fact set up to a 49mm overhang and the spec quoted 48mm, but worse still, both were in fact wrong, the ideal figure for this arm being measured at 45mm. Such mistakes are hard to credit with a company of JVC's size and reputation, as 4mm of overhang misalignment significantly increases cartridge distortion and also degrades separation.

A thin rubber mat provided reasonable damping of the light platter, the combination just weighing 0.7kg. The plinth was mounted on the usual feet, and testing exposed a serious platter resonance at 20Hz, due to inadequate stiffness of the main bearing and its mount, while the plinth lateral mode was present at 16Hz. The resonant polystyrene lid was of course unavoidably well coupled to the arm via the plinth hinges.

Lab performance

The weighted wow and flutter was satisfactory, but wow alone was worse than average at 0.2%. Speed accuracy was satisfactory, slowing under load minimal, and start up very rapid at approximately 0.5 seconds. The rumble level was adequate but below average at 66/67dB, and although the maker's specification was met, spectral analysis revealed a wide spread of motor vibration breakthrough.

The arm had a fairly high effective mass at 18g, suited to low compliance cartridges. As supplied the lateral geometry was suspect but a revision of the overhang to 45mm, or better still using an accurate protractor would correct this problem. The arm was very well finished and quite well engineered although the biasing was only just beginning to work at 1.5g setting, and hence is not recom-

mended for use below a 2g downforce. Vertical friction was satisfactory but the lateral value was rather high, again precluding the use of low downforce cartridges. No accuracy problems were present on the downforce calibration however, and the cue was fine.

Arm resonances were classed as just average, with the break at 210Hz quite severe and several modes recorded thereafter. This result is, however, fairly typical of this type of arm. On acoustic breakthrough the *JLA-11* scored slightly better than average if a trifle peaky at 230Hz. Conversely for vibration isolation and feedback resistance it was placed below average, although hum induction was very good and impact shock resistance just average.

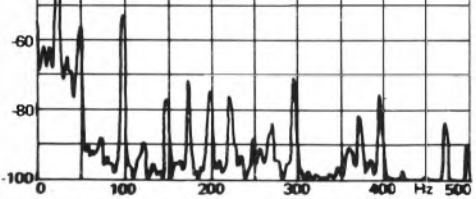
Sound quality

Considered to be somewhat below average the susceptibility to feedback in the bass was reflected by the bass sound quality – light, 'boomy' and lacking in real 'weight'. Otherwise the sound balance was quite neutral, although a loss of detail and depth ambience was apparent on stereo information and slight motor rumble was also audible on occasion.

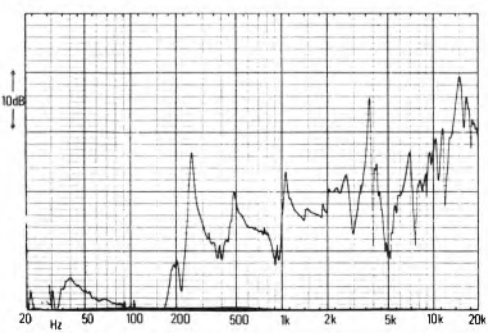
Conclusion

This unexceptional deck does not make the recommendation category for its price grade, despite the inclusion of a fitted cartridge. The latter was not (on paper at least) particularly compatible, while the rumble, friction and bias compensation were below par, and feedback resistance unsatisfactory.

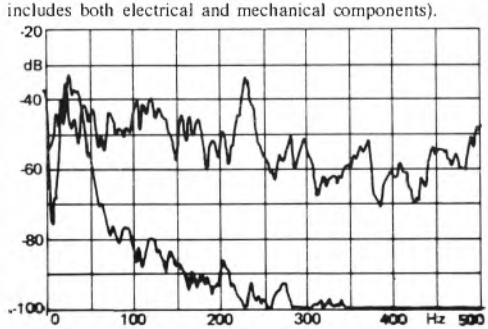
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto return, belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.12%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.2%/0.06%
Absolute speed error	−0.15%
Speed drift 1 hour/load variation	mains synchronous/−0.2%
Start up time to audible stabilisation	0.5secs
Rumble: DIN B wtd L/R av (see spectrum)	66/67dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	11g
Type/mass of headshell	universal detachable/10g
Geometric accuracy	fair
Adjustments provided	overhang, lateral angle, tilt
Finish and engineering	very good/fairly good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	100mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	approx 75mg/225mg
Downforce calibration error: 1g/2g	<0.05g/−0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.2secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	75pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	43.8(w) x 38.2(d) x 14.5(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	very good/below average
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£77



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

JVC QLF4

JVC, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621

Features facilities setting up and use

Of the three JVC models reviewed the *QL F4* is the only one offering fully automatic operation. Visually it resembles the *QL-A2*, and as the type number suggests a quartz reference oscillator for accurate speed is incorporated, this controlling the flat profile direct drive motor via a frequency generator servo system.

In common with the *QL-A7,* the *F4* arm has adjustments for tilt, height, and overhang, and was well aligned. No cartridge was supplied, the universal socket headshell ready to accept any compatible model. Estimated effective mass at 14g with moderate damping, a 1.25-2g tracking cartridge with a 10-20 cu would be suitable. The non-adjustable rubber feet did not provide much freedom of movement from shock or vibration isolation, although the attractive single band strobe was extremely clear and flicker free, the led illumination derived from an internally generated reference frequency.

Lab performance

Good wow and flutter was recorded with the 0.12% linear flutter reading somewhat on the high side. The quartz lock ensured superb speed accuracy and stability, while the lack of overshoot and the attendant good torque meant that dynamic wow could not occur. Start up was rapid at 1.5 seconds and rumble very good at 73-74dB, proving quite inaudible in practice. However, acoustic breakthrough levels were rather poor especially in the 50-80Hz range. In apparent contradiction, feedback was classed as good (lid up or down) but shock resistance was poor.

A rather peaky character was revealed by the arm resonance graph, somewhat below average in terms of control and quality of breaks. Conversely the arm proved to be well adjusted and had excellent downforce plus biasing, with low friction and an effective cue action.

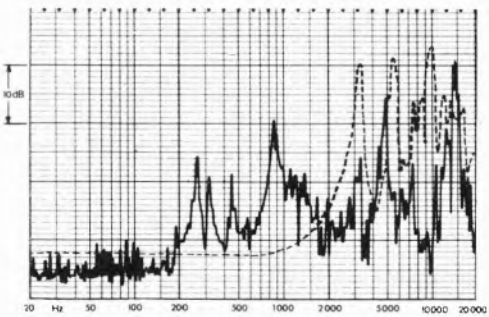
Sound quality

Partly due to the stable tracking performance of the arm and the good feedback margins that were achieved in the auditioning location, this deck achieved an 'average' rating for sound quality, agreeing fairly well with its price. A trace of that 'loud' midrange effect was present, with a softening of bass detail, upper bass life and low bass recession. The midrange musical balance tended to the 'cold' side, with a thinner elevated upper band. Fairly good hum levels were obtained with a sensitive moving-coil cartridge and moving magnet types proved excellent in this respect.

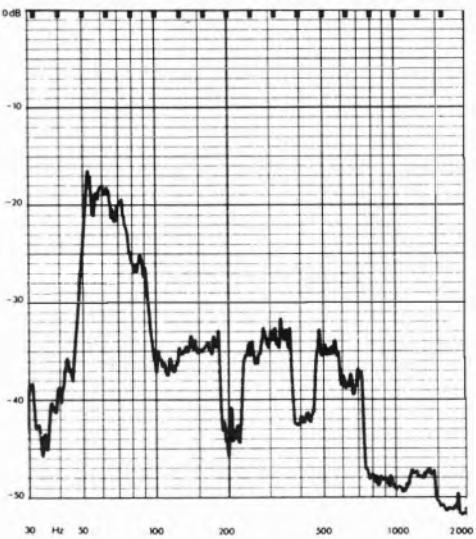
Conclusions

While the value for money is insufficient for the *QL-F4* to gain a recommendation in this report, it remains a reasonable turntable with well above average arm quality except for its wide band resonance characteristics.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic quartz direct drive
Platter mass/damping	1.25kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.10%/0.12%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	73/74dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5g
Geometric accuracy	good
Facilities for adjustment	till, overhang
Finish and engineering	good
Ease of assembly/setting up	fairly good
Friction lateral/vertical	50mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/165mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/4.0secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	moderate
System as a whole	
Size/rear clearance for lid	46(w) x 36.5(d) x 14.9(h)cm/4.2cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/very good
Vibration or shock sensitivity	poor
Ease of use	very good
Estimated typical purchase price	£210



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

JVC QLA5

JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6–8 Priestley Way, London NW2. Tel. 01-450 2621

Features, facilities, setting up and use

This model is the key member of a series of JVC turntables with the number 5 in their title, being more or less representative of the technical performance of the group as a whole. To take them individually, the *QLA5* is a quartz referenced direct drive deck with an auto-return function, with the *QLA5R* basically the same but possessing a reject/auto return which may be actuated by a remote control unit, and finally the *LA55*, comprising a *QLA5* but without the quartz speed reference. All come fitted with the JVC *Z1S* cartridge noted in the *LA11* review, and as mentioned there, the compliance would appear to be too high for proper compatibility with the accompanying tonearm. In addition to the two quartz locked speeds, the *QLA5* offered fine variable control with a linear array of levels providing indication of the set deviation over a ±6% range. An unimportant but attractive feature was the colour change apparent on the stroboscope illuminator prism, this altering from red to green when quartz lock was engaged.

The same faulty cartridge alignment instructions were provided as for the *LA11*, the supplied cartridge again incorrectly set; 45mm is the optimal overhang measurement and not 48mm as stated by JVC and this approximately doubles the tracking error for the arm. Although the first sample demonstrated excessive lateral arm friction at some 150mg, the second was rather better at 60mg, but the plinth was not particularly well decoupled on its resilient feet, possessing complex resonances at 10, 16 and 20Hz, these too close to the arm/cartridge region for comfort.

Lab performance

The weighted wow and flutter was fine with excellent speed stability and good torque, resulting in a quick 1.4 second start up time. A trace of wow overshoot was detected but the high torque precluded any subjective criticism on this score. The weighted rumble reading was pretty good if not quite up to the 'better than 75dB' standard quoted by the manufacturers. Two static electronic components were shown by the rumble spectrogram at 50Hz and 250Hz, but the remainder were mechanically generated motor rumble. The mains frequency selected content suggests 'ripple' on the motor power supply, whilst the others were pole originated.

The arm effective mass was approximately 14g and suited medium to low compliance cartridges (12–15cu), with the cable capacitance low at 75pF. The incorrect geometry has already been mentioned as has the poor lateral friction of the first sample. However bias compensation was of the right order and in the correct ratio from rim to

centre with downforce calibration to within 5%, and cue drift negligible, though the descent rate could have been quicker than the measured 3 seconds.

Rated just above average on arm resonances, generally good control was shown apart from the headshell/arm flexure at 190Hz which resulted in an acceptable 12dB displacement in the curve section before and after resonance.

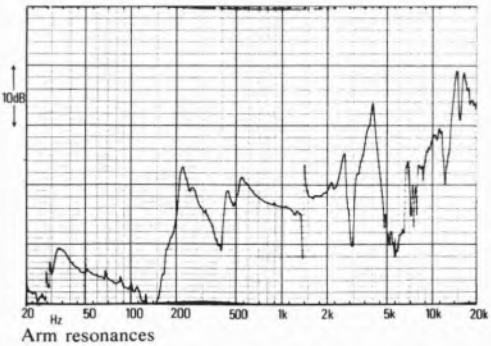
The acoustic breakthrough response was distinctly below average, showing a peaky uneven characteristic particularly at 150Hz, this sensitivity reflected by the vibration isolation measurement at a similar frequency. The latter breakthrough was judged average as was impact shock resistance, but in the listening test location the feedback behaviour was less satisfactory.

Sound quality

Ranked below average, the midrange was compressed in character and sounded 'louder' than usual, with restricted depth and ambience information. The overall balance was quite pleasant, but the low frequencies were softened noticeably and lacked definition.

Conclusion

In view of the below average sound quality, the average rumble content and the rather ordinary and incompatible cartridge supplied, it was felt that no recommendation was possible. In addition, there were quality control queries as regards the arm, while the recommended geometry also requires correction.



Arm resonances

GENERAL DATA — Integrated Turntable

Motor Section

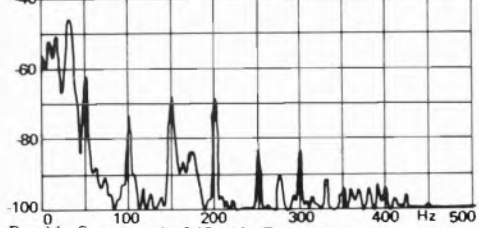
Type	auto-return, quartz direct drive
Platter mass/damping	1.4kg/good
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd Sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.09%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.4secs
Rumble: DIN B wtd L/R av (see spectrum)	71/72dB

Arm Section

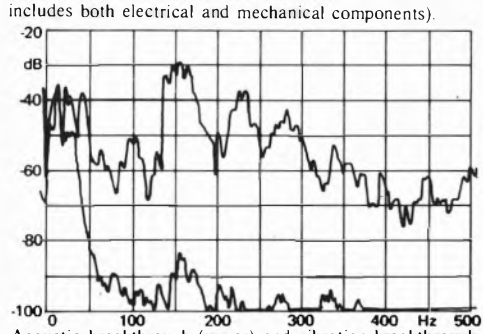
Approximate effective mass inc screws, excl cartridge	14g
Type/mass of headshell	universal detachable/8g
Geometric accuracy	fair
Adjustments provided	overhang, lateral angle, tilt
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	(60 2nd sample) 150mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/250mg
Downforce calibration error: 1g/2g	+0.05g/+0.05g
Cue drift/8mm ascent/descent	negligible/2secs/3secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	75pF/soft decoupled counterweight

System as a whole

Size/clearance for lid rear	43.7(w) x 38.0(d) x 13.2(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£224



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

JVC QLF6

JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner. 6–8 Priestley Way. London NW2. Tel. 01-450 2621

Features, facilities, setting up and use

This fairly prestigious model costs around £250.00 and sported some interesting features. The main plinth was an alloy die casting with the remaining section moulded in a high quality density loaded plastic. A quartz locked design, the motor used direct drive frequency synchronisation rather than the usual proportional voltage control, and potentially this offers even greater speed stability both in the long and short term. It also incorporated some torque and efficiency improvements, these later confirmed under test.

A fully automatic design, the arm employed a universal detachable headshell and was of medium/high effective mass (15g), being more suited to low compliance cartridges, although this compatibility recommendation is moderated by the incorporation of a viscous damping device in the bearings. Provision was made for independent dialled adjustment in both the lateral and vertical planes, this damping proving quite effective in moderating the resonance of high 'Q' over-compliant cartridges; for example, it reduced a 15dB rise to 9dB or so, but had much less effect on better damped low compliance models such as a moving-coil type. The damping was also found to increase the apparent static bearing friction by 50mg or so.

Two speeds were provided plus fine variable control of ±6%, this obtained when the quartz lock was disengaged, and with the deviation from nominal shown by a centre zero indicator meter. In general the unit was well engineered, very well finished, and the arm bearings were quite well adjusted with only slight play.

Lab performance

The motor was quite excellent, with (on our test rig) unmeasureable wow and flutter, superb speed accuracy and negligible speed variation under load, or with time. The stability in the variable speed mode was also excellent. Start up was rapid at 1.1 seconds for the reasonably heavy 2.1kg platter, indicative of ample torque. The DIN rumble was very good at −77dB with the spectrum analysis composed of electrical components at 50Hz and 150Hz plus some residual motor noise, the latter mainly appearing below 50Hz. At 15g the arm was of medium/high effective mass and a low lead capacitance of 80pF was noted, allowing scope for flexible cartridge/amplifier electrical matching.

Arm friction was satisfactory at 50mg lateral with the damper off, but virtually doubled with it

engaged – not really good enough at this price level. On the other hand, the bias compensation was accurate and effective, while downforce was well calibrated and cue operation fine, as were all the automatic play facilities.

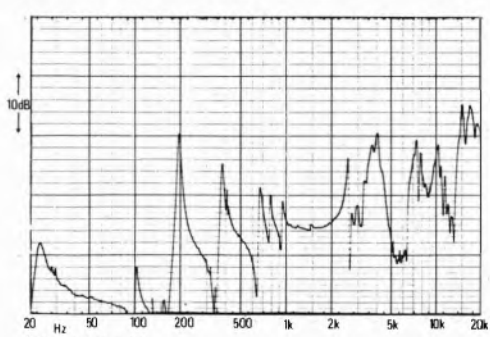
Rated just average on arm resonances in the 20Hz–20kHz audio range, a minor counterweight mode was present at 100Hz followed by a severe arm/shell mode at 180Hz, the latter repeated harmonically at 360Hz. Further resonances were also present and the result looked none too promising. Rated as average on acoustic breakthrough, some 'peakiness' was observed, while the ineffective insulator feet provided below average vibration immunity. With average impact shock resistance and less satisfactory average feedback resistance in the listening location, at least the hum levels were good.

Sound quality

Rated a disappointing 'below average', the *QLF6* sounded somewhat coloured with clearly deficient low frequency definition and extension, and only moderate stereo depth and ambience, although frontal stereo imaging was satisfactory.

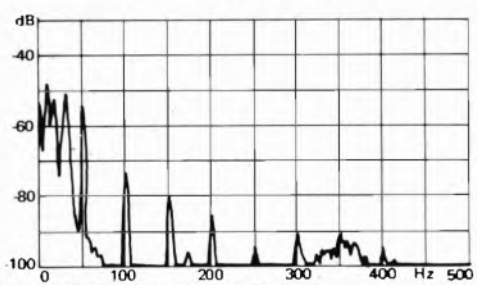
Conclusion

Despite the excellent motor quality, the key areas of arm and plinth coloration have not been adequately dealt with. A reasonable sound quality is in fact obtained with solid shelf mounting, but the overall quality is inadequate for a recommendation, considering the relatively high price involved.

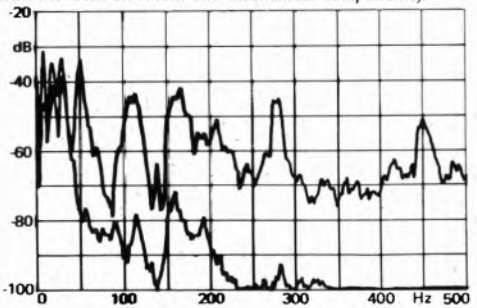


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	fully automatic, quartz direct drive
Platter mass/damping	2.1kg/fairly good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.04%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.08%/<0.04%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz <0.05%/<0.05%
Start up time to audible stabilisation	1.1secs
Rumble: DIN B wtd L/R av (see spectrum)	76/78dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	15g
Type/mass of headshell	universal detachable/11g
Geometric accuracy	good
Adjustments provided	overhang, tilt
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	50mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/225mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.4secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	80pF/separate horiz & vert oil damping + decoupled counterweight
System as a whole	
Size/clearance for lid rear	45.6(w) x 39.5(d) x 14.3(h)/5.0cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£250



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).

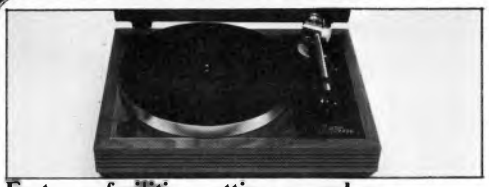


Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Linn Sondek LP12

Linn Products Ltd., 235 Drakemire Drive, Glasgow G45 9SZ. Tel. 041-634 3860



Features, facilities, setting up and use

Arguably something of a 'hi-fi warhorse', the *LP12* appears here for the third time in *Choice*. It is so well known that a retest using the new measurement standards was considered worthwhile, although we had no real doubts concerning its fine sound quality. To recap, this is a spring subchassis model with a massive precision turned zinc alloy die cast platter weighing 4.1kg and fitted with a removable felt mat, being driven at a single 33⅓rpm speed via a flat ground rubber belt. The subchassis resonance was below that for the arm/cartridge at 5.8Hz lateral and 4.8Hz vertical, although the chassis dynamic balance was not particularly good. The well finished plinth sported improved hinges as well as a less resonant type of acrylic lid, and was still manufactured from solid rather than composite timber. Full performance was however only attained when the internal cabling was properly dressed so as not to impede the subchassis freedom. Fine as it was, I was not entirely happy with the long wooden arm mounting board and its potential for flexure with such super-rigid arms as the *Ittok* and the *Syrinx*.

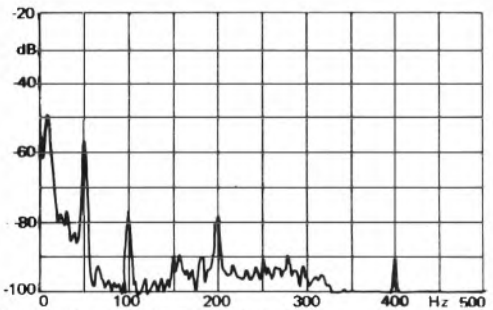
Classed as 'very good' on acoustic breakthrough, a mild peak was observed at 230Hz this believed due to the record on the felt mat. Vibration isolation was also very good, with one or two minor harmonic couplings via the springs, while impact shock resistance was just average and both hum levels and acoustic feedback very good. Wow and flutter was fine if not outstanding, with the speed a little slow, but loading resistance good. Start up at 4.5 seconds was reasonable in view of the massive platter, while rumble averaged a very good 77dB, though the spectrogram did show that the fairly stiff belt did serve to couple some mild motor vibration to the platter. On this graph the electrical components were however negligible.

In the top category on sound quality, most arms performed very well with this model*, the *Ittok* providing clean deep bass and excellent transients, plus a clear and spacious stereo image free from muddle and compression. It is however worth noting that while the *Ittok* sounded very good with the *LP12*, we felt the bass quality was slightly better from the *Systemdek* with its more rigid arm mounting arrangements.

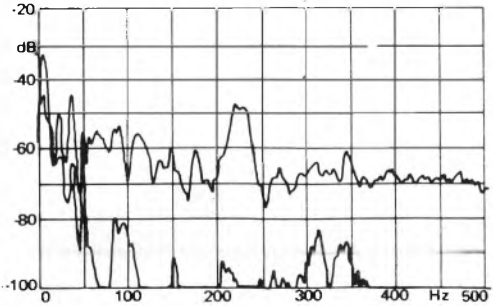
Continuing to deserve recommendation, this simple turntable has all its engineering in the right places to produce optimum sound quality.

**As with other subchassis models, side-entry cabled arms were the most successful due to the limited internal depth.*

GENERAL DATA	Motor unit
Type	belt drive
Platter mass/damping	(inner & outer) 4.1kg/very good
Finish and engineering	very good/excellent
Type of mains lead/connecting leads	3 core/—
Speed options	33⅓rpm
Wow and flutter (DIN peak wtd sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/0.07%
Absolute speed error	−0.3%
Speed drift 1 hour/load variation	synchronous/−0.15%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (see spectrum)	77/76dB
Size/clearance for lid rear	44.5(w) x 35.8(d) x 14.9(h)/5.7cm
Ease of use	fairly 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/average
Estimated typical purchase price	£294



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).

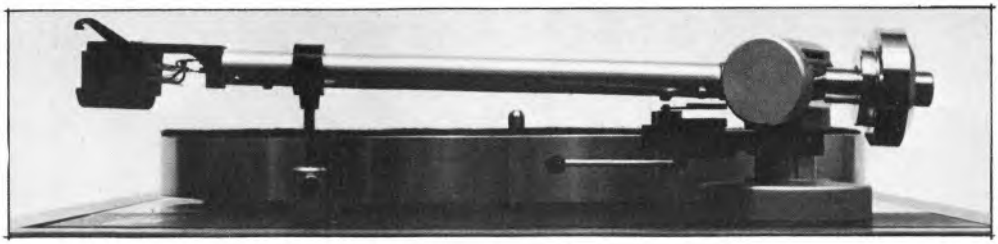


Acoustic breakthrough (upper) and vibration breakthrough

Linn Ittok LVII

Linn Products Ltd., 235 Drakemire Drive, Glasgow G45 9SZ. 041 634 3860

RECOMMENDED



This costly enthusiast's component enjoyed several years' gestation, and while it is of Japanese manufacture, certain details of its design were specified by Linn, who have been rigorous in their analysis and control of production quality and final performance. Both engineering and finish were in fact excellent. This arm is undoubtedly an engineer's rather than a stylist's creation, as every feature has a functional purpose. Clearly built for strength, the large diameter alloy arm beam – larger still than the Breuer – was securely attached to a perforated fixed headshell, the latter of extraordinary strength and provided with an ample surface for firmly screwing down the chosen cartridge. The shell fixings were slotted for lateral geometry adjustment, while the strength objective was continued at the massive and superbly adjusted bearings, which offered a single rigid coupling right through to the substantial three-contact-point pillar fixing. The cable was rather stiff, though the side entry plug was helpful for lead dressing. Bias and downforce were set by calibrated dials, the slightly decoupled counterweight having a sliding fit for zero balance adjustment.

Lab performance

The effective mass was moderate at 12g, suitable for the majority of moving-coil cartridges and a number of medium compliance low mass models with compliances of up to 20cu. Geometry was excellent (though no vertical tilt provision was made) while friction and bearing play were almost undetectable, and the bias compensation was spot on. Downforce was highly accurate and the cue operated well with a marginally slow descent, while lead capacitance was low at 80pF, allowing full matching flexibility on electrical grounds.

One of the very few models to be classed as 'good' on arm resonances, the mild modes up to 400Hz were mainly attributable to mounting on the test turntable and due to the arm's exceptional rigidity, while the first arm mode proper was at an exceptionally high though sharp 800Hz. The energy trend was hardly interrupted with a good characteristic thereafter.

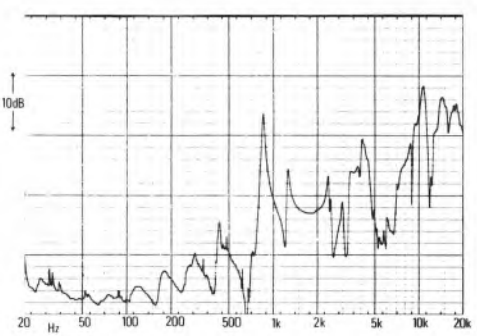
Sound quality

One of the best arms to be auditioned, it demonstrated satisfying clarity, focus and depth, while eveness was maintained throughout the frequency range. However we suspect that the bass was very slightly 'soft' and that the treble tended to be slightly bright but without the usual fizzy emphasis. Treble clarity was in fact striking.

Conclusion

Notwithstanding the price of around £230.00, this is virtually a textbook example of how an arm should be designed and made. A recommendation is therefore mandatory for what is in our estimation Linn's best product to date.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	12g
Type/mass of headshell	fixed/N/A
Geometric accuracy	excellent
Adjustments provided	height, overhang, lateral angle
Finish and engineering	excellent/excellent
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/200mg
Downforce calibration error: 1g/2g	<0.025g/<0.025g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.8secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	80pF/–
Estimated typical purchase price	£230



Arm resonances

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Marantz TT2000

Marantz (UK) Ltd., 203 London Road, Staines, Middx. Tel. 0784 50132

Features, facilities, setting up and use

This brand new model retailing at around £85.00 is one of an extensive range. Relatively inexpensive for a direct drive design, it also offered an up to date low mass pickup arm with special detachable headshell. An auto-return model, the platter was of rather light construction, but nonetheless weighing a reasonable 1.3kg with mat, the latter affording quite good damping. Fine variable control was provided in addition to the two fixed speeds, with a clear reflection type strobe for reference, the latter mains neon illuminated on the platter underside.

Apart from its low mass, the arm was straightforward, with the usual rotating scale counterweight, the latter decoupled a little *via* a resilient bushing. However the lateral bearing almost rattled, and cartridge alignment was by the clumsy overhang method, using an awkward 45rpm centre boss marking. The chassis/plinth was rather light and (in common with the Linn *LP12*) it possessed a hardboard underside, in this case with rather stiff isolator feet. The suspension resonances were placed at 12.5Hz lateral and 16Hz vertical, and were neither in the right range nor very effective, while the light resonant polystyrene lid was as usual closely coupled to the arm/platter. The main bearing quality was fine, but the motor assembly did not seem well fixed to the plinth, and at first this compliance was mistakenly believed to be bearing play.

Lab performance

The wow and flutter was quite good, with the motor generating reasonable torque and the second order servo control obviating any dynamic wow overshoot. Start up was fairly rapid at 1.5 seconds, and while the nominal speed accuracy was good, the drift over one hour was worse than average as was the slowing under a 2g load. Rumble was quite good at better than 70dB DIN B, the spectrogram revealing low level motor noise, with those readings at 250 and 350Hz identified as being of a static electrical nature, while the rest were mechanical – in other words motor-generated. So despite the favourable readings, this motor was not particularly 'clean'.

The arm effective mass was low enough at 6.5g to permit the use of almost all cartridges, thus resolving one severe criticism of Marantz arms made in previous reviews. The lead capacitance was average at 135pF, and with adjustment will allow matching with most cartridges. Proving well aligned, the arm also gave satisfactory levels of friction and reasonable bias compensation, even if the rim/centre ratio was in reverse. However the bias was found to increase lateral friction, the

rating in the main results table reflecting this fact, and in consequence tracking below about 1.6g is not recommended. The cue was drift free but gave slow rates.

On arm resonances the *TT2000* was judged below average, with the 28Hz counterweight mode quite serious and the headshell/arm mode at 155Hz severe and low in frequency, being repeated at the 2nd harmonic 310Hz. Overall the energy trend was quite broken up.

Rated as just average on acoustic breakthrough, the isolation was noticeably poorer around 250Hz. Vibration breakthrough, while extending to higher frequencies than usual, was at a reasonable level, while feedback was average at the listening location, hum was good and impact shock resistance average.

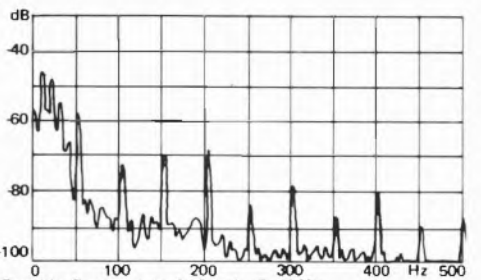
Sound quality

Rated below average, some oddities were apparent, notably treble coloration with a character change on vocal sibilants and cymbals, for example. Stereo depth information was suppressed and the low frequencies lacked a degree of precision.

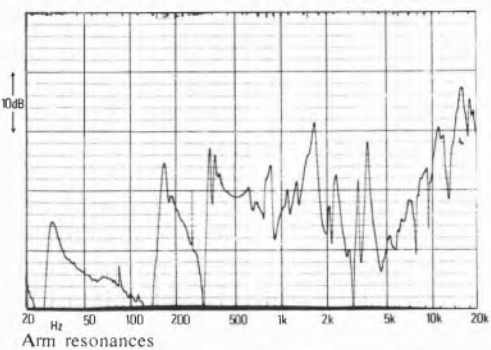
Conclusion

In many respects this was a quite reasonable turntable for the price, its low mass arm proving an asset where the better quality high compliance cartridges are concerned. It could well be worth thinking about even if our conclusions are not consistently enthusiastic.

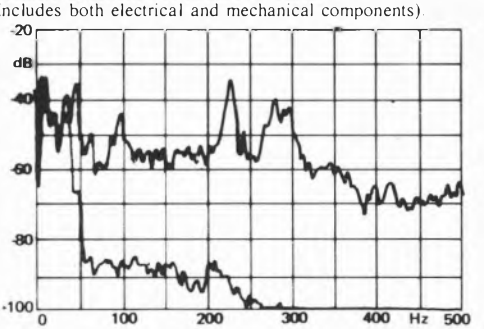
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto return, direct drive
Platter mass/damping	1.3kg/very good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.13%/0.08%
Absolute speed error	variable, <0.1%
Speed drift 1 hour/load variation	−0.4%/−0.45%
Start up time to audible stabilisation	1.5secs
Rumble: DIN B wtd L/R av (see spectrum)	70/71dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	6.5g
Type/mass of headshell	detachable special/3.5g
Geometric accuracy	very good
Adjustments provided	overhang, lateral angle
Finish and engineering	good/fairly good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	60mg/15mg
Bias compensation method	internal spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	250mg/150mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/3.0secs/3.0secs
Arm resonances	average
Subjective sound quality	below average
Lead capacitance/damping method	135pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	44.5(w) x 39.5(d) x 14.0cm/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£85



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components)



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Marantz TT4000

Marantz, Marantz (UK) Ltd., 203 London Road, Staines, Middx, 0784 50132

Features, facilities, setting up and use

The *TT4000* closely resembled the *TT2000* also reviewed in this issue, the major difference being the addition of a quartz lock speed reference for the motor, with a commensurate increase in price of some £60.00. Despite this, the facility for fine speed variation present on the *2000* was omitted. Our first sample worked satisfactorily although several measured parameters were a little poorer than the specification indicated, and were in fact significantly worse by comparison with the less expensive *2000*. Accordingly a second sample was obtained, which provided somewhat improved results for wow and flutter as well as rumble, but still did not reach the *2000*'s standard.

An auto-return design, the *4000* incorporated a low mass tonearm fitted with a special lightweight detachable headshell which weighed 3.5g including screws. In terms of torsion the arm was not felt to be very rigid (see arm resonance at 160Hz). The fairly frail plinth carried the rather resonant polystyrene lid, and this did not augur well for feedback and acoustic breakthrough (indeed, just average results were obtained for both these parameters). Plinth/foot resonances were measured at 12.5Hz and 16Hz, and these are likely to be coincident with or overlapping the arm/cartridge resonance range with the low mass arm, so that when plinth borne vibration is present they would tend to further excite the arm/cartridge.

Lab performance

The fairly light platter was well damped by the sensible mat, and the unit showed good finish, being quite well engineered. Wow was only just satisfactory on the first sample, improving slightly to 0.11% DIN with the second, but no wow overshoot was produced, which was a plus factor. As expected, with quartz referencing, speed accuracy was excellent, and the start up fine at 2 seconds. Sample one typically produced 63dB on rumble which was audible on listening tests, but the second improved to an average of 69dB and did not give any problems. The spectrum analysis showed some electrical contribution, but in the main the noise energy was motor generated, the spectrum illustrated being that for the first sample tested, showing a strong rumble content at 200Hz.

Well aligned geometrically, predictably the arm mass was the same as for the *2000* at 6.5g, although lateral friction was higher in this case at a just satisfactory 75mg, while the bias compensa-

tion was less accurate and the disc centre value rather low. As in the case of the *2000,* the arm resonances were also judged to be below average, with the 30Hz counterweight mode poorly damped and the 160Hz torsional resonance severe. This reappeared an octave higher at c. 320Hz, while the energy trend was distorted at higher frequencies as well. The acoustic breakthrough was rather peaky at 230 and 270Hz, but the low mean level indicated an average rating, with the vibration isolation similarly rated.

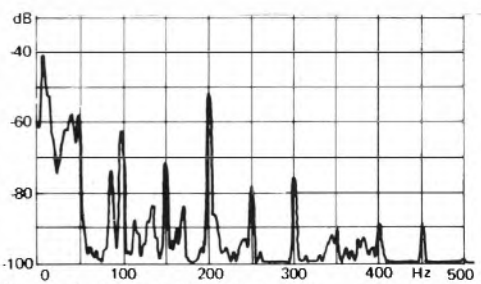
Sound quality

Considered to be below average, the listening test results suggest that the less expensive *2000* was in fact marginally superior to the second sample *4000.* Essentially similar in character it appeared possible that the poorer arm tracking parameters, combined with the higher rumble, arm friction, and wow and flutter served to tip the subjective balance scales in favour of the cheaper model.

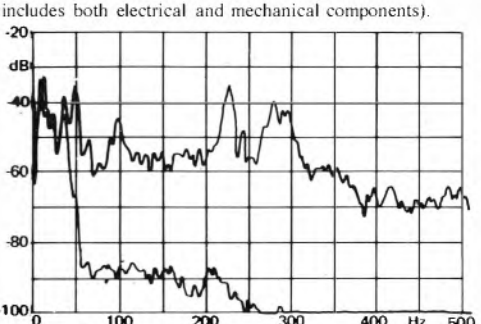
Conclusion

As regards the two Marantz decks, the *4000* would appear to offer exceptional speed accuracy but a poorer overall performance by comparison with the cheaper *TT2000*, and one also loses the variable speed control with the more expensive model.

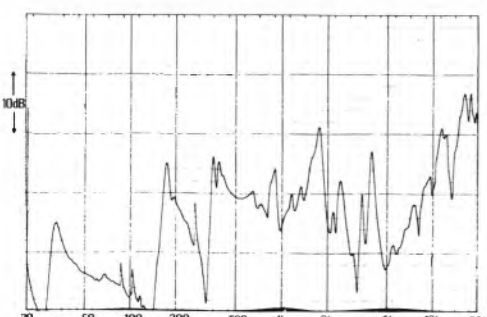
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto return, quartz direct drive
Platter mass/damping	1.3kg/very good
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	(2nd sample 0.11) 0.15%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.18%/0.13%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	2.0secs
Rumble: DIN B wtd L/R av (see spectrum)	(2nd sample 67/71) 62/64dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	6.5g
Type/mass of headshell	special detachable/3.5g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	75mg/20mg
Bias compensation method	internal spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	approx 200mg/125mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/2.5secs/2.0secs
Arm resonances	average
Subjective sound quality	below average
Lead capacitance/damping method	133pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	44.5(w) x 39.5(d) x 14.0(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£115



Rumble Spectrum (ref 10cm/s @ 1kHz: includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Marantz 6170

193 London Road, Staines, Middlesex.
Tel. Staines (0784) 50132

Features facilities setting up and use

One of a new range of turntables recently released by Marantz, the *6170* is a relatively inexpensive direct drive model, with an auto return facility. Fitted with the latest Matsushita motor, the deck used a die cast platter with integral stroboscope markings, the latter seen through an illuminated viewing window. The finish was attractive, a plastic moulding spray-painted in a light metallic gold, while the internal construction was quite good, although the mains transformer was not isolated from the plinth. In addition, the latter was not effectively decoupled from the environment, since the rubber feet offered very little lateral freedom and only a limited range is the vertical plane, and produced a vibration frequency of 8Hz — right in the cartridge subsonic frequency range. Two fine speed controls were fitted for $33\frac{1}{3}$ and 45 rpm, and all facilities operated smoothly.

Lab performance

While wow and flutter readings were almost in the excellent category, rumble was only classed as 'good' at 67/64dB, although it is not known whether this is typical of the new motor. However, the latter did possess better loaded speed stability that its predecessor, together with reduced speed overshoot, and these factors should eliminate the dynamic wow problem of the old Matsushita motor. Speed drift was rather high at –0.3% over half an hour, while measured acoustic feedback was about average, the band at 200-300Hz being rather high. In practice acoustic feedback was pretty good although vibration resistance came out as poor.

The resonance curve showed a none too promising characteristic with the entire midrange 250 to almost 2kHz badly dissected, matters improving somewhat at higher frequencies. Friction levels were reasonable and bias compensation a trifle high while the cue and downforce calibration were both fine. Geometrical accuracy was considered good, while the effective mass was at an estimated 14g, with no subsonic damping.

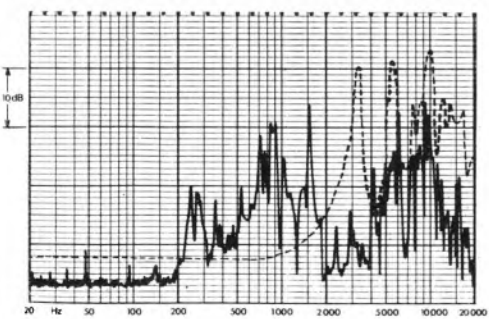
Sound quality

No wow was detectable, while rumble, although just audible, was still quite satisfactory. Rated as 'average' overall the turntable was considered to have a fair bass register, if on the 'full' side. The midrange was a trifle coarse and loud, with reduced depth information, although frontal imaging was fairly good. By comparison, the treble range was slightly dull.

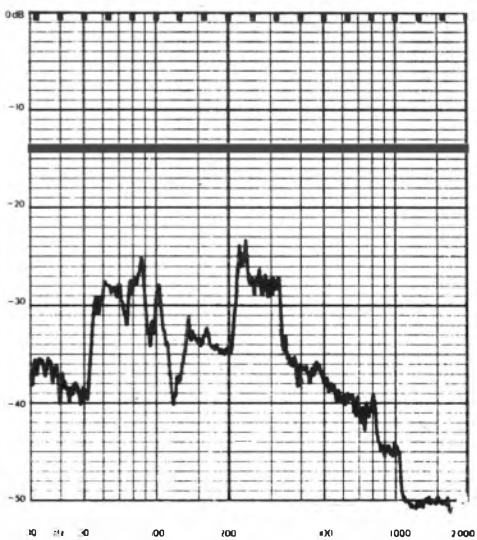
Conclusion

Best suited to low to medium cartridges (8-15cu), the *6170* is an attractively packaged turntable giving a fair performance at a below average price, and is thus worth considering, particularly if used on a firm surface.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto stop, direct drive
Platter mass/damping	1.5kg/good
Finish and engineering	good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.7%/<0.7%
Speed accuracy/drift/variation under load	adjustable/-0.3%/-0.2%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	67/64dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	9.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/220mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/4.0secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45(w) x 36(d) x 13.5(h)cm/6.4cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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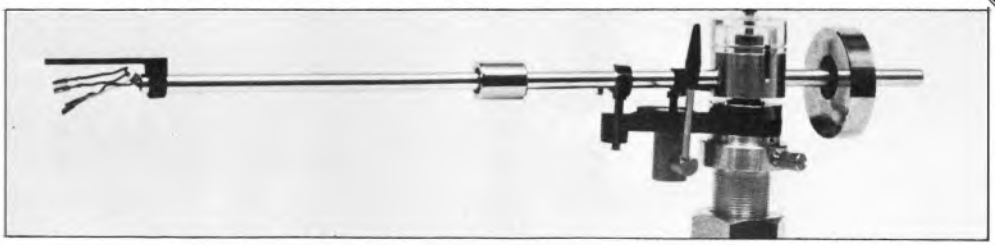


Features, facilities, setting up and use

This Japanese made arm was one of the first low mass component tonearms to be produced for an independant distributor, in this case the British firm Mayware. Since its introduction a few years ago a number of improvements have taken place. In pursuit of very low mass a rather flexible alloy sheet was used for the headshell in the original model, and this has now been replaced by a substantial strong casting; nonetheless the effective mass remains low at 4.5g.

A beautifully engineered and finished unipivot design, the *4 III* offers variable damping at subsonic frequencies using a silicone fluid well around the unipivot, with convenient access via a removable pillar cap made of clear acrylic. The counterweight was decoupled on a rubber bush and afforded some upper range damping, while a calibrated downforce scale using a rider weight on the main tube was also incorporated, and proved a trifle loose on our sample. The thread/pulley/lever bias compensator was also calibrated, the arm proving easy to set up and align, and offering full geometric adjustments; a tracking protractor was provided. Readers may recall this arm being recommended in the last issue when it cost around £70.00, and as the price is now £50.00 despite inflation (a petrocurrency benefit?), things looked promising indeed.

Lab performance

At 4.5g the effective mass was low, as was the lead capacitance at 85pF, thus rendering the matching flexibility good. As with other low mass arms extra mass may be added if required by using a backing plate on the cartridge, and this may well prove worthwhile with some low compliance moving-coil models. The *4 III* also proved very well aligned, and delivered excellently low friction. Although the bias compensator gave high values, these were easily corrected and the mechanism added little extra friction. Downforce was accurately calibrated and cueing fine, if a trifle slow in descent. Numerous 'breaks' were apparent, but resonances were classed as above average due to the maintenance of the correct energy trend. The upper register was a bit 'scrappy': the mode at 62Hz was due to the counterweight bush and that at 600Hz to the arm tube, the latter also related to the smaller amplitude flexure at 300Hz. In sequence a 1.2kHz mode was also present, with that at 2.4kHz possibly related, though it could have been coincidental.

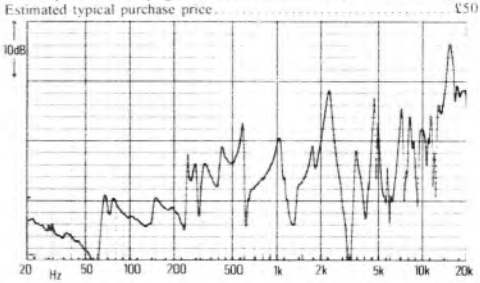
Sound quality

Rated as 'good', the arm gave fine stereo, clean bass and a generally well integrated sound. The upper range tended to slight roughness and forewardness, but not unduly so.

Conclusion

This arm represents a complete and highly versatile product, whose good standard of engineering, as well as its good sound quality ensure a firm recommendation at its current price.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	4.5g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, height, overhang, lateral angle
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	20mg/<15mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	250mg/265mg
Downforce calibration error: 1g/2g	<0.02g/<0.03g
Cue drift/8mm ascent/descent	negligible/0.8secs/2.2secs
Arm resonances	above average
Subjective sound quality	good
Lead capacitance/damping method	85pF/fluid well unipivot
Estimated typical purchase price	£50



RECOMMENDED

Michell Focus

Michell, J. A. Michell Engineering Ltd., 2 Theobald Street, Borehamwood, Herts. 01-953 0771

Features, facilities, setting up and use

This attractively presented turntable came supplied with the Focus arm but the deck may be obtained separately and it is also planned eventually to make the arm available independently too. Overall finish and engineering were very good. An entirely manual design built on a laminated plinth suspended on three coil spring feet, the fabricated non-resonant acrylic lid was hinged from the plinth and was not isolated from the arm. The deck was powered by an isolated synchronous motor driven *via* a long rubber cord.

The arm was a jewelled inverted unipivot design with optional silicone fluid damping. It comes comprehensively equipped with geometric and balance adjustments, and with care both overhang and height may be corrected during play. A genuine low mass design suited to medium and high compliance cartridges, (20–40cu), the lead capacitance was fairly high at 220pF and needs consideration with some cartridge/amplifier combinations.

The system was reviewed in the last issue in a rather early production form, and some improvements have taken place since then. Speed accuracy is now much better and shows great stability under load, while the bias compensation calibration has been resolved, and the structural form of the arm tube finalised. This is now a composite laminated beam made from two closely fitted low-'Q' alloy tubes. A metal alignment gauge was supplied which we did not find particularly effective. In fact one of the test cartridges (a Dynavector *10X*) could not be aligned at all, and we found a conventional protractor more useful. The rigid die-cast headshell was fixed at two points for maximum rigidity, and both overhang and tilt adjustments were incorporated. The feet provided an effective 5Hz resonance well clear of the arm/cartridge resonance zone.

Lab performance

Wow and flutter was just satisfactory, with a poorer than average linear wow result of 0.15% which is not as good a result as for the sample reviewed last year. Speed accuracy and load stability were fine with start up reasonably quick at 2.5 seconds, while the 2.1kg platter with a thin suede surface proved well damped with a record present. Rumble has been improved and now measured a typical 70dB. Examination of the spectrogram revealed that the resonances were not of an electrical nature; rather all were mechanical, including the 50 and 100Hz components.

The arm mass was low at 5g with excellent geometric accuracy and versatile adjustments. In the last issue we noted friction levels were not brilliant but they were actually worse for this sample. The manufacturer was contacted, investigated the fault, and demonstrated to us that a manufacturing stage involving setting the leadout wires was resulting in excessive tension inside the arm pillar. Correct adjustment resulted in figures c.20mg, and this will be applied to all future production we understand. The bias compensation was consequently difficult to measure but appeared to be of the right magnitude and in the correct ratio. The downforce calibration produced readings about 12% high, but the cue operation was fine.

This new tubed version improved on its pre-

RECOMMENDED

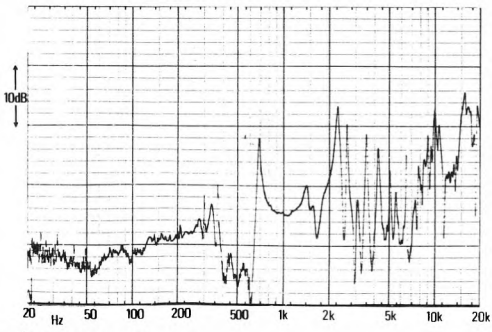
decessor's resonances, and provided a break-free response to 400Hz with the major mode delayed until 650Hz. Some irregularities were however apparent from 2–5kHz, but overall the result was above average. Acoustic breakthrough was classed as good, with the heavy acrylic lid proving its worth here, and the vibration isolation was in fact very good. Hum levels were fine despite the combined earth wiring, and the feedback resistance was good, but conversely, impact shock was not well received.

Sound quality

Rated significantly above average, the Focus system was quite competent, though not without faults. The whole sound did not appear completely integrated, with some loss of definition apparent in the low bass, as well as the mid and extreme treble, the latter possessing a 'wispy' character on occasion. It is more than likely that the arm friction levels disturbed matters, and an improvement in stability and clarity would result if the friction levels were lower.

Conclusion

In many respects the *Focus* shows significant improvements in a number of areas over the earlier sample in the last edition which was recommended with some reservations. Once again certain 'niggles' are bound to mute our enthusiasm somewhat, though we have every reason to believe they will be solved in production, so the high standard of presentation and finish, plus a sound quality rating that would probably improve to 'good' with a perfect sample means that our recommendation for the product as a combined player or separates at reasonable prices still holds.



Arm resonances

GENERAL DATA — Integrated Turntable may be available without arm

Motor Section

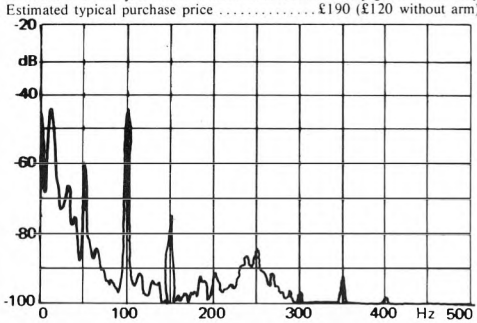
Type	manual belt drive turntable
Platter mass/damping	2.1kg/good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	3 core/ phono, no earth wire
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.12%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/<0.05%
Absolute speed error	−0.13%
Speed drift 1 hour/load variation	synchronous/−0.25%
Start up time to audible stabilisation	2.5secs
Rumble: DIN B wtd L/R av (see spectrum)	69/72dB

Arm Section

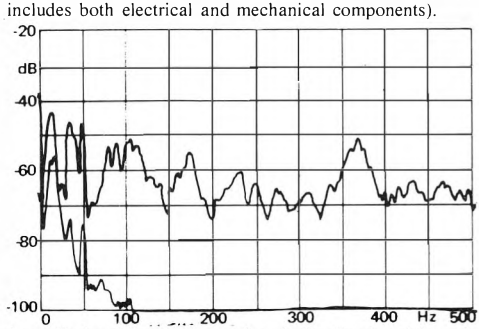
Approximate effective mass inc screws, excl cartridge	approx 5g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	excellent
Adjustments provided	height, tilt, overhang, balance (lat), angle (lat)
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	good/some skill required/very good
Friction: typical lateral/vertical	(2nd sample 20mg/20mg) 175mg/150mg
Bias compensation method	thread and weight, no pulley
Bias force: rim/centre (set to 1.5g elliptical)	approx 200mg/approx 250mg
Downforce calibration error: 1g/2g	+0.1g/+0.2g
Cue drift/8mm ascent/descent	negligible/typically 0.8secs/1.5secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	220pF/sil fluid well around unipivot

System as a whole

Size/clearance for lid rear	43(w) x 37.6(d) x 15.2(h)/8.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	very good/satisfactory
Estimated typical purchase price	£190 (£120 without arm)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Micro-Seiki MB10

Harman UK, St. John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR.
Tel. 049-481 5221

Features, facilities, setting up and use

Although this model appeared in the first *Turntables and Cartridges* issue, it was subsequently unavailable at the time of the second edition, but was re-released and has been completely re-tested. Basically a manually operated design, the price was a little high for a deck of this type, although a modest and correctly aligned cartridge was included A belt drive model powered by a synchronous motor, the *MB10* was a neat looking design, with a dark metallic finish on a fabricated wood plinth. Unfortunately in one respect, namely the efficacy of the isolator feet, the *MB10* did not look too promising. The plinth resonance was at a high 17Hz and provided poor isolation at higher frequencies, while the light and rather resonant polystyrene tinted cover was also unhelpful with regards to acoustic breakthrough.

The arm, fitted with a rigid alloy headshell, was of the universal fixing socket type, proving medium to high in effective mass, and suited to cartridge compliances of below 15cu. Lead capacitance was higher than usual at 200pF. The finish was quite good with the arm bearings fine if not very substantial. However some play was evident in the main platter bearing and the bias compensator was faulty, requiring to be reset beneath the deck for correct operation.

Lab performance

Coincidentally all the wow and flutter readings were 0.1%, and all fine at that. The speed accuracy was also good, running slightly fast with an almost equal slowing under the test load, while the rather light (0.8kg) but well damped platter was accelerated to rated speed in 0.8 of a second. Despite the bearing slackness, the rumble result was more than satisfactory at 70/71dB DIN. Little electrical breakthrough was present on the spectrogram, with the noise present being of mechanical origin.

The arm proved well aligned geometrically but bearing friction was on the high side, with the 100mg lateral figure only just satisfactory. Biasing was quite good though excessive, requiring a reduction in the dialled value of some 30%. Downforce calibration was about 10% low, and the cue operation was rather slow, unnecessarily prolonging the damage-inducing 'half contact' period between the stylus and groove.

Judged below average from the arm resonance point of view, the graph showed a severe break at 50Hz pointing to a lack of rigidity in the pillar or

counterweight. The headshell mode was also severe at 180Hz with further steep breaks to 600Hz; after a short interval with reasonable control the 2.5–8kHz band was also strongly interrupted.

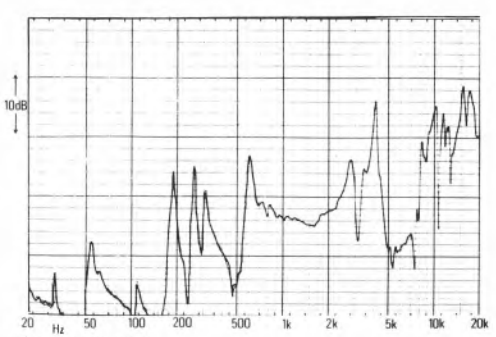
Acoustic breakthrough was also classed as below average, the graph illustrating peak resonances at 60Hz and 180Hz, with the overall trend most uneven. Rated as poor on vibration isolation, a peak in transmission was noted at 200Hz, and in general the trend was well below average, particularly below 100Hz. Feedback at the listening test location was poor, demonstrating little margin at low frequencies, while impact shock immunity was also poorer than average.

Sound quality

Rated well below average, the *MB10* was significantly poorer than its appearance and price would otherwise suggest. On the test location the low frequency sounds were boomier and less well defined than usual, with a noticeable loss of low bass. The treble range was brittle with some apparent emphasis of distortion and sibilants, while coloration was noticed in the mid-range particularly at high listening levels, and stereo depth and ambience also proved disappointing.

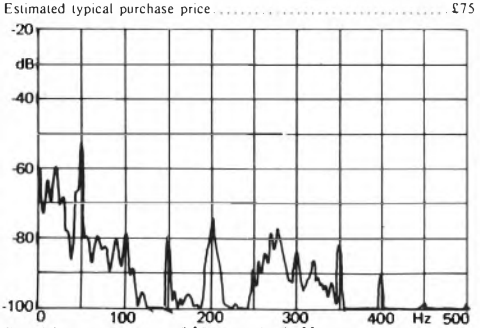
Conclusion

Though a modest cartridge was included, its removal (suggested value c.£7.00) still priced the *MB10* around a typical £68.00, at which level the arm friction and resonances, plus the disappointing overall sound quality and poor rating on isolation and feedback preclude any recommendation.

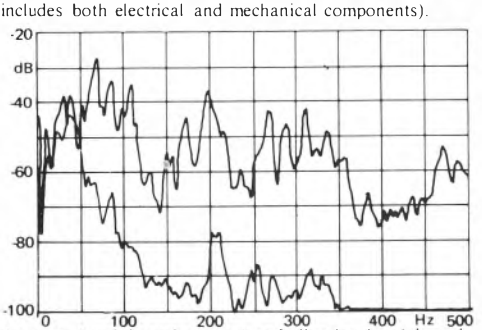


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	manual belt drive
Platter mass/damping	0.8kg/very good
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/0.1%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	synchronous/−0.25%
Start up time to audible stabilisation	0.8 secs
Rumble: DIN B wtd L/R av (see spectrum)	70/71dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	14g
Type/mass of headshell	universal detachable/9.5g
Geometric accuracy	good
Adjustments provided	overhang, lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/good
Friction: typical lateral/vertical	100mg/50mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/275mg
Downforce calibration error: 1g/2g	−0.1g/−0.15g
Cue drift/8mm ascent/descent	negligible/2.0secs/4.0secs
Arm resonances	below average
Subjective sound quality	below average
Lead capacitance/damping method	200pF/—
System as a whole	
Size/clearance for lid rear	45.5(w) x 37.5(d) x 14.4(h)/6.1cm
Ease of use	good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/poor
Vibration sensitivity/shock resistance	poor/below average
Estimated typical purchase price	£75



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).

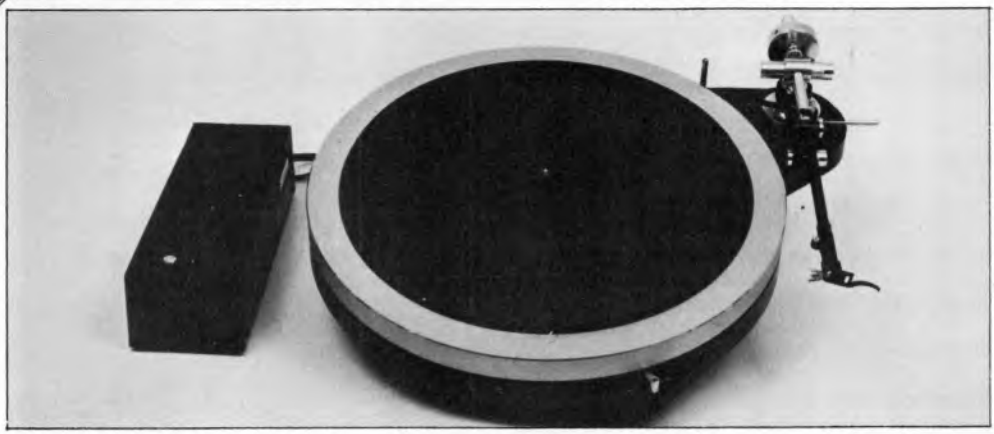


Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Micro-Seiki DDQ500

Harman UK, St. John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR.
Tel. 049-481 5221



Features, facilities, setting up and use

This integrated player came fitted with the Micro Seiki *MA707* arm which may also be obtained as a separate component, costing around £110.00. However, operation was entirely manual, and in one sense the *DDQ500* could be regarded as a form of *DQX1000*, since no plinth or cover was provided with the die cast chassis of the motor supported on feet and providing the arm mounting, and only an acetate dust cover of limited life supplied as part of the package. Quartz-locked at two speeds, the massive 350mm flywheel platter was fitted with a dense *SE22* mat, and was very well damped. A separate power unit was employed, affording very good hum rejection.

The *707* arm was longer than usual at nearly 240mm pivot-to-stylus, and incorporated a unique variable effective mass facility whereby a rider weight may be positioned on the alloy arm tube to bring the mass in stages from a low 6 to a high 16g. With its special light but not very rigid headshell, almost any cartridge may be accommodated in terms of effective mass, and as lead capacitance was also low at 95pF, this permits full flexibility as regards electrical matching. Well made and finished, the arm had fully calibrated bias and downforce dials to aid setting up, while the headshell fit was firm, secured by a ring clamp.

It was a surprise to find that the isolator feet here were more effective than for its bigger brother, the *DQX1000*. Nonetheless resonances were too high at 12Hz lateral and 22Hz vertical, although at higher frequencies the isolation was much improved.

Lab performance

With an unusually high platter mass of 3.4kg considering the direct drive motor, the start up time was reasonable at 3.2 seconds, indicating good torque. Wow and flutter, speed accuracy, stability and load tolerance were all excellent and essentially below our measurement thresholds. A trace of wow overshoot was observed but was not audible. Rumble was excellent at a typical 78dB although the spectrogram did show slight noise at 350Hz, but aside from residual hum, periodic motor components were absent.

The arm's variable mass (6–16) was verified and the lowest 6g setting adopted for the test procedure. However both extremes were tried on the audio range resonance sweep, and though differences were noted due to altered mass distribution, the effect was slight and did not materially affect the resonance rating. Geometry was very good, the unit was well built and proved easy both to set up and use, although a trace of lateral bearing play was evident. Friction was low and the biasing pretty accurate and free of added friction, while downforce was quite accurate and the cue also worked well.

Judged somewhat above average as regards arm resonances, the *707* still had its problems. Breaks at 70Hz (probably counterweight) and at 140Hz (possibly torsion in the light headshell) were present, but other modes were better controlled, and aside from a lapse around 5kHz the general energy trend was reasonably maintained. Rated as good on acoustic breakthrough, the absence of a lid was a contributory factor here, but the unit never-

RECOMMENDED

theless illustrated a worsening in the 350Hz range (similar to the rumble spectrogram). Vibration isolation was also quite good, although not very consistent, while feedback was suprisingly good especially in the bass, with hum levels very good, and impact shock resistance above average.

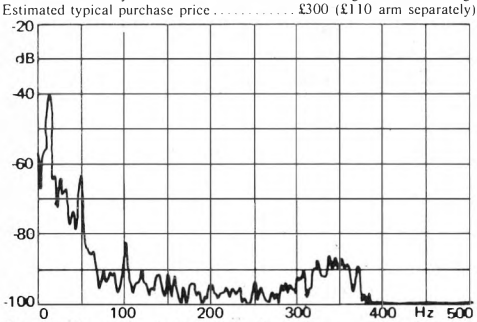
Sound quality

Overall this player system was considered good which is exceptional for a unit lacking a floating sub-chassis, and which also served to confirm the favourable sound quality available from the *707* tonearm. A slight loss of low bass was noted but the upper registers were pretty clean and free of boom, and ambience was well portrayed. Stereo imaging was to a high standard with pleasing depth and detail, while arm coloration was mild, and no wow or rumble was audible from the motor.

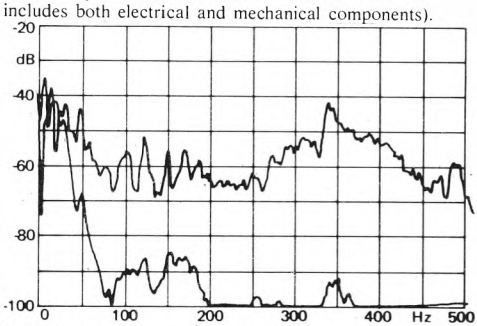
Conclusion

A relatively expensive deck lacking automatic features, the *DQX500* is best regarded as a convenient combination of two high class audio components, arm and motor unit. While the arm does not quite merit recommendation in its own right, it did offer a variable mass feature, plus a detachable headshell, and the performance was undoubtedly good. The motor section was of excellent quality, but the deck will of course only give of its best if mounted on a rigid shelf, and the lack of an included cover is also to be borne in mind; however all things considered it remains reasonable value for money.

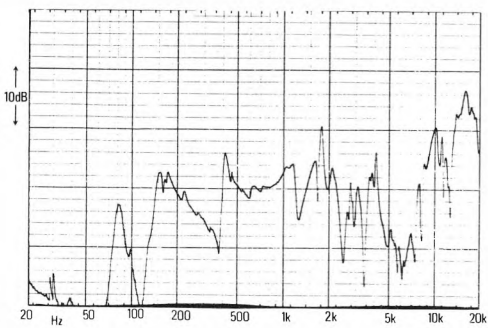
GENERAL DATA	Integrated Turntable
Motor Section	
Type	quartz direct drive manual
Platter mass/damping	3.4kg/excellent
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core detach pwr unit/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.07%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	3.3secs
Rumble: DIN B wtd L/R av (see spectrum)	79/76dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	var., 6 to 16g
Type/mass of headshell	special detachable/4g
Geometric accuracy	very good
Adjustments provided	overhang, lateral angle, height
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/very good/very good
Friction: typical lateral/vertical	20mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	200mg/200mg
Downforce calibration error: 1g/2g	−0.05g/−0.08g
Cue drift/8mm ascent/descent	negligible/1.8secs/1.5secs
Arm resonances	above average
Subjective sound quality	good
Lead capacitance/damping method	95pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	44.2(w) x 37.0(d) x 13.0(h)/N/A
Ease of use	(no lid) fairly good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/above average
Estimated typical purchase price	£300 (£110 arm separately)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



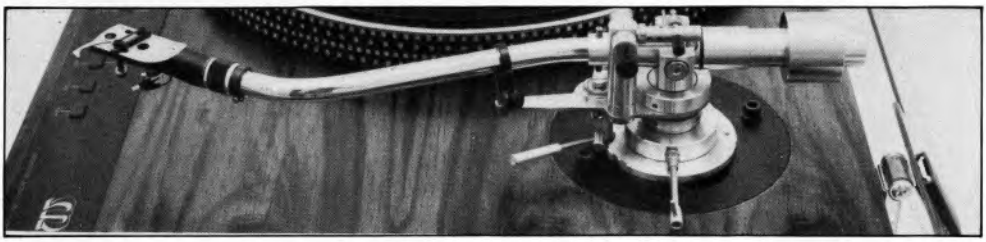
Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Micro-Seiki MA505 (revised & reprinted)

Micro-Seiki, Harman U.K., St. Johns Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049 481 5221



Features facilities setting up and use

Reviewed in the previous issue, the *MA505* universal tone arm has been retested, using the *DDX1000* turntable it normally partners as well as several others, including the Monitor Audio *ET500*.

The design included full geometrical adjustment for tilt height and overhang, but no damping was provided. An unusual spring method of downforce application was incorporated, which utilises a tungsten wire laterally tensioned via a series of cams, thus resulting in frictionless bias compensation. This may be controlled while a cartridge is tracing a record, thus greatly facilitating optimisation of the tracking parameters. Height could also be adjusted during play via a smooth operating cam. Last but not least, finish and engineering were both to the usual excellent standard that we have come to expect from high quality Japanese products.

Lab performance

Superb arm friction was recorded together with fairly accurate bias values, the latter about 30% high but in the right ratio. Downforce was highly accurate, and cue drift negligible with sensible rates, while the effective mass was estimated at 15g, indicating compatability with low to medium compliance cartridges in the 8-15 cu range. The vibrational resonance graph was pretty average with the headshell/socket mode present at 300Hz, and a typical spread of fairly well controlled resonances thereafter.

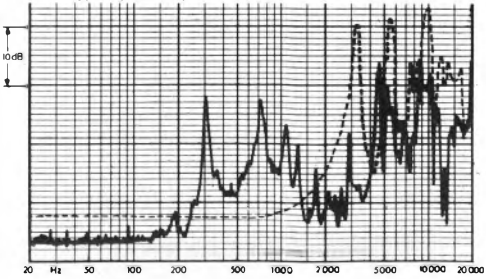
Sound quality

A good sound quality rating was established, which is a worthwhile result, if a little disappointing at this price level. The bass register was powerful and extended with only mild transient blurring, while the mid coloration was considered very low with a lightish balance and a moderate treble emphasis. The latter lent a touch of brightness and slight sibilant 'splash', while stereo depth and precision were considered to be pretty good.

Conclusion

Despite the good sound quality rating, this arm just misses a recommendation when one also takes into consideration its price, but if its unique adjustments and controls are deemed important, then this arm is well worth considering with appropriate cartridges. A silver wire version is now available (£20 extra), and we understand slight detail modifications have taken place since the above review was prepared.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	14-15g
Type of headshell	Universal detachable
Headshell mass (inc screws)	10g
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	lateral tension/ 200mg/225mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/4secs
Downforce calibration error 1g/2g	< 0.01g/< 0.04g
Amount of damping	none
Arm resonances	average
Subjective sound quality	good
Motor recommended	DDX1000 etc
Estimated typical purchase price	£130



Arm resonances (compared to cartridge resonances, dotted).

Micro-Seiki DQX1000

Micro-Seiki, Harman U.K., St. Johns Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049 481 5221

Micro Seiki DQX1000

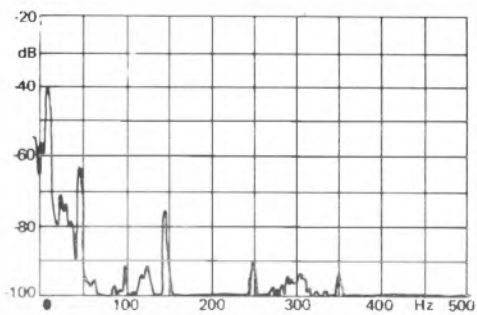
This specialised turntable represents a development of the well known *DDX1000*, and comprised a massive device built on a rigid die-cast aluminium chassis. Essentially an arm carrier capable of simultaneously accommodating three models, its suitability for cartridge and tonearm comparison during test and demonstration are obvious, but apparently a limited number of domestic users also require these facilities. This latest version employed an improved platter fitted with a solid rubber *SE22* mat and a quartz lock had also been added, though the fine variable speed option was still available. At considerable extra cost a lid cover comes as a separate box structure, and while the skeleton "plinth" promised good acoustic feedback, the hydraulic adjustable feet were none too effective, providing an overdamped 9Hz resonance. Big coil springs would have done the job far better.

The start up was quite good at 3 seconds considering the 3.7kg platter, the latter incidentally well damped by the thick mat. Finish and engineering were excellent, with wow and flutter, speed accuracy and stability all in the same category, as was the fine rumble at 78/79dB DIN B. The spectrogram showed a trace of electrical breakthrough at 50 and 150Hz, although the remaining modes were of a mechanical nature, and pretty small at that. The *DQX1000* was also judged very good on acoustic breakthrough, but just average for vibration, while feedback and impact shock resistance were both good, and fine hum levels were assured by the separate power supply control unit.

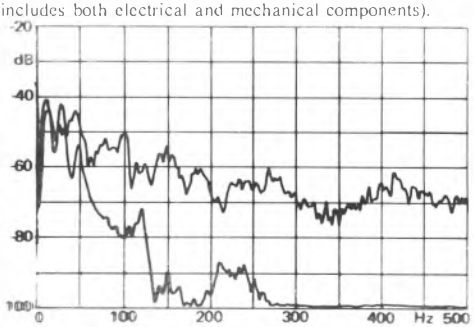
Rated as 'good' on sound quality, its ultimate performance was clearly limited by the poor isolation. On the test coffee table location some loss of bass depth and clarity was apparent, with removal to a structural wall shelf effecting something of an improvement in this respect.

Despite its excellent technical performance, as a motor unit the *DQX1000* is really too expensive to merit a recommendation, and rigid shelf mounting is virtually mandatory to extract the best performance. Its merit lies in its arm mounting facilities, and its worth depends essentially on their utilisation.

GENERAL DATA	Motor Unit
Motor Section	
Type	quartz direct drive manual
Platter mass/damping	3.7kg/very good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	3 core/power box/N/A
Speed options	variable plus 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.06%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	<0.05%/<0.05%
Start up time to audible stabilisation	3.0secs
Rumble: DIN B wtd L/R av (see spectrum)	79/78dB
Size/clearance for lid rear	39.0(w) x 38.0(d) x 12.0(h)/—
Ease of use	fairly good (no lid)
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£450



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

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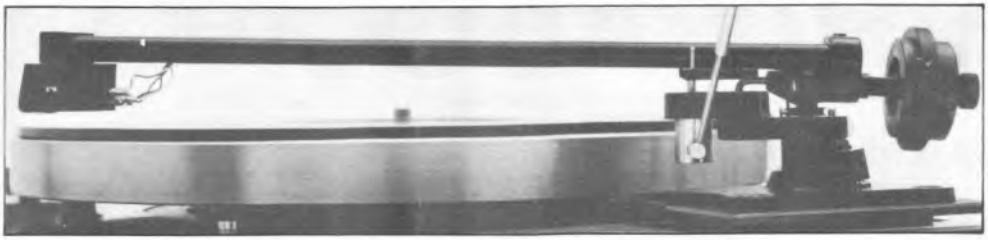


Features, facilities, setting up and use

This arm was reviewed in early form in the last issue, where it achieved high ratings. Originally tooled for relatively low volume production, the arm then employed several fairly rough-hewn sand castings, and the finish and fit of some parts were none too good. In addition, an error was present on the offset angle, which made proper two point tracking correction difficult with some cartridges. On the latest production version the fit of the parts was better, offering even greater rigidity, while the sand castings had shown some improvement. The offset angle had also been corrected to the original specification.

Briefly the *774* is a rigid arm employing pairs of stressed ball bearings, the low mass cartridge carrier tube being detachable with a flying lead and miniature plug. The arm employed subsonic damping with a fluid well, and arm structure damping *via* a special Sorbothane insert in the counterweight, this material offering good energy absorption over a wide frequency range. A vestigial cartridge mounting block was also provided in the form of a small offset threaded block on the strong aluminium alloy carrier tube. Full geometric adjustments were available, with the base-plate fitting SME fixing centres.

Lab performance

Of low effective mass at 5g, the lead capacitance was a little high at 180pF and may need consideration with some cartridge/amp combinations. Our sample was excellently adjusted, with negligible play or friction. Bias compensation was fine and added no perceptible friction, while the cue worked well and downforce was well calibrated. On arm resonances the result was also good, with a small mode at 250Hz barely interrupting the trend, and the bending mode at 750Hz appearing well damped. The first severe resonances occurred at 2kHz and 2.5kHz, but thereafter the behaviour was well controlled.

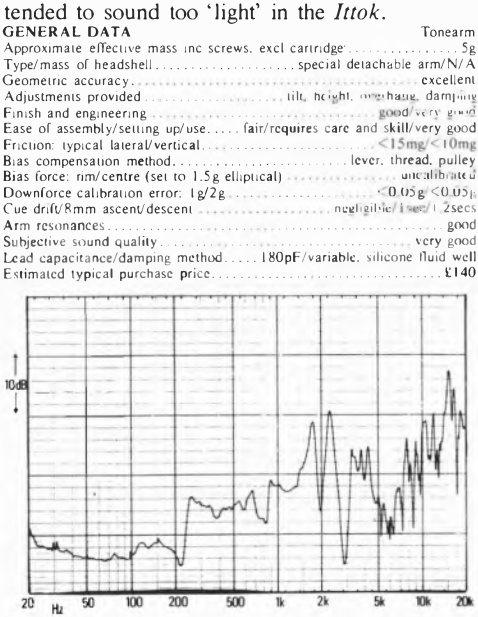
Sound quality

Rated as very good, the *774* was in the top category, providing clean bass transients (if a trifle dry) with excellent stereo image depth and precision, plus a smooth restrained treble. However the upper mid did show a trace of nasal 'coldness'.

Conclusions

In our view this excellent product was a close rival to the *Ittok*, and was preferred to the latter with some combinations of cartridge. For example, while the *Ittok* gave the best results with the *Asak* and other similar types, the *774* suited the slightly 'bright' and 'open' designs such as the Mission *773* and Dynavector *DV100R*, which tended to sound too 'light' in the *Ittok*.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	5g
Type/mass of headshell	special detachable arm/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, height, overhang, damping
Finish and engineering	good/very good
Ease of assembly/setting up/use	fair/requires care and skill/very good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	lever, thread, pulley
Bias force: rim/centre (set to 1.5g elliptical)	uncalibrated
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1sec/1.2secs
Arm resonances	good
Subjective sound quality	very good
Lead capacitance/damping method	180pF/variable, silicone fluid well
Estimated typical purchase price	£140



Arm resonances

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(revised & reprinted) **Monitor Audio ET500**

Monitor Audio, Monitor Audio Ltd., 347 Cherry Hinton Road, Cambridge CB1 4DJ. 0223-42898/46344

This turntable's predecessor appeared as a stop-press addition to the previous issue, and while it fared reasonably well it was to some degree censured for its use of the Matsushita motor, possessing a mild dynamic wow effect. This motor was in fact fitted to the deck supplied for review here, but as with the JBE, the manufacturer has since informed us that by publication date this old motor will have been replaced by the new version. However, again like the JBE, we understand that although the motor has been improved, the new type is still not fitted with the sophisticated servo necessary to avoid the dynamic wow effect.

Important changes to the *ET500* since the first issue include the new calculator type touch controls which replace the old electric sensing buttons, these proving expensive to produce in relation to their ergonomic value, and a lead laminated high mass plinth and new acrylic lid of low resonance properties. A well made separate power supply was also included.

Results applying to the old motor version showed good steady state wow and flutter, very good rumble, significant slowing under load and speed overshoot upon recovery, the latter servo problem responsible for the slight dynamic wow on program. Acoustic breakthrough measured well, much improved by comparison with the last issue, and hum levels were also good. Acoustic feedback was classed as pretty good and improved with the lid down, while shock resistance was satisfactory.

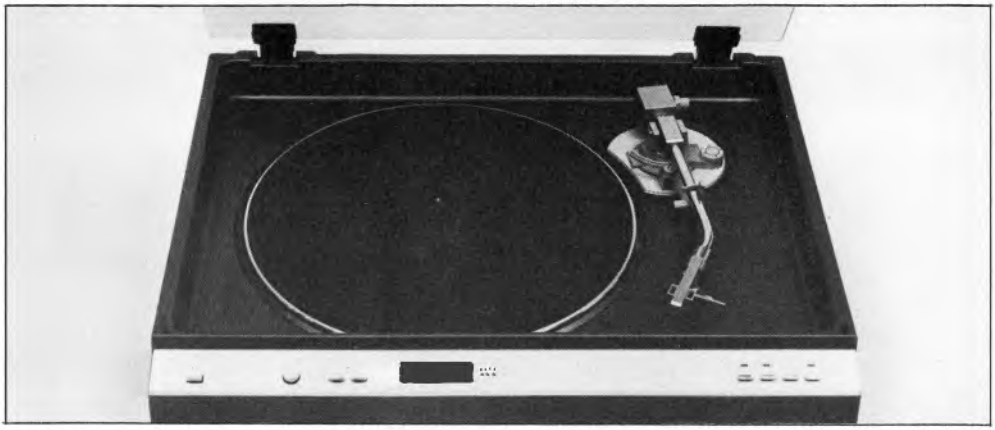
An 'average' rating was described, the wow problem being partly responsible, and as with the DDX1000 and other similar good direct drive turntables with inadequate vibration isolation, the ultimate sound quality is dependant on the location and strength of the shelf or structure on which they are mounted. On a normal cabinet the *ET500* showed the frequently encountered upper bass emphasis. low bass loss, and slight lower-midrange coloration, but carefully mounted these effects can be greatly ameliorated.

GENERAL DATA	Motor Unit
Type	manual direct drive
Platter mass/damping	1.7kg/good
Finish and engineering	good
Type of mains leads	three core
Speed options/variable?	33⅓/45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.1% (see text)
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.2%/0.1%
Speed accuracy/drift/variation under load	adjustable/-0.1%/-0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	71/72dB
Size/rear clearance for lid	47(w) x 38(d) x 13.7(h)/7.6cm
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good (see text)
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	fairly good
Ease of use	good
Estimated typical purchase price	£150

Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Optonica RP-5100

Sharp House, 107 Hulme Hall Lane, Manchester M10 8HL. Tel. 061-205 7321



Features, facilities, setting up and use

Built in Japan by Sharp, the Optonica range is an extensive one, and has been well represented in *Choice*, although this is in fact the first turntable unit to be assessed. Relatively inexpensive at £100.00, the unit was unusually and attractively styled, with a deep 'well' plinth and employing a heavy plate glass lid/cover mounted on excellent hinges. This form of construction should aid the unit in respect of acoustic feedback at middle frequencies at least, since plate glass is far less resonant than the thin polystyrene mouldings commonly employed. On the other hand the isolator feet were found to be relatively ineffective, the plinth exhibiting resonances at 10Hz lateral and 18Hz vertical, with excessive damping and little free movement.

The finish was excellent with the control buttons on the plinth front edge clear of the lid possessing a delicate 'microswitch' feel. Overall the arm was not particularly rigid with some play noted in the main bearings, and the counterweight was a more or less loose fit on its rack and pinion. Furthermore, the universal headshell/arm fixing was none too secure when fitted. The instructions were notably clear but the less favoured overhang method for cartridge alignment was again recommended, in this case involving a 50mm measurement from the stylus tip to the headshell grommet. Fully automatic arm functions were incorporated and worked well, which was fortunate since the deep plinth gave limited access to the headshell for manual operation.

A direct drive motor was used with a fairly large 1.7g platter and good mat damping. Slight play was noted in the main bearing, and two speeds were offered, plus fine variable control. The recessed strobe was clear and easy to use, referenced of course to a mains frequency illuminated neon lamp. Incidentally a similar model to this is also available, namely the *RP7100,* which includes quartz speed reference and photo-electric track seeking and 'selectric' systems.

Lab performance

Weighted wow and flutter was fine, and the motor appeared to have the preferred second order servo type, delivering no perceptible wow overshoot. Speed accuracy and stability were both good, but the load variation at a 0.7% slowing for a 3g load was considered to be excessive. Start up however was typical at 2.3 seconds. The average rumble figure of 69dB was fine, although some imbalance between the channels was noted, the spectrum analysis showing a predominance of hum related components with some pole switching effects. The hum was mechanical in origin and was felt to emanate from the mains transformer rather than the motor itself.

The arm mass was in the 'medium' class at 13g: compatible with cartridges in the c.10–17cu range. The lead capacitance was very low at 75pF allowing flexible cartridge electrical matching. A slight headshell list downgraded the geometry rating a little, but otherwise the arm was well aligned and proved easy to set up and use. Lateral friction was unfortunately rather high at 150mg, although a similar model examined earlier had

produced a better result, so perhaps this was atypical. The bias was effective and in the right ratio, while downforce was within 5% and the power cueing excellent.

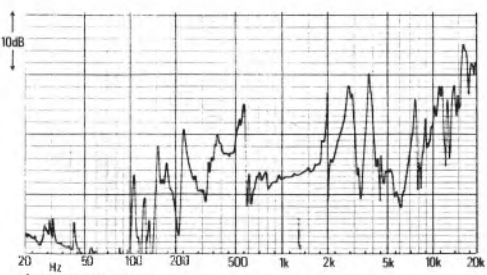
On arm resonances the *RP5100* was classed a little above average, mainly because the visible resonance modes were quite well controlled and the energy trend for the cartridge was quite well followed. Problems did however occur at 100, 150, 200 and 580Hz, and again from 2–8kHz. Acoustic breakthrough was well above average and promisingly even, with the dip at 250Hz not as serious as a peak of the same magnitude would have been. Vibration sensitivity was also above average and again fairly even, but at the listening location the working feedback margin was less satisfactory, though impact shock was fairly well blocked.

Sound quality

The *RP5100* did not sound as good as some of the lab results might have suggested. Rated below average, the bass quality was below par, presumably associated with the relative ease with which bass feedback could be sustained. At higher frequencies, the spectral balance was quite good, although the sound possessed some edginess and exaggerated sibilants, and vocal clarity was also reduced. Stereo imaging was just average.

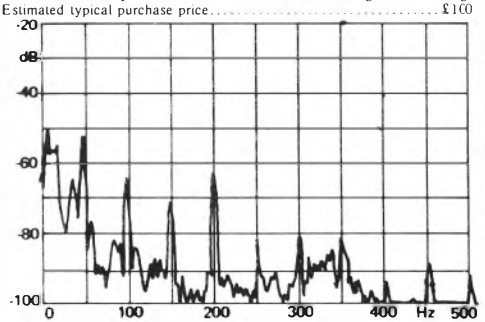
Conclusion

This attractive deck had a number of useful facilities and was not overpriced. If the arm friction had been lower and the bass feedback superior then a recommendation could have been quite likely. As it stands, the bass problem can in fact be resolved by siting the turntable carefully, although the friction is up to the manufacturers to cure, and at the measured level tracking at downforces below 1.75g cannot be recommended.

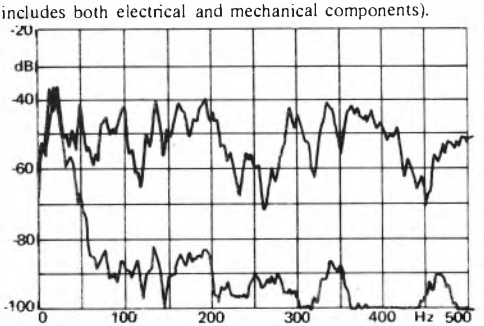


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	fully automatic direct drive
Platter mass/damping	1.7kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.11%/0.06%
Absolute speed error	variable, <0.15%
Speed drift 1 hour/load variation	−0.2%/−0.7%
Start up time to audible stabilisation	2.3secs
Rumble: DIN B wtd L/R av (see spectrum)	71/66dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	universal detachable/7.5g
Geometric accuracy	good
Adjustments provided	overhang, lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	150mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	approx 150mg/175mg
Downforce calibration error: 1g/2g	+0.05g/+0.1g
Cue drift/8mm ascent/descent	negligible/0.3secs/0.8secs
Arm resonances	above average
Subjective sound quality	average
Lead capacitance/damping method	75pF/—
System as a whole	
Size/clearance for lid rear	48.0(w) x 39.7(d) x 11.0(h)/0.2cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£100



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Philips 685

Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR.
Tel. 01-689 2166

Features, facilities, setting up and use

Costing approximately £65.00 including a Philips *GP400 II* moving magnet pickup cartridge, the *AF685* was the least expensive model in a large range of eight turntables. Taken to task concerning comments I made in the past about the estimated compatibility of Philips' own cartridge and tone-arm combinations, I took the precaution of recording the system resonance as supplied, in addition to measuring the effective mass. The latter was in the medium to high range at 14g, which in conjunction with the fairly high compliance *GP 400* cartridge fitted, gave a resonance at 7.5Hz. Bearing in mind the accepted *Choice* target of 10Hz, this result implied that either the effective mass or the compliance was double the required value, or alternatively that both were partially at fault. Furthermore this figure was exacerbated by the plinth/foot resonance at 8Hz – not a helpful coincidence!

As supplied, the cartridge was misaligned by a significant 2° at the inner radius, and we were confused by the references in the instructions to a slotted detachable headshell which was not a feature of our sample. The fitting of an alternative cartridge is questionable in view of the absence of any provision for geometrical alignment. Workmanship was fairly good, but play was evident in both arm and platter main bearings, with the light (0.8kg) and just acceptably damped platter carrying a stroboscope disc that was covered when a record was in position. On this belt drive model, auto-stop and arm lift functions were incorporated, and the unit was powered by a small DC motor providing fine variable control at 33⅓ and 45rpm.

Lab performance

Weighted, the wow and flutter was very good, with the speed accuracy fine and the drift well controlled. However speed slowing under load was on the high side at 0.5%, and the strobe was of course hidden just when such a correction could be useful. Start up time was average at 2.8 seconds, and the system was free from dynamic wow effects. At typically 60dB DIN B rumble was just adequate and just met spec. On the spectrogram only the 50Hz line was electrical, with all the others mechanical in origin; such a performance is not really hi-fi.

The effective arm mass has already been noted, but the high lead capacitance of 250pF also deserves consideration. However as the Philips cartridges prefer a highish capacitative loading, the arm contribution should be helpful here. The geometric accuracy was not quite to standard and no adjustments were provided. Lateral arm friction

was just satisfactory at 75mg, but worse than the specified 50mg, and while the bias compensation was effective and contributed no extra friction, it was also excessive, providing nearly double the required value. Downforce accuracy and cue operation were both satisfactory. Rated as average on arm resonances the arm was physically none too rigid, exhibiting numerous breakup modes, but fortunately these were of a fairly mild nature, and the general trend was not badly distorted. The counterweight mode appeared at 45Hz, and the tube flexure at 180Hz, with further modes at 600Hz, 1.2kHz, 1.6kHz and 6.0kHz.

Acoustic breakthrough was definitely below average, peaking at 50Hz and at 150–200Hz, while vibration breakthrough was also disappointing – probably just about average. Feedback and impulse shock gave more favourable results, and rated above average.

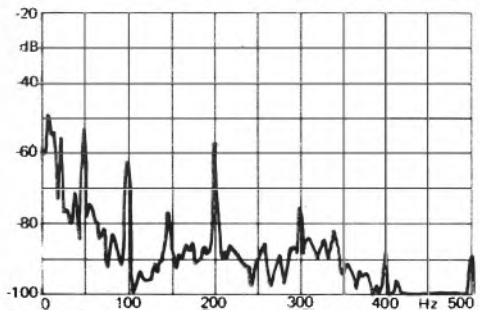
Sound quality

Considered to be below average, the motor noise and hum harmonics were audible on critical quiet programmes; otherwise the sound quality was unexceptional but nonetheless reasonable at the price level (the *GP400 II* cartridge was not included in this assessment).

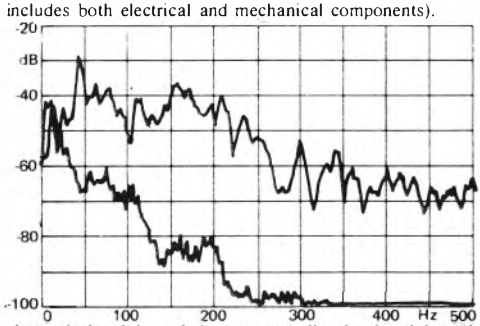
Conclusion

Choice was happy to recommend an earlier budget model from Philips (the *GA437*), which has since been discontinued, but this replacement is however inferior, and did not warrant any recommendation.

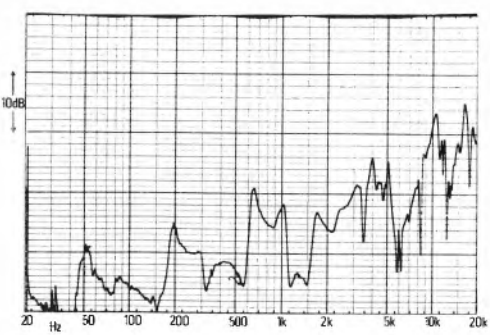
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-stop, belt drive
Platter mass/damping	0.8kg/good
Finish and engineering	good/fair
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.15%/0.06%
Absolute speed error	variable, <0.2%
Speed drift 1 hour/load variation	+0.2%/−0.5%
Start up time to audible stabilisation	2.8secs
Rumble: DIN B wtd L/R av (see spectrum)	59/62dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	14g
Type/mass of headshell	fixed/N/A
Geometric accuracy	fairly good
Adjustments provided	none
Finish and engineering	good/fairly good
Ease of assembly/setting up/use	very good/good/good
Friction: typical lateral/vertical	75mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	275mg/300mg
Downforce calibration error: 1g/2g	−0.1g/−0.1g
Cue drift/8mm ascent/descent	negligible/1.2secs/1.2secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	250pF/—
System as a whole	
Size/clearance for lid rear	42.1(w) x 35.8(d) x 15.4(h)/8.1cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	average/above average
Estimated typical purchase price	£65



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Philips 677

Philips, Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR. 01-689 2166

Features facilities setting up and use

A replacement for the inexpensive and highly recommended *GA437* included in the last issue, the *AF677* belongs to a completely new range of models from Philips, with certain features and styling common to the entire group. All use a new Philips servo speed system called 'direct control' which is not to be confused with direct drive. The players are belt driven, and whereas in the past such servo systems have taken their feedback/error control from a generator on the motor shaft, Philips have positioned the tacho generator in a far more logical place, namely on the platter hub.

The *AF677* is an auto return player incorporating a sub-chassis with a moderate degree of 'float' mainly in the vertical plane. However, there was insufficient suspended mass to produce a low suspension frequency, and the design brought the suspension resonance too close to that of the arm/cartridge combination. Philips have also designed a new die cast aluminium detachable headshell (unfortunately not interchangeable with the normal SME type), and a clever stylus balance was built into the arm rest. The old steel platters have been replaced by non magnetic aluminium ones, and the overall construction and finish were to a fairly high standard. All controls operated well, and the deck was easy to set up, the latter procedure facilitated by the intelligently designed finger-operated transit catches. A GP400 II (spherical tip) cartridge comes ready fitted.

Lab performance

Wow and flutter was classed as very good, with rumble levels rating almost as high and beating the specification (see sound quality). Running some 0.3% slow (acceptable) the proof of the servo control was given by the unmeasureable slowing under load, while drift was fine and start up rapid. In addition the servo did not possess significant overshoot, which is impressive for so inexpensive a player. Shock resistance was good and acoustic feedback even better, but hum was only satisfactory except when using normal cartridges. Acoustic breakthrough on the graph was average above 100Hz but rather poorer below — some 10dB worse that the *877* for example, another model from the Philips range.

The arm showed fairly good geometrical accuracy (slight headshell tilt) and was well adjusted with good downforce calibration and reasonable friction. Cue operation was fine but the bias compensation was excessive, in the right ratio but double the amount required, and the user should accordingly compensate when setting the dial. Dissected by two dominant regions, some favourable qualities were nonetheless evident from the resonance graph, noteably the first break occurring higher than average at 400Hz. The 1.5kHz - 12kHz range was under good control, no other serious anomalies being present.

Sound quality

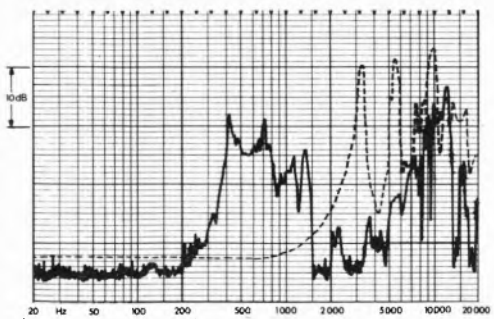
Using a reference cartridge the deck rated as below average but this is nevertheless reasonable

when considering the price. The bass was felt to be a trifle light and the midrange to possess a slightly coloured 'boxy' and 'dead' quality. Stereo depth was reduced and the high treble seemed relatively accentuated and slightly tizzy. A trace of motor noise was also audible at high volume settings.

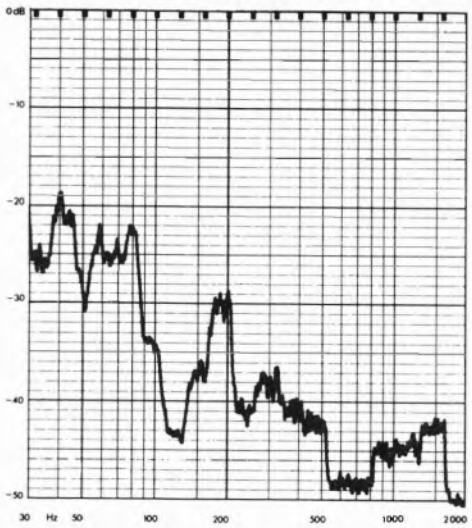
Conclusion

In the context of its integral cartridge, plus measured and subjective performance ratings and competitive price the *AF677* fails to receive firm recommendation by a relatively small margin.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<=0.07/0.1
Speed accuracy/drift/variation under load	-0.3%/+0.1%/<=0.05%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	70/67dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	7g
Geometric accuracy	fairly good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	50mg/60mg
Bias comp: type/force rim/centre	spring/300mg/400mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/2secs
Downforce calibration error 1g/2g	-0.075g/0.0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	41.8(w) x 34.4(d) x 14.5(h)/7.6cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	average/very good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Philips 877

Philips, Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR. 01-689 2166

Features facilities setting up and use

The *877* is one of two top-of-the-line models, the other being the closely related *977*, which is not included in this report. Unlike the *977* which uses quartz speed control, the *877* employed the same speed system as the cheaper *677* and *777*, and in common with all these models the deck was belt driven and incorporated a floating sub-chassis. However, the *877* uses a more substantial glass fibre reinforced plinth plus higher mass platter than its cheaper relatives, while the speed indicator has also been expanded to comprise 9 lamps, in four +/− 1% steps; whereas the *977* is a fully automatic deck, the *877* simply has an auto-stop facility.

Philips' electronic touch controls were used for speed change and start/stop, with bias compensation set by a large dial calibrated for various styli types (a spring mechanism of low lateral friction.) The standard of construction was very high with good quality engineering throughout. A fairly expensive Philips cartridge was ready fitted, in this case a *GP401 II* with an elliptical tip, as opposed to the spherical-tipped *400 II* fitted to the cheaper players.

Lab performance

Very good wow and flutter as well as rumble figures were recorded, although a trace of motor noise could nevertheless be heard at high listening levels with wide dynamic range program. Speed accuracy was satisfactory at +/−0.2% depending on the control settings, while load stability was excellent, drift low, and start up achieved in 1.5 seconds.

From the graph it can be seen that acoustic breakthrough has been improved in comparison with the less expensive models, being now a little better than average; while shock immunity was good, feedback was less so. Hum levels (DIN signal leads) were barely adequate with a moving coil cartridge (Supex 900 E Super) but were fine using a conventional type such as the supplied *GP401 II*.

Reasonable but below spec friction values were recorded, and although biasing was claimed to increase towards the centre the reverse was in fact found to be the case, the values being double that required; in contrast, downforce was about 10% low. Cue operation was fine and the effective mass is at the low end of the medium range, at an estimated 9g, suiting cartridges in the 12-25cu compliance bracket. A 10Hz arm/cartridge resonance was claimed by the manufacturers, but our sample gave nearer 7Hz, which is dangerously close to the sub-chassis resonance frequency. The graph did illustrate improved damping in the 300-1500Hz range but was poorer than the *677* and *777* around the 4kHz region.

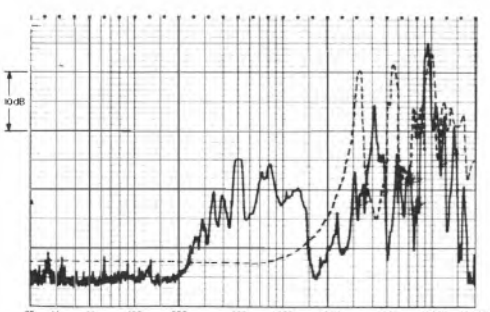
Sound quality

Rated as below average on its sound quality, the *777* was felt to be preferrable. The mid register seemed both cold and mildly coloured, detail was muddled and a loss of both stereo depth and location was apparent. The bass register was, however, considered to be quite good.

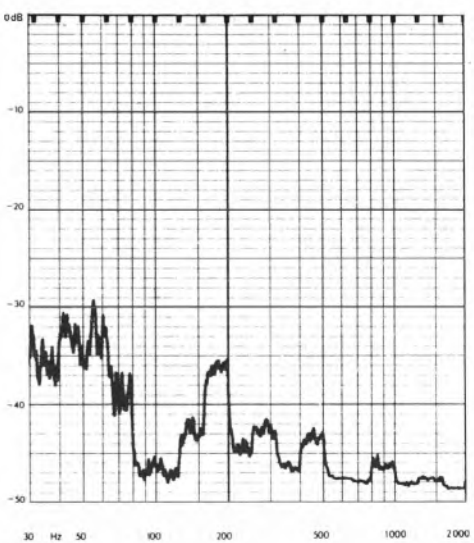
Conclusions

Overall the balance tips in favour of the cheaper *777*, and in consequence the *877* does not gain a recommendation. It would appear that there were minor quality control problems on our sample particularly in regards to arm friction and biasing.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return, belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	very good
Type of mains/connecting leads	two core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd α2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07%/0.08%
Speed accuracy/drift/variation under load	adjustable/-0.1%/+0.05%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	73/73dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	7g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	55mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/320mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/1.5secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	41.8(w) x 34.5(d) x 14.3(h)/7.5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£130



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Philips 829

Philips, Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR. 01-689 2166

Features, facilities, setting up and use

Described as a fully automatic model the *AF-829* is almost Philips' top line model (basically the similar *AF-877* only adds quartz referencing to the speed). Automatic record size detection was derived from a mechanical sensor built into the platter and mat, and a Philips cartridge was ready fitted. Belt driven via a DC motor, the platter was tacho-generator coupled to the servo system so that its speed was under what Philips call *Direct Control.* Fine variable speed control was incorporated, the speed deviation visible on a bar array of LED lamps.

This design is fitted with a sprung subchassis whose action was not free enough, mainly possessing a vertical mode which was spot on the arm/cartridge resonance at 6.3Hz; furthermore in dynamic terms the subchassis was not well balanced.

A special Philips detachable headshell was included, but an extra shell will probably be needed if another cartridge is to be fitted, although it should be noted that there is limited clearance to accommodate deeper cartridge models. Arm effective mass was moderate at 12g, but was still too high for the supplied cartridge, a *GP412 11* with a high compliance elliptical stylus. The subsonic resonance of this combination was excessively low at 6.5Hz (20°C), while the specification claims 10Hz using a 'test cartridge' (unspecified). The measured resonance in fact indicated a serious incompatibility, although it could be tamed by a *Disctracker* or other similar stabiliser. The arm bearings showed significant looseness in both planes, but otherwise the engineering and finish were generally good.

Lab performance

The wow and flutter readings were very good with satisfactory speed accuracy, good stability, and minimal slowing under load. Torque was high and the servo system free of dynamic wow or overshoot, while start up time was satisfactory at 2.5 seconds, the platter being a rather light 1.0kg. The DIN weighted rumble was excellent averaging 76dB, but some motor noise was nevertheless apparent on the spectrogram, so it was not quite as clean as the weighted reading would have lead us to believe.

The arm effective mass has already been discussed, but the high lead capacitance also deserves mention as it may need to be borne in mind with many other cartridges. As supplied, the Philips cartridge was well aligned and potentially the geometry was very good. Arm friction was fine, and the bias compensator friction free, but in common with other Philips models it proved excessive, producing almost double the accepted

correction readings. Downforce calibration was quite accurate, cue operation very good if a trifle fast on the 45 rpm speed, and arm resonances good. The graph illustrated a respectably well maintained energy trend, albeit with some breaks at 90Hz, 580Hz and 2kHz but overall exhibiting good control.

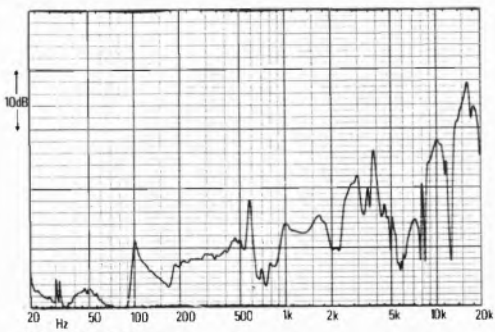
Acoustic breakthrough was promising with a fairly even characteristic apart from a 50Hz prominence, and was rated as good. Above average on vibration isolation, the 130Hz band was not too well rejected, but acoustic feedback was good, hum rejection very good, and shock immunity above average.

Sound quality

Rated as average (not using the supplied *GP412 II* cartridge), the unit was entirely free of subjective rumble or wow. Stereo information was to a reasonable standard, with depth and ambience in evidence, but slight mid coloration was audible and the overall sound did not appear well integrated. Bass quality was fairly good though lacking in the extreme registers.

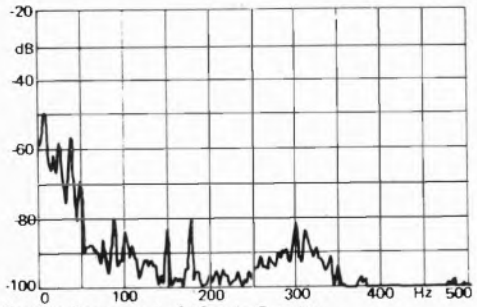
Conclusion

Had the fairly expensive fitted cartridge proved more compatible with the arm (and subchassis), and hence been more secure on tracking, the unit's generally good performance would have suggested recommendation. As it happens the *GP412 II* has not found particular favour in past issues of *Choice*, and in our estimation, cannot give of its best in the *829* arm in any case. The unit nevertheless remains worth considering, particularly if used with a more compatible cartridge.

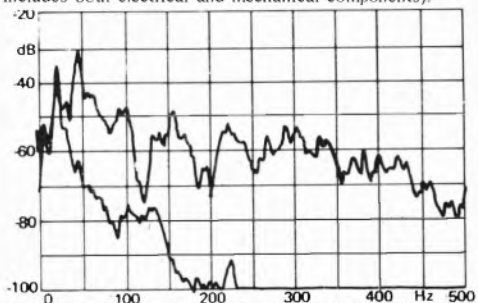


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	fully automatic, servo belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/0.06%
Absolute speed error	variable, <0.3%
Speed drift 1 hour/load variation	−0.2%/<0.05%
Start up time to audible stabilisation	2.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75/77dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	12g
Type/mass of headshell	Philips detachable/7g
Geometric accuracy	very good
Adjustments provided	none
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	<25mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	275mg/300mg
Downforce calibration error: 1g/2g	−0.05g/−0.1g
Cue drift/8mm ascent/descent	negligible/1.0sec/0.8secs
Arm resonances	good
Subjective sound quality	above average
Lead capacitance/damping method	270pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	44.7(w) x 36.4(d) x 14.4(h)/7.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£175



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Pickering FA300A

Sound Source, Station Approach, Rickmansworth, Herts. Tel. 09237 75242

Features, facilities, setting up and use

This unusual turntable is available in two forms, either with a Pickering *XSV3000* cartridge fitted (a Recommended *Choice* item) denoted the *FA330A,* or as the *FA300* without cartridge reviewed here. The price differential is about £60.00 – the typical cost of the cartridge – so no saving accrues from purchasing the combination unit, except perhaps in terms of time, as the cartridge will of course be set up and nearly ready to use.

In some respects the *FA300* parallels the Thorens *TD160* by offering a coil sprung subchassis system powered by a synchronous motor *via* a belt, with the two speeds selected by a mechanical rocker switch on the plinth which moves the belt onto one of two motor pulley diameters. A small arm mounting platform was fitted with a Pickering arm of undamped partial unipivot design, the lateral bearing seeming to be of conventional form. The effective mass was in the medium category at 10g, and together with the low mass mounting bracket was in fact quite compatible with the Pickering *XSV3000* cartridge. An auto-stop and lift was provided at end of side.

The main bearing did not have a thrust contact point, but instead the moderate 1.5kg platter mass was magnetically floated on two ceramic ring magnets, which it is claimed will reduce rumble. However, quite simple bearings these days can produce excellent rumble results, and the figures for the *FA300* were in fact only adequate, so the merits of this particular configuration were not proven in this application. The subchassis did not feel very free and needed careful levelling to work well, while its suspension resonances were on the high side at 6.3Hz (a lateral rocking mode) with a none too desirable vertical bounce at 10Hz – too close to the arm/cartridge for comfort.

Lab performance

The motor was audibly slightly noisier than usual, and before the subchassis was properly 'free', the rumble reading was only 55dB DIN. Careful adjustment however provided an improvement to a fairly good 67/68dB DIN B. The spectral analysis still showed a significant motor noise contribution, with static electrical components hardly affecting the issue. Wow and flutter weighted was fine at 0.1% although the linear wow figure of 0.13% was just average. Speed accuracy was very good, with slowing under load moderate, and the 2 second start up normal for the platter mass, no wow overshoot being present. With a 10g effective mass the arm was suited to medium compliance cartridges (13–25cu), while the lead capacitance was a fairly typical 150pF.

The headshell alignment was not quite square, accounting for the 'fairly good' geometry rating, while the finish and engineering reservation refers to the high plastic content of the arm as well as to a feeling of looseness and imprecision around its bearings. Vertical friction was unmeasureable but the lateral 50mg result was only just satisfactory considering the highish asking price. The bias compensation was on the high side at 250mg (the ideal value at 1.5g is about 175mg), and the mechanism also appeared to introduce additional lateral friction. Rated as above average on reson-

ances, the arm exhibited a serious loss of rigidity at 150Hz, with a curve displacement of 12dB or so. Resonances were then quite well controlled up to the 2–4kHz region, beyond which frequency the behaviour was again quite good.

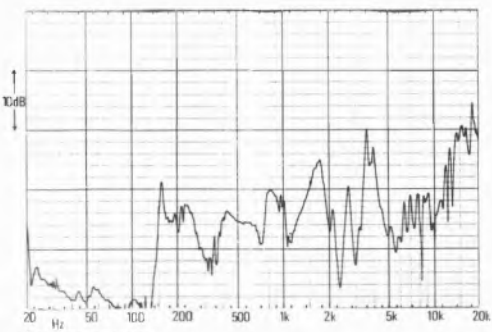
Overall, acoustic breakthrough was also regarded as good, but not very even, and definitely poorer at 50Hz. The vibration isolation was only a little above average suggesting the suspension was over-damped, and breakthrough peaks at 120 and 200Hz were evident. On location, however, the feedback margin was good, but the shock resistance only fair (the imbalance in the chassis is believed to be responsible here).

Sound quality

Although the marks for the *FA300* were significantly below those attained by the good suspended subchassis decks in this report, it did appear to possess a proportion of the subjective merits of such models, and was ranked as 'above average'. The sound did not appear quite stable, but stereo image depth and detail were both promising, while the bass extension and transients were also above average.

Conclusion

While elements of a good performance were evident with this design, the overall results did not really justify the price. The arm was rather unusual, and we were not happy with its alignment or bias contributed friction, while the coincidence of the arm and subchassis resonance was also unfortunate. Furthermore, the subchassis suspension was not really free enough for optimum isolation.



Arm resonances

GENERAL DATA — Integrated Turntable

Motor Section

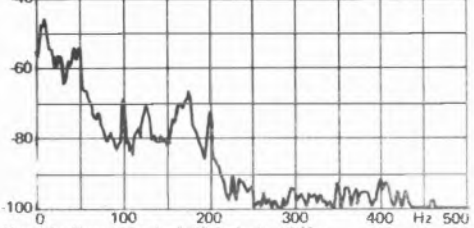
Type	auto-stop, manual belt drive
Platter mass/damping	1.5kg/fairly good
Finish and engineering	good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (DIN peak wtd 0.2–6Hz/6–300Hz)	0.12%/0.13%
Absolute speed error	−0.05%
Speed drift 1 hour/load variation	synchronous/−0.3%
Start up time to audible stabilisation	2.0secs
Rumble: DIN B wtd L/R av (see spectrum)	67/68dB

Arm Section

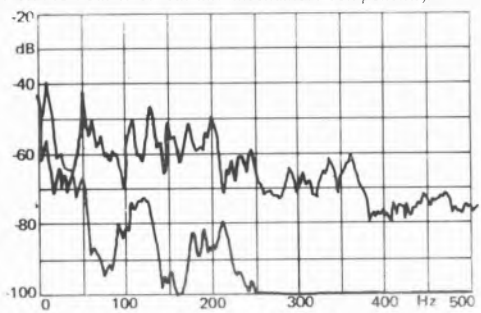
Approximate effective mass inc screws, excl cartridge	10g
Type/mass of headshell	special detachable/5.5g
Geometric accuracy	fairly good
Adjustments provided	overhang
Finish and engineering	fairly good
Ease of assembly/setting up/use	fairly good/very good
Friction: typical lateral/vertical	50mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	approx 250mg/approx 250mg
Downforce calibration error: 1g/2g	−0.05g/−0.15g
Cue drift/8mm ascent/descent	negligible/0.8secs/2.0secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	approx 150pF/—

System as a whole

Size/clearance for lid rear	42.5(w) x 35(d) x 14(h)/7cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	above average/fair
Estimated typical purchase price	£260



Rumble Spectrum (ref 10cm/s @ 1kHz, includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Pioneer PL512

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks SL0 9JL.
Tel. 0753 652222/7

Features, facilities, setting up and use

This represents Pioneer's cheapest model, costing around £55.00 and provided with a modest 2.2g tracking spherical tipped cartridge. A manually operated deck, it comprised a four pole synchronous motor driving the light 0.9kg platter *via* a resilient rubber belt; despite the lightness of the rubber mat, the platter was in fact well damped. Although fairly brief, the instructions were clear and the turntable proved quite easy to set up and use. The plinth was of composite wood construction and was fitted with a light, clear perspex lid, being supported on fairly soft rubber feet. The latter were in fact not too highly damped, but nonetheless gave rather high plinth resonances of 10Hz lateral and 16Hz vertical.

Of quite good quality construction, the platter and main bearing were of good tolerance, but noticeable play was apparent in the arm bearings. The arm mass was quite high at 18g, suited to low compliance cartridges, and the lead capacitance was typical at 150pF. The cartridge as fitted was not particularly well aligned, and an accessory protractor would be a worthwhile addition, since the usual Japanese method of alignment by the measurement of overhang is both clumsy and error-prone.

Lab performance

At 0.07%, weighted wow and flutter was very good, with wow alone moderate at 0.12% linear. The deck ran a significant 0.75% fast with only a minor 0.15% slowing under load, while start up was a rapid 0.7 seconds. Considering the price the average rumble was very good at better than 70dB DIN B, the spectrogram however charting almost exclusively mechanical rumble components with only the 50Hz line attributable to electrical breakthrough.

The arm geometry as supplied with a cartridge was just satisfactory, but in any case proved amenable to improvement. Lateral friction was acceptable at 75mg, but clearly the arm was better suited to higher tracking weight cartridges. The biasing was fine and added no extra friction, but cue rates were slow, particularly the 4 second descent for an 8mm drop. Arm resonances were classed as average, with the trend strongly stepped at the first 150Hz resonance. Another step was also present at 60Hz, the response being dissected between 2 and 6kHz, with even the high treble range not free of breakup.

RECOMMENDED

However the *PL512* did surprisingly well on acoustic breakthrough, producing a commendably even characteristic, while vibration isolation was also better than expected, scoring average. Impact shock resistance was good and acoustic feedback in the listening test location above average.

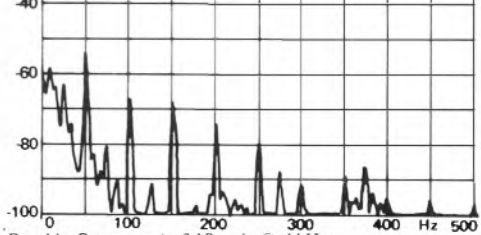
Sound quality

Overall the sound quality was judged to be below average, but at this price level this did not preclude recommendation. Its character was not unpleasant, although it did sound a trifle thin, with a midrange vagueness and a lack of stereo depth and ambience, while the low frequencies were also lacking in definition.

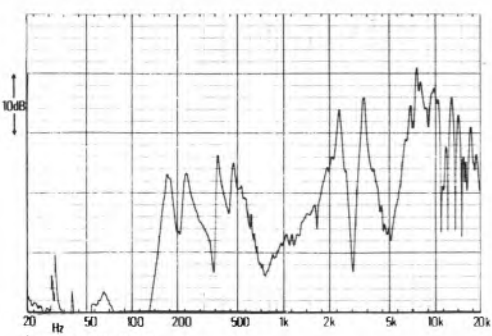
Conclusion

With inaudible wow or rumble, a good finish, and an acceptable sound quality rating for the price, the *PL512* with cartridge is recommended as a value for money product. A better cartridge would probably be worth fitting; for example, the ADC *QLM 34 III* is well suited to this sort of highish effective mass arm.

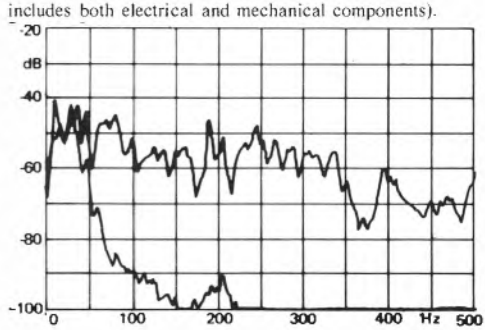
GENERAL DATA	Integrated Turntable
Motor Section	
Type	manual belt drive
Platter mass/damping	0.8kg/fairly good
Finish and engineering	very good/good
Type of mains lead/connecting leads	IEC lead and socket/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.12%/<0.04%
Absolute speed error	+0.75%
Speed drift 1 hour/load variation	synchronous/−0.15%
Start up time to audible stabilisation	0.7secs
Rumble: DIN B wtd L/R av (see spectrum)	68/74dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	18g
Type/mass of headshell	universal detachable/10.5g
Geometric accuracy	fairly good
Adjustments provided	lateral angle, overhang
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	75mg/15mg
Bias compensation method	internal spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	175mg/250mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/1.0sec/4.0secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	150pF/—
System as a whole	
Size/clearance for lid rear	44(w) x 36.5(d) x 13.2(h)/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£55



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Pioneer PL200X

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks SL0 9JL.
Tel. 0753 652222/7

Features, facilities, setting up and use

This represents Pioneer's least expensive direct drive turntable, retailing at just under £100.00. A compact model, from the same range as the *400X*, the *200X* was an auto-return design with a conventional mains stroboscope and two speeds, plus fine variable control. A hanging rotor configuration was employed, providing a degree of platter self-balancing on the inverted main bearing. In such a design, the shaft becomes the fixed portion attached to the chassis, while the sleeve section is attached to the platter and is placed over an inverted shaft. A form of rather stiffly suspended subchassis was built in, with the lateral mode measured at 10Hz, the vertical resonance appearing at 16Hz. These were unfortunately coincident or too close to the arm/cartridge range for comfort, a fault encountered with many other similar turntables in this report.

The *200X* came supplied with a modest cartridge, a 2g tracking moving magnet model equipped with a spherical tip, mounted in a universal detachable headshell arm, whose effective mass was fairly high at 17g and suggested the use of low compliance cartridges for optimum compatibility. At 150pF the lead capacitance was moderate and should not cause any problems except where the matching amplifier has a higher than usual input capacitance, and where the fitted cartridge suits a lowish 200pF or so of total capacitative loading.

Lab performance

Strangely, the *200X* bettered the results for the *400X*, returning excellent figures for wow and flutter, and generating no detectable dynamic wow-overshoot. Speed accuracy and stability were both good, with only moderate slowing under load, and the start up time was comparatively rapid at 1.4 seconds, considering the 1.2kg platter. Platter damping was reasonable, although a more substantial mat would have been advantageous, but judged from the DIN weighted figures, rumble was excellent. The spectrogram charted electrical breakthrough at 50, 150, 200 and 250Hz, with the remaining components motor generated.

Considering its low rigidity, the headshell mass was rather high at 10.5g, and in common with many other models this arm should be a good candidate for the Ortofon 'Concorde' cartridges with their integral low mass headshell (though these have yet to be evaluated by *Choice*). Arm friction was low, biasing near perfect, and downforce calibration satisfactory, with the cue operation fine. As with the *400X*, the *200X* was rated as average for arm resonances, and similarities between the two

RECOMMENDED

models were clearly apparent from the resonance graphs. The decoupled counterweight vibrated at 30Hz, while at 200Hz the shell/arm tube flexed, probably at the junction, with a further quite severe break at 500Hz, after which point the ideal rising energy trend was more or less resumed.

The acoustic breakthrough was better than expected and rated as good, while above 50Hz the output was favourably below the centre line at −40dB, albeit a little uneven. The vibration isolation was about average, although a sharp failure was evident at 40Hz, and this was borne out by the feedback tests which gave a good result overall, but showed signs of breakaway at high volume settings around 40Hz. Both the hum levels and impact shock vibration resistance were quite good.

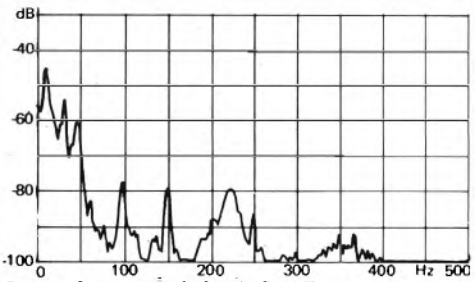
Sound quality

Rated at 'average', the sound quality was quite promising for the price. Both rumble and wow were inaudible and the general character was quite well balanced and neutral, but a loss of depth information was however apparent on relevant stereo program, while the bass depth and definition could also have been improved.

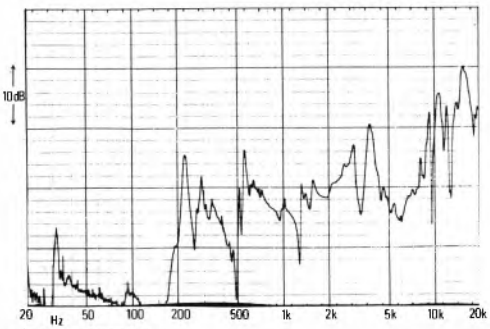
Conclusion

The performance balance was sufficient to qualify for a recommendation at the price level. The modest cartridge supplied could prove a bonus, but we would expect most users to replace it with a better model, and the best results will be obtained with the turntable sited on a rigid shelf.

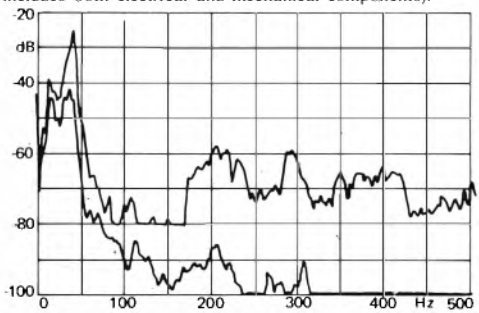
GENERAL DATA	Integrated Turntable
Motor Section	
Type	direct drive, auto return
Platter mass/damping	1.2kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.07%/<0.045%
Absolute speed error	+0.15%
Speed drift 1 hour/load variation	<0.15%/−0.25%
Start up time to audible stabilisation	1.4secs
Rumble: DIN B wtd L/R av (see spectrum)	77/78dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	17g
Type/mass of headshell	universal detachable/10.5g
Geometric accuracy	good
Adjustments provided	lateral angle, overhang
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/very good
Friction: typical lateral/vertical	15mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/250mg
Downforce calibration error: 1g/2g	−0.1g/−0.1g
Cue drift/8mm ascent/descent	negligible/1.1secs/0.8secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	150pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	42(w) x 36.5(d) x 9.6(h)/4.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£100



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Pioneer PL400X

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks SL0 9JL.
Tel. 0753 652222/7

Features, facilities, setting up and use

The automatic *400X* is a middle unit from a range of related turntables which also includes the *500X* (possessing an extra motor for powered automatic and cueing functions) the *300X*, (an auto-return only version of the *400X*), and the *200X*, (a non quartz auto-return version also reviewed in this issue). All have essentially the same arm and general structure, plus quite similar specifications for wow and flutter. In fact, our first sample of the *400X* was marginally faulty, and returned a high linear wow figure of 0.37%, although the combined weighted value was quite good at 0.09%. A second unit was obtained, and proved much better, producing 0.08% for linear wow with a combined weighted reading of 0.065%.

A form of sprung subchassis was used for the *400X*, though the spring resonances were high at 10Hz lateral and 16Hz vertical, and were also overdamped. The motor was a 'hanging rotor' direct drive with, in this case, a quartz locked speed reference. As two fixed speeds was all that was provided, the quartz-referenced illuminated stroboscope was rather redundant.

The player was quite slim in construction and carried the short travel function push buttons on the plinth front edge, clear of the lid. A conventional design, the arm employed the usual universal detachable headshell, and was quite high in effective mass at 17g, while the lead capacitance was moderate at 150pF.

Lab performance

Judged by the second sample, wow and flutter was very good, for while a trace of wow overshoot was present, it was not judged to be very important in view of the available torque, which was relatively high. (In this respect the *300X* should prove similar to the *400X*, with the *500X* free of this effect due to the use of a different servo control; however it is interesting to note that the *200X*, which uses the same motor as the *400X* but with the quartz lock removed, proved entirely free of dynamic wow.) Speed stability and accuracy were predictably excellent, and the start up fairly good at 1.6 seconds, considering the moderate 1.3kg mass of the platter and mat. Platter damping was fairly good and rumble very good, particularly as regards the weighted figures, although some spurious noise was evident on the spectrogram, where only the 150Hz and 250Hz components were electrical, the remainder being caused by the motor.

Overall the arm was quite well aligned and finished, though some play was evident in the bearings. Friction was low and the bias of the right order but in the inverse ratio; however it did not introduce any appreciable extra friction. Downforce calibration was fine and cueing highly satisfactory. On audible range resonances, the arm was classed as average, with the counterweight mode

appearing at 28Hz and the first and rather severe shell/tube break at 200Hz. Another break also occurred at 500Hz although the control was much improved at higher frequencies.

Acoustic breakthrough was fairly good despite the 200–400Hz plateau, while vibration isolation was rated above average with fairly even distribution. The hum levels and impact shock resistance were both good, but the feedback margin turned out to be below average on our test 'coffee table'.

Sound quality

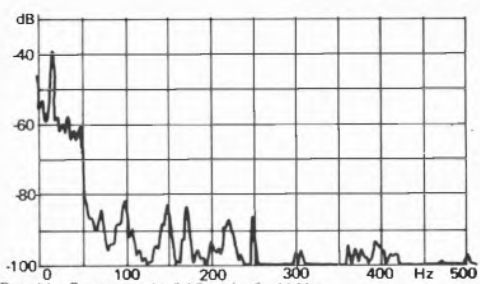
Rated as average, and not as good as one might have expected, the sound appeared marginally thick and dulled, with vague bass definition, and showed a restricted depth and a low frequency feedback margin that was poorer than, for example, the *PL512*.

Conclusion

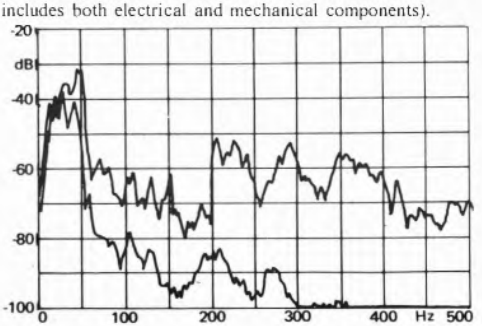
This turntable's subchassis system was relatively ineffective and the player would benefit significantly from rigid shelf mounting. On the basis that some care is taken with siting, it would prove to be a pretty good automatic quartz direct drive for the price, and is worth considering. (Likewise its auto-return *PL300X* brother also merits the same consideration.)

However, it is worth remembering that the *400X* gave different bias results to the *200X*, and yet both carry substantially the same arm; this raises a question concerning quality control, as did the poor wow on the first *400X* sample.

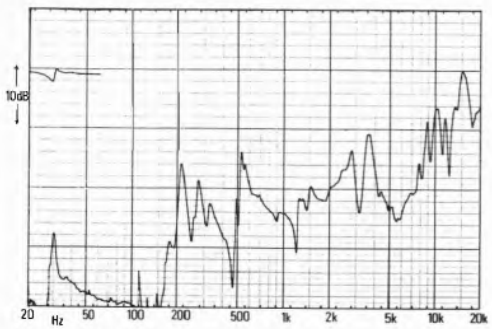
GENERAL DATA	Integrated Turntable
Motor Section	
Type	quartz direct drive, fully automatic
Platter mass/damping	1.3kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	(0.065 2nd sample) 0.09%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	(0.08) 0.37%/ (<0.05) <0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.6secs
Rumble: DIN B wtd L/R av (see spectrum)	75/76dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	17g
Type/mass of headshell	universal detachable/10.5g
Geometric accuracy	good
Adjustments provided	lateral angle, overhang
Finish and engineering	good/good
Ease of assembly/setting up/use	very good/very good
Friction: typical lateral/vertical	25mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	230mg/180mg
Downforce calibration error: 1g/2g	−0.05g/0.1g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	150pF/some counterweight decoupling
System as a whole	
Size/clearance for lid rear	42(w) x 36.5(d) x 9.6(h)/4.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£145



Rumble Spectrum (ref 10cm/s @ 1kHz: includes both electrical and mechanical components).



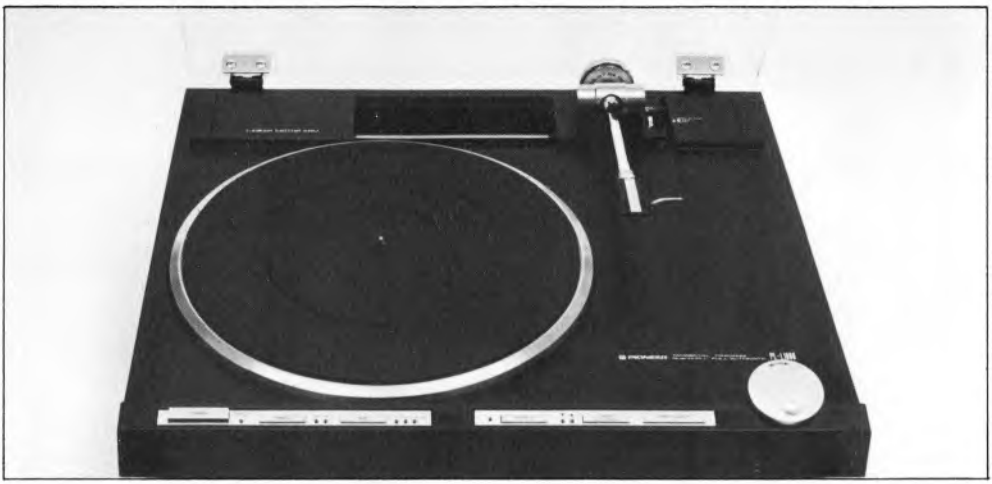
Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Pioneer PLL1000

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks SL0 9JL.
Tel. 0753 652222/7



Features, facilities, setting up and use

This exotic creation sported an unusual parallel tracking tonearm, the latter comprising a pair of polished parallel rails with the arm pillar section mounted on precision ball races. Lateral movement was virtually silent and frictionless, the arm powered by a sensitive linear motor. As the arm was 'bi-directional' and controlled by approximately 0.2° of tracking error, it could cope well with disc eccentricities; the majority of other parallel tracking arms are forward error types only, and have a higher tracking error 'dead band' for negative pitch changes.

The arm itself was a fully pivoted design with the usual universal headshell, and although reduced mass was claimed, the 16g measured hardly confirms this, and suggests compatibility with low compliance cartridges. Lead capacitance was higher than expected at 200pF, and also deserves consideration. The arm incorporated automatic start and return functions plus power cueing, while the micro-switch function touch buttons were on the front canted section of the plinth, clear of the lid, with a large rotary control (possessing a fine finger depression) responsible for the power controlled lateral arm shift.

The direct drive motor was Pioneer's own 'hanging rotor' design, with an inverted main bearing (this feature incidentally appearing on many Garrard belt drive decks some five or six years ago). Quartz lock was provided on the motor speed but with no variable control and no need for a stroboscope. A peculiar, albeit minor fault was present on our sample, whereby the internal arm wiring had a signal inversion on one channel (*ie* it was out of phase). This was identified early on during lab testing and corrected before auditioning, but it was the first time in the testing of several hundred tonearms for *Choice* that such an inversion has been found!

Lab performance

The typical 2.2kg platter mass was well damped by the sensible flat mat, and overall both finish and engineering were excellent. Start up was rapid at 1.2 seconds and entirely free of wow overshoot, while all the following parameters were excellent; wow, flutter, weighted wow and flutter, speed accuracy, speed stability, and last but by no means least, rumble. Averaging 77.5dB DIN, the rumble spectrogram contained two electrical components at 50Hz and 150Hz (the first spike on most graphs being of course the tonearm/cartridge resonance at c.8–10Hz), but in other respects was surprisingly clean.

Geometry and alignment were predictably excellent with vertical and lateral friction almost unmeasurable, and of course no need for bias correction. However downforce calibration was a little high, and while the power cueing essentially worked well, for some reason the switch did not always engage the mechanism. Unfortunately the arm resonances in the audible range proved disappointing, and were rated below average. The

rising energy trend was severely dissected, with a counterweight mode at 80Hz, an arm/headshell mode at 280Hz, and numerous resonances thereafter. That at 1kHz was particularly severe, and no region appeared under complete control.

The turntable incorporated a sprung subchassis stiffly suspended at 10Hz, and although this is coincident with the arm resonance, impact shock resistance was quite good and vibration isolation better than average. Acoustic breakthrough was also similarly rated so the system showed good feedback immunity.

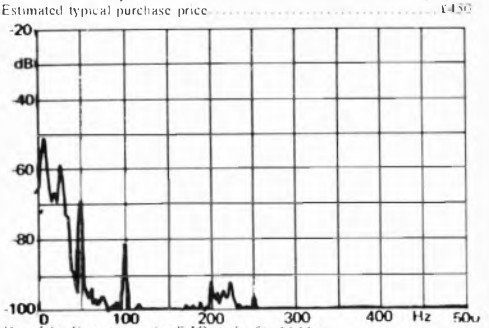
Sound quality

Despite the arm resonances which we felt did affect the sound significantly, this deck acquired a 'good' rating. It proved to be a stable tracker (often the case with linear arms), while the motor was subjectively flawless. Lateral stereo information was well presented, and the bass register was reproduced to a good standard, although the arm sound was a little 'broken up' with a slightly coloured and forward quality, accompanied by a treble range exhibiting some emphasis of sibilants and mild spurious treble 'splash' on transients.

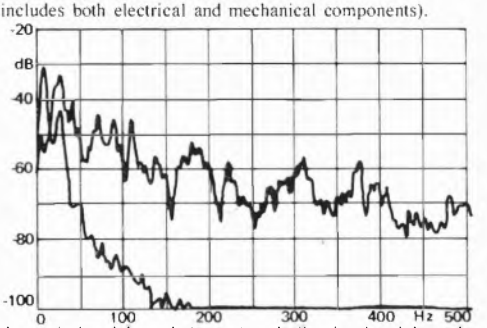
Conclusion

The *PL-L1000* was physically quite large, which could be significant if shelf space is limited, and although it was too expensive for a recommendation, it nonetheless had some good points and was pleasant to use. It is however crying out for a better quality low mass tonearm, plus an improvement in the subchassis. Nevertheless, it does contain some very fine engineering.

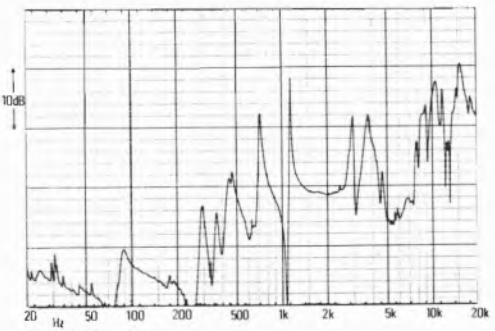
GENERAL DATA	Integrated Player
Motor Section	
Type	parallel tracking, automatic quartz d.d.
Platter mass/damping	2.2kg/very good
Finish and engineering	both excellent
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.045%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.07%/<0.04%
Absolute speed error	<0.02%
Speed drift 1 hour/load variation	quartz lock/<0.02%
Start up time to audible stabilisation	1.2secs
Rumble: DIN B wtd L/R av (see spectrum)	76/79dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	16g
Type/mass of headshell	universal detachable/11g
Geometric accuracy	excellent
Adjustments provided	height, overhang
Finish and engineering	both very good
Ease of assembly/setting up/use	very good/excellent
Friction: typical lateral/vertical	<20mg/<15mg
Bias compensation method	not required
Bias force: rim/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g/2g	+0.1g/+0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.3secs
Arm resonances	below average
Subjective sound quality	average
Lead capacitance/damping method	200pF/—
System as a whole	
Size/clearance for lid rear	49.4(w) x 45.6(d) x 15.4(h)/5.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£450



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Realistic Lab 250

Tandy Corporation, Branch UK, Bilston Road, Wednesbury, W. Midlands. 021-556 6101

Features facilities setting up and use

This deck is manufactured in Japan for the American marketing organisation Radio Shack, this company represented in the UK by the Tandy chain stores. The *Lab 250* was a moderately priced belt driven deck employing a synchronous/induction motor, the latter recognised as being the same as that fitted to the Garrard *GT25P*. The turntable came complete with a fitted cartridge, namely an Audio Technica *AT12E* tracking at a 1.5g downforce, and the deck incorporates an auto return facility and the universal SME-type detachable headshell socket system. The clumsy overhang measurement method for the alignment of additional cartridges was again specified, it being unfortunate that the cartridge supplied possessed a serious 5° lateral tracking angle error.

The unit came fitted with a moulded continental 2 pin power plug with side contact earth connectors, and this would have to be removed by the purchaser for UK use. Fairly soft feet were fitted which gave a small amount of plinth decoupling but the resulting resonance was placed too high at 12Hz.

Lab Performance

Wow and flutter was satisfactory with an 0.14% DIN peak reading — some sensitive listeners might just be aware of such a level. Speed was an acceptable 0.2% slow with a further reasonable slowing of 0.3% under load.

Start up was rapid at 1.25 seconds while rumble was pretty good on measurement (see also sound quality), and acoustic breakthrough just about average. Feedback margins were fine with the lid both raised and lowered, while hum levels were very good, even using a moving-coil cartridge. Vibration sensitivity was also classed as good.

The arm resonance characteristic was undoubtedly disappointing being dissected by numerous sharp discontinuities of considerable peak-to-trough ratio, the first bending mode appearing at a low 200Hz. Friction was moderate, biasing close to the required values and downforce accurate. Cue operation was spot on, and geometric accuracy fine, if correctly set up using a protractor.

Sound quality

With some favourable characteristics the sound quality as determined using the reference cartridge, was judged to be 'average' — a good result considering the price, and taking into account the average listeners' tolerance of mild wow effects. A touch of coarseness was evident in the middle register with a flattened stereo perspective and a 'loud' effect, while detail rendition was quite good and the bass just a little 'tubby'. Stereo imaging showed a mild widening of the central stage.

Conclusion

The performance was quite good for the price and the inclusion of a reasonable cartridge plus auto return facility gains this model a recommendation. Note that the supplied cartridge may require realignment before use.

Update

We understand that some minor styling changes only will affect this model, and while it just fails to reach the more stringent recommendation standards adopted in this latest edition, it remains a model worthy of consideration.

GENERAL DATA Integrated Player

Motor Section

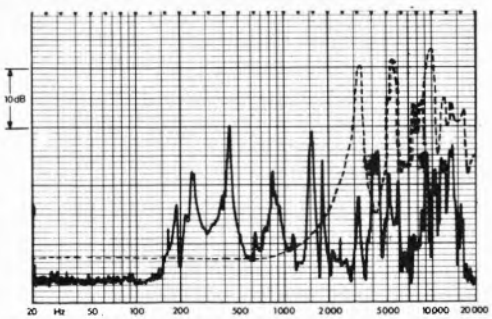
Type	auto return belt drive
Platter mass/damping	1.2kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core (non standard plug) /earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.14%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/0.10%
Speed accuracy/drift/variation under load	-0.30%/synchronous/-0.30%
Start up time to audible stabilisation	1.25secs
Rumble (av DIN B wtd L/R)	68/71dB

Arm Section

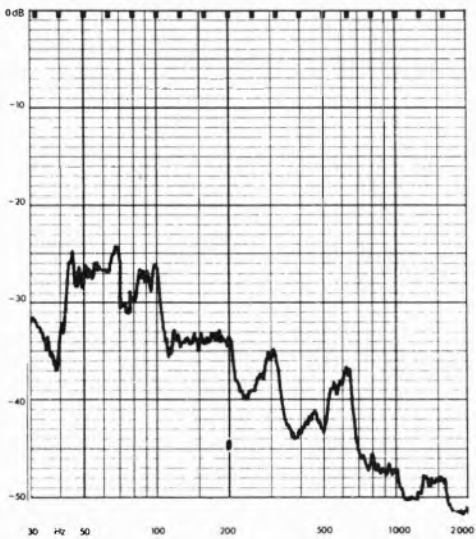
Approximate effective moving mass (excl cart, inc screws)	15.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	7.0g
Geometric accuracy	fair
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50mg/40mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/180mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.25secs/2.0secs
Downforce calibration error 1g/2g	-0.05g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44.2(w) x 35.9(d) x 15.9(h)/5.2cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£80



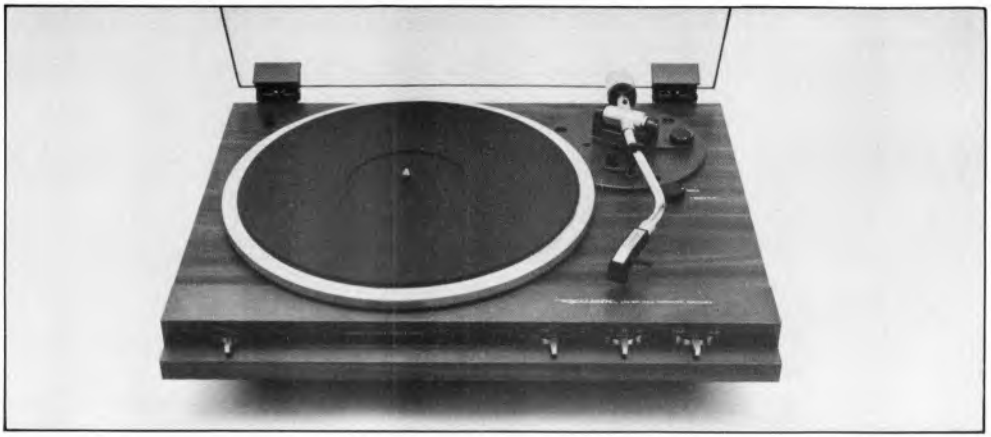
Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Realistic Lab 500

Tandy Corporation, Branch UK, Bilston Road, Wednesbury, W. Midlands. 021-556 6101



Features facilities setting up and use

A quartz locked direct drive turntable, the Lab 500 exhibited many ergonomic as well as visual similarities to the ITT *8012,* believed to have originated from the same Japanese factory. Some American influence was shown by the incorporation of a special slimline headshell of standard socket fixing, which had inbuilt a special permanently aligned version of a Shure cartridge, believed to be the *M95ED.* Tracking force was set to 1g, which we felt to be a trifle on the optimistic side in view of the estimated moving mass of 15g, with the stylus compliance in the 30-40cu range.

A typical arm/cartridge subsonic resonance of 7Hz was estimated — on the low side and close to record warps; a tracking force of 1.25-2.5g would give greater safety margin on tracking.

Fully automatic operation was provided but due to the fixed cartridge/headshell, no geometrical adjustments were included, and it was unfortunate that the supplied assembly appeared some 2-3° out of alignment as referred to the SME protractor.

Lab performance

Very good wow and flutter was recorded but rumble proved inferior to that produced by its less expensive brother, the *250.* The measured 68/7dB result improved to 75dB with power off (platter still rotating), this indicating the presence of electro-mechanical 'pole' noise. Torque was high, resulting in rapid 1.5 second start up with no significant servo-overshoot. Speed accuracy was superb due of course to the quartz control, and while acoustic breakthrough was fairly good (a trifle high in the 250Hz range), the vibration isolation was only rated as adequate. However, feedback margins appeared very good, with the lid both open and shut.

Arm friction was very satisfactory while biasing was quite accurate, as was the downforce calibration. Cue ascent was considered slow at 4 seconds, although no lateral drift occurred. It should be noted that an accessory headshell could be purchased to permit the use of another cartridge in addition to the one supplied, and this was in fact done to generate the arm resonance curves, which showed a typically average characteristic.

Sound quality

Using both the supplied as well as the reference cartridge, the sound quality was considered just about average — fair enough at the price. Some motor rumble could be heard at higher listening levels, the overall sound quality characterised as a little 'loud' with a sharpened high treble and a loss of stereo depth and positional accuracy. The bass register was, however, considered fairly good.

Conclusion

While the *Lab 500* represents fairly good value, of the two Realistics tested, the honours must go to the *Lab 250.* Minor styling revision only is expected for 1980.

GENERAL DATA Integrated Player

Motor Section

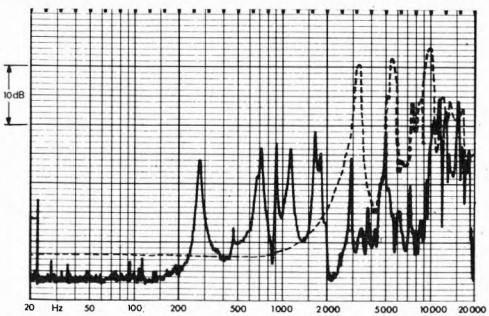
Type	automatic quartz, direct drive
Platter mass/damping	1.7kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.075%
Wow/Flutter (Iin pk wtd 0.2-6Hz/6-300Hz)	0.10%/0.11%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	68/70dB

Arm Section

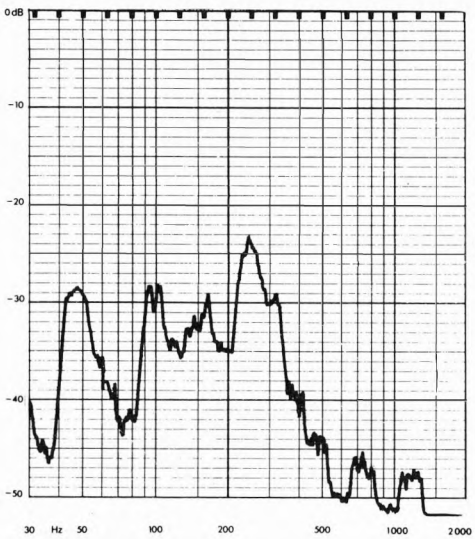
Approximate effective moving mass	15.0g (estimate)
Type of headshell	special integral cartridges; universal socket
Headshell mass (inc screws)	N/A
Geometric accuracy	fair
Facilities for adjustment	none
Finish and engineering	fairly good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	30mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/110mg/175mg
Cueing: drift/8mm ascent/8mm descent	negligible/4.0secs/4.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	48(w) x 38.6(d) x 15.8(h)cm/4.3cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£170



Arm resonances (compared to cartridge resonances, dotted).

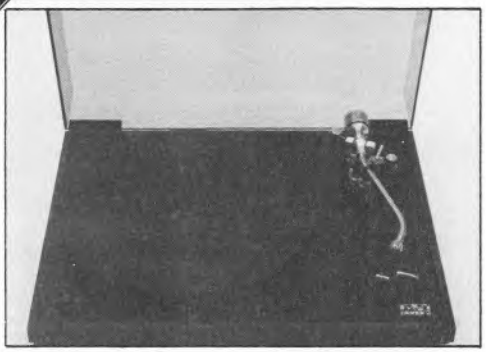


Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Rega Planar 2

Rega, Rega Research Ltd., Swaines Industrial Estate, Ashingdon Road, Rochford, Essex. 0702 546674



Features, facilities, setting up and use

This simple and tidy turntable costing just under £100.00 is also available in a similar but improved form as the *Planar III*, and can also be occasionally obtained without an arm. Manually operated, the deck was built on a thick composite board panel with solid hardwood edging and a satin finish hard laminate top surface, while the high quality non-resonant acrylic moulded lid was hinged without friction onto the plinth rear, and remained open by virtue of gravity.

A belt, or more precisely a cord drive design, the motor offered two speeds via two pulley diameters, these selected by hand after removal of the platter, The platter itself was a substantial piece of 10mm thick tinted plate glass, and rested on an inner drum, precision moulded in glass fibre reinforced plastic. Centration was very good, the slim bearing being of good quality with no perceptible play. A Linn type rubber mat was fitted which damped the platter well, but whose infrequent radial ribs did not provide much record surface support. (See the section on mats for results of this platter and mat.)

The arm was made in Japan by Lustre to Rega's specification, which included good bearing tolerances, and a side entry fixed cable with a low 75pF capacitance. As with the motor unit it can also be obtained separately, and was reviewed in a previous *Choice* under the Lustre (Rega) label; costing around £35.00, it remains a model well worth considering. A conventional detachable headshell type, the arm effective mass was fairly high at 16g, and is suited to lower compliance cartridges. It worked surprisingly well with quite advanced moving-coils. Large rubber feet supported the unit, the motor isolated from the deck panel by a simple rubber cord loop on three hooks, (the drive cord in fact).

Lab performance

While linear wow was poorer than average at 0.15%, both flutter and wow and flutter combined (weighted) were excellent. Absolute speed was slightly fast and slowing under load greater than we would have liked at 0.7%*, but as the platter mass was pretty high at nearly 4kg, so the momentum was sufficient to preclude audible dynamic wow from this source. Start up time was slow at 5 seconds. Rumble proved difficult to precisely quantify, since the basic DIN reading was averaging 63dB, but spectral analysis revealed that the proximity of the motor (it is located quite close to the platter spindle and the deck has no metal screening) produced considerable static hum induction, of the order of a typical 20dB poorer than average at 50Hz, and with sufficient at 250Hz to impair the weighted rumble reading. The rumble bridge we used for measurement located the cartridge near to the spindle, and another reading taken towards the platter rim served to reduce the breakthrough sufficiently to establish a better than 70dB typical rumble result.

The arm mass has already been noted and the geometrical accuracy was very good, with fine finish and engineering apparent. Arm friction was low with the biasing effective and friction free, and although it gave values 30% low, simply dialling a higher setting will easily compensate for this. Downforce calibration was accurate and the cue fine. The arm resonances were judged above average – unusual for a turntable in this price range. The energy trend was more or less continuous with several regions of good behaviour; for example, from the counterweight resonance at 70Hz to the first tube mode at 400Hz; from 1kHz–2.4kHz, and over the final octaves above 400Hz. However significant modes were of course present, in this instance at 500Hz, 800Hz and 3kHz.

Rated a little above average on acoustic breakthrough, a region of prominence was graphed, centred on 250Hz. The rubber feet endowed the unit with a single fairly high resonance at 18Hz, only just subsonic, but at least well clear of the arm/cartridge resonance range. The vibration isolation was rated as just average and again reflected the 250Hz central prominence. Feedback resistance was in fact below average, appearing first in the bass, but a rigid shelf, well clear of the test location's suspended floor was found to improve matters greatly here. Hum levels were only just satisfactory towards end of side, though better elsewhere, with the reading at 50Hz being only 40dB below 10cm/sec, 1kHz. As is often

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the case with stiff feet, the impact shock resistance was good.

Sound quality

The substantial platter was one of this deck's greatest assets, and it was rated as above average despite the poor bass feedback margin. The arm sound was liked and offered a good balance, with promising detail, fine imaging and reasonable stereo depth, while the mid frequencies were quite clean, the acrylic lid a contributory factor here. In fact the low frequency range was its weakest point, and some loss of depth and definition was noted here.

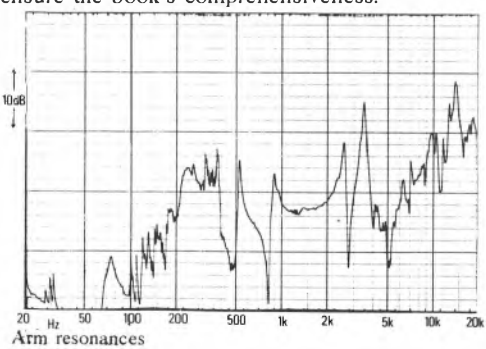
Conclusion

At the price and notwithstanding the marginal hum levels, this turntable and arm deserved recommendation on grounds of both the sound quality and several aspects of the technical performance, notably flutter, bearing integrity and the like. Without the arm and costing around £70.00 it must be one of the cheapest motor units available of this quality, and if high compliance cartridges are of interest, the ADC *ALT1* or better still the *Formula 4* might make attractive alternative tonearms to the more robust and massive *Lustre*.

**Our sample had been in the editor's possession for a couple of years and may not be typical.*

Note

Rega prefer not to have their products reviewed, particularly on a measurement basis, because they believe that these can be misleading, and that their turntables should only be sold after demonstration. While accepting the last point, we believe that comparative measurement does have its place, and that the inclusion of this review was mandatory to ensure the book's comprehensiveness.



Arm resonances

GENERAL DATA Integrated player or separate components

Motor Section

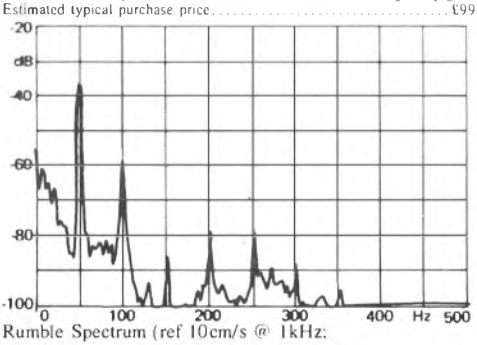
Type	belt drive, manual
Platter mass/damping	3.9kg/very good
Finish and engineering	both very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	manual change 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.055%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.18%/<0.04%
Absolute speed error	+0.5%
Speed drift 1 hour/load variation	synchronous/−0.7%
Start up time to audible stabilisation	5secs
Rumble: DIN B wtd L/R av (see spectrum)	70/72dB

Arm Section

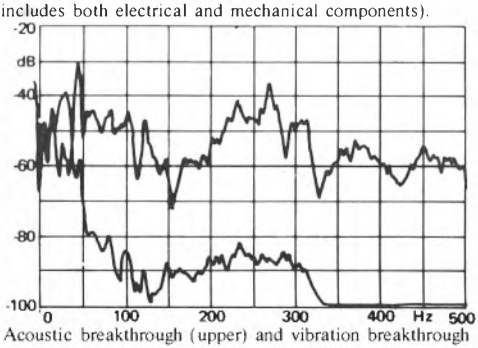
Approximate effective mass inc screws, excl cartridge	16g
Type/mass of headshell	universal detachable/8g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang, height via washers
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/very good/very good
Friction: typical lateral/vertical	25mg/<10mg
Bias compensation method	magnetic
Bias force: rim/centre (set to 1.5g elliptical)	100mg/115mg
Downforce calibration error: 1g/2g	−0.05g/−0.1g
Cue drift/8mm ascent/descent	negligible/2.5secs/2.0secs
Arm resonances	good
Subjective sound quality	above average
Lead capacitance/damping method	75pF/mild counterweight decoupling

System as a whole

Size/clearance for lid rear	44.5(w) × 35.5(d) × 13(h)/7cm
Ease of use	good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average*
Hum level/acoustic feedback	satisfactory/below average
Vibration sensitivity/shock resistance	average/very good
Estimated typical purchase price	£99



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Revox B790

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

Features facilities setting up and use

Representing the first Revox entry into the turntable field, the *B790* is a highly innovative design. Perhaps the closest comparable model is the current B & O *4002*, as both decks are equipped with servo-controlled parallel tracking arms, and likewise, factory fitted cartridges are standard; in the case of the Revox, one of Ortofon's top line induced magnet models, the *M20E Super*. Whereas the B & O arm is a fairly standard length, driven from a concealed track at the rear of the platter, the short stub arm of the Revox is concealed in a rectangular box which is swivelled over the playing surface after a record has been put on the platter. If any manual interference is attempted during play the cartridge instantly retracts. However despite the sophisticated engineering involved (or perhaps because of it?) the arm needed to be visually tracked to the record start using the control buttons provided, although end-of-side return was automatic. In general superbly engineered, a version of the coil-spring floating subchassis top deck plate was incorporated. The motor was a direct drive unit, apparently from Dual, using a Revox quartz control system with digital speed readout and also equipped with 'fine' variable speed.

Its special design made certain aspects of testing very difficult, notably downforce, friction and arm resonances, and a minor doubt is still present concerning possible increased warp wow caused by the very short arm.

Lab performance

Revox have achieved an exemplary performance with this motor, with wow and rumble undoubtedly at the limits of our test facilities. Motor torque was excellent, with a rapid 0.9 second start up and negligible overshoot, and speed accuracy to the expected superb quartz standard. Acoustic breakthrough above 60Hz measured extremely well although deteriorated at very low frequencies, and the shock immunity proved outstanding — clearly the deck has been optimised for this parameter. On the test location feedback was also excellent provided that the lid was not tipped back excessively.

A very low 3g effective mass was estimated for the arm, this proving highly compatible with the supplied cartridge, as a 'perfect' 10Hz subsonic resonance was recorded. Alignment was very good, friction low in the estimated 25mg region, and cue operation excellent. The arm resonances graph is of course non-standard, and relates to a side or lateral excitation of the accelerometer using a M20E cartridge; by fitting this to a conventional reference arm a scaled version of the resonances are also shown, to aid comparison. A vital point concerns the first break deferred to 400Hz, and the generally even characteristic thereafter.

Sound quality

Auditioned with the supplied cartridge the sound quality was rated as good. Low bass seemed softened, and upper midrange a little thin with a touch of coarseness, exhibiting mild coloration. On

the plus side the stereo quality was pleasant with good image precision and detail.

Conclusion

A superb motor with foolproof arm, and offering many special facilities, the *B790* cannot and is not really intended to compete with audiophile turntable systems. In engineering terms it represents good value, but a recommendation depends entirely on how important its individual facilities are to the purchaser.

GENERAL DATA Integrated Player

Motor Section

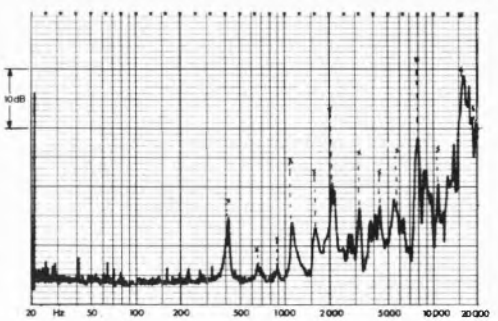
Type	auto return quartz direct drive
Platter mass/damping	1.2kg/adequate
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.07%/<0.06%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	0.9secs
Rumble (av DIN B wtd L/R)	76/75dB

Arm Section

Approximate effective moving mass (excl cart, inc screws)	3.0g
Type of headshell	non detachable
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	no user adjustments
Finish and engineering	very good
Ease of assembly/setting up	excellent
Friction lateral/vertical (typical)	estimated 25mg/estimated 25mg
Bias comp: type/force rim/centre (1.5g ell set)	none required/0/0
Cueing: drift/8mm ascent/8mm descent	negligible/0.23secs/1.0sec
Downforce calibration error 1g/2g	preset/preset
Amount of damping	none

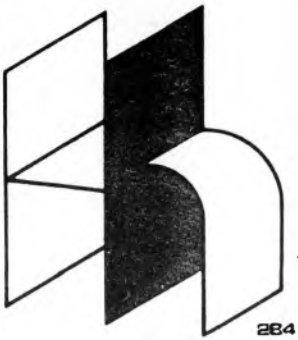
System as a whole

Size/rear clearance for lid	45.0(w) x 38.0(d) x 14.5(h)/0cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/excellent
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£388



Arm resonances, fitted cartridge. Dotted lines marked 'x' represent an attempt to show how resonances would have been exaggerated using the more 'energetic' reference cartridge.

Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).



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Revox B795

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

This deck was delivered almost as the issue was completed, its entry as a 'stop press' review only permissible by virtue of its close similarity with the established *B790*, a review of which is reprinted in this edition. The similarity is in fact so close that for almost every specified parameter the test result for the *790* can be taken as read for the *795*. The physical dimensions of the two decks are almost identical, the design meaning that no extra back clearance is required when the lid is elevated. Incidentally, Revox quote 220pF of cable capacitance for both models.

Preliminary checks on the *795* showed a motor performance equal to if not better than the fine standard offered by the *790*. Despite a near doubling of platter mass to 2.1kg, the rapid start up was maintained with negligible overshoot and high torque, the deck thus proving free of dynamic wow. The rumble figures were excellent at around 75dB DIN B, while the high shock immunity of the *790* was also present with the *795*, due to the latter's coil spring suspension. Vibration resistance and feedback were also both very good.

Improved circuitry in the *795* has allowed a reduction in the number of ICs used from 29 to 21, and transistors from 30 to 19. However, the major difference between the two decks lies in the *795's* ommission of the *790's* variable speed synthesiser and its digital speed display; the *795* is simply quartz locked at 33⅓ or 45rpm. The parallel tracking arm is almost identical to that fitted to the earlier model, with the full damage proof interlocks, manual (powered) start, and auto-return at the end of side. Although our sample was fitted with an AKG *P8ESR*, it is understood that a cartridge of Revox' own manufacture will eventually be fitted as standard in future production, this designated the *P20 MDR*.

By comparison with the *790* the best news is of course the price reduction of some 25–30%, at what appears to be no compromise save the loss of the variable speed control. We can thus provisionally recommend the *795* in the expectation that the Revox cartridge will deliver good results.

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Rotel RP300

Rotel UK Ltd., 2–4 Erica Road, Stacey Bushes, Milton Keynes, Bucks. Tel. 0908 317707

Features, facilities, setting up and use

An inexpensive model, the Rotel *RP300* retails at around £65.00 and comes with a modest Rotel *2RC* cartridge, which is a low compliance type fitted with a spherical tip. As supplied the alignment was none too good however, with the correct overhang as specified in the instructions set at 17mm, but the cartridge in fact fitted at 20mm. A belt drive model powered by a synchronous motor, the unit incorporated a form of primitive subchassis for vibration isolation, but the active resonance range was 12–16Hz and considering the low arm mass, this was judged to be rather near the arm/cartridge resonance. However the subchassis did provide some blocking of acoustic breakthrough, as did the heavier than usual polystyrene cover that was fitted.

Two fixed speeds were provided, and the light 0.95kg platter was well damped by the sensible rubber mat. Overall the deck was quite well engineered, with certain aspects exhibiting quite a degree of skill. For example, the bias compensation was quite well judged and added no additional friction, while the detachable headshell – rather similar to the ADC *LMF* series – showed good rigidity and was low in mass at 4g. However the fit of the shell in the arm was not as secure as with the more expensive ADC designs.

Arm effective mass was calculated at 6g, which was low and suited to a wide range of medium to high compliance cartridges, though the friction levels suggest that tracking forces below 1.5g are unsuitable.

Lab performance

In general the wow and flutter results were very good, with absolute speed a little high and showing minimal slowing under load. Start up was very rapid at approximately 0.6 seconds, while rumble was also very good at 73/74dB DIN B, with the spectrogram showing a fine clear characteristic in view of the fact that two of the major components at 50 and 150Hz were of a static electrical nature.

As received the arm alignment was not too good but a simple alignment protractor could easily correct this. Lateral friction was just satisfactory at 75mg, although the vertical was rather better at a low 15mg, and the internal spring biasing gave slightly low values but in the correct ratio at least. The cue worked well if rather slowly. Classed as average on arm resonances, the trend suffered a 12dB step at the first bend resonance located at

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190Hz, while another mode was centred on 280Hz, above which point the curve showed a pretty reasonable behaviour with acceptably good damping.

Acoustic breakthrough and resonances were average in severity mainly due to the more prominent breakthroughs at 150 and 200Hz, and below 50Hz. Despite the subchassis, vibration isolation was considered to be below average; this is clearly an overdamped design, with mild breakthrough continuing to 220Hz. Acoustic feedback was also poorer than average, appearing worst in the bass.

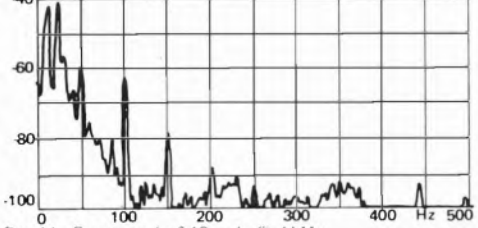
Sound quality

Just making the average grade, the sound quality is therefore quite promising at the price. The midband was pleasant with a natural balance, while fair stereo depth and precision were exhibited (this assessment made without reference to the fitted cartridge). The low frequency register was none too firm but did improve with rigid shelf mounting.

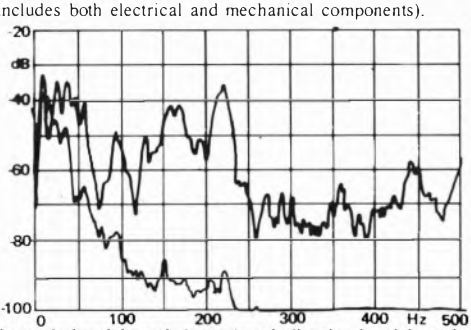
Conclusion

Even without a cartridge the *RP-300* would justify for a recommendation on grounds of value for money. In the event the modest model fitted is at least a start, and the low tonearm mass will permit an improved model as and when required, tracking fairly comfortably above a 1.5g downforce. Furthermore, an auto return feature was provided, which is fairly uncommon at this price level. The high level of lateral arm friction does need watching however.

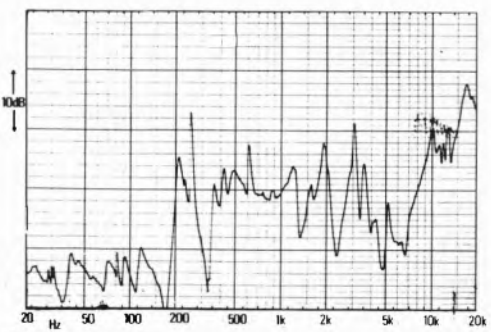
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	0.95kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.13%/0.08%
Absolute speed error	+0.8%
Speed drift 1 hour/load variation	synchronous/−0.2%
Start up time to audible stabilisation	0.6secs
Rumble: DIN B wtd L/R av (see spectrum)	73/74dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	7g
Type/mass of headshell	special detachable/4g
Geometric accuracy	fairly good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/fairly good/very good
Friction: typical lateral/vertical	75mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/175mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/3.0secs/2.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	approx [illegible]pF/—
System as a whole	
Size/clearance for lid rear	43.8(w) x 36(d) x 13.5(h)/6.4cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/below average
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£70



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough



Arm resonances

Rotel RP6400

Rotel UK Ltd., 2–4 Erica Road, Stacey Bushes, Milton Keynes, Bucks. Tel. 0908 317707

Features, facilities, setting up and use

The *RP6400* is an inexpensive model from Rotel with a fitted cartridge. No mean affair this, however, since the model supplied was an Audio Technica *AT30E* moving-coil, which has a user replaceable stylus feature. (The coils are simultaneously replaced too.) Although it has not been fully reviewed in *Choice*, it received favourable mention in the recent *Stereo Systems* issue, being of medium compliance and well suited to the *RP 6400* low mass arm. However the need for either a step up unit or a moving coil facility on the matching amplifier should not be overlooked. As regards engineering quality, some looseness was apparent in the arm bearings, while the instructions again referred to the clumsy overhang measurement method for cartridge alignment.

A direct drive auto-return model, the plinth and chassis construction differed from that in the *RP300*, and this unfortunately impaired the results. The plinth resonance was measured at 10Hz – more or less at the arm/cartridge resonance – which is an unhealthy coincidence, as interaction between the two is inevitable, with a further reduction in tracking ability. The platter was modest at 1.1kg, but the mat provided good damping, and two speeds plus fine variation were included, together with the usual mains illuminated strobe engraved on the platter.

Lab performance

Wow and flutter results were very good under steady state measurement, but some wow overshoot was present with load changes which will result in greater dynamic wow on music than the readings actually imply. The platter was not sufficiently weighty to counteract this, neither did the modest start up time indicate high torque, but considering the price level, these effects were not judged too serious. Speed accuracy and stability were fine, and slowing under load satisfactory. Rumble judged by the DIN B reading was good at 71dB, though some motor pole noise was evident on the spectrogram, the cheaper *RP300* proving superior in this respect.

A genuine low mass arm (especially considering the detachable headshell), the effective mass was 7g. Geometry was fairly good, but could have been improved by careful alignment using a proper protractor, while lateral friction was satisfactory at 60mg. The bias compensation was in the correct ratio, with the values averaging about 15% low, downforce calibration was good, and the cue operated well, if rather slowly. Lead capacitance was very low at 75pF, which may be of interest, although this is of course irrelevant in the case of

the moving-coil cartridge supplied. Judged just average on arm resonances in the audio range, predictably the results were as for the *RP300*. The reasonable behaviour in the upper band was marred by the 12dB energy jump associated with the tube mode at 190Hz.

Rated as poor on acoustic breakthrough, the curve was most uneven with a severe peak at 225Hz, while the 60Hz region was also poor. Vibration isolation was disappointing, again tracing the peak at 225Hz, and while hum levels were very good, (necessary in view of the sensitive cartridge supplied) the feedback margin was poor, appearing first around 200Hz – a not altogether unexpected finding. Impact shock immunity was just average.

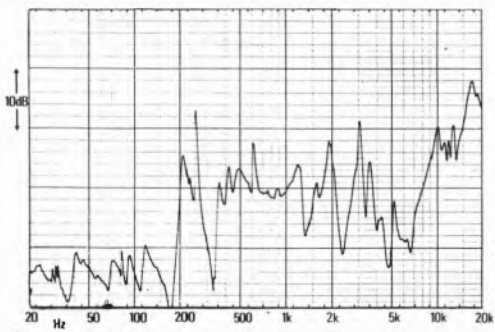
Sound quality

Significantly below average, the *RP6400* clearly suffered from the effect of its poor feedback margin. The lower midband showed a coloured quality which masked detail and strongly impaired stereo depth, and as a result it was found difficult to identify other subjective problems.

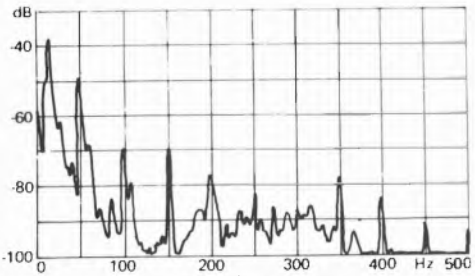
Conclusion

Despite the incorporation of a moving-coil cartridge, this more elaborate and more costly Rotel deck cannot be recommended, unlike its cheaper and less sophisticated brother. The feedback performance dominated, a factor which can be readily illustrated by removing the *RP6400* and the amplifier to a different room, away from the speakers. This aside however, the dynamic wow was really not good enough, the overall result falling significantly short of the required standard.

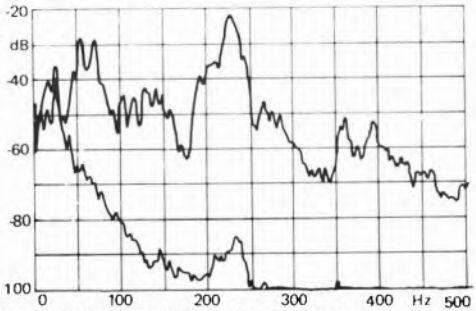
GENERAL DATA	Integrated Turntable
Motor Section	
Type	semi automatic, direct drive
Platter mass/damping	1.1kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.12%/0.06%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	−0.2%/−0.3%
Start up time to audible stabilisation	2.8secs
Rumble DIN B wtd L/R av (see spectrum)	71/71dF
Arm Section	
Approximate effective mass inc screws, excl cartridge	7.0g
Type/mass of headshell	special detachable/4.0g
Geometric accuracy	fairly good
Adjustments provided	overhang, lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/fairly good/very good
Friction: typical lateral/vertical	60mg/<15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	130mg/180mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/3.5secs/3.0secs
Arm resonances	average
Subjective sound quality	below average
Lead capacitance/damping method	75pF/—
System as a whole	
Size/clearance for lid rear	43.7(w) x 36.0(d) x 14.0(h)/4.8cm
Ease of use	very good
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	very good/poor
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£[illegible]95



Arm resonances



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).

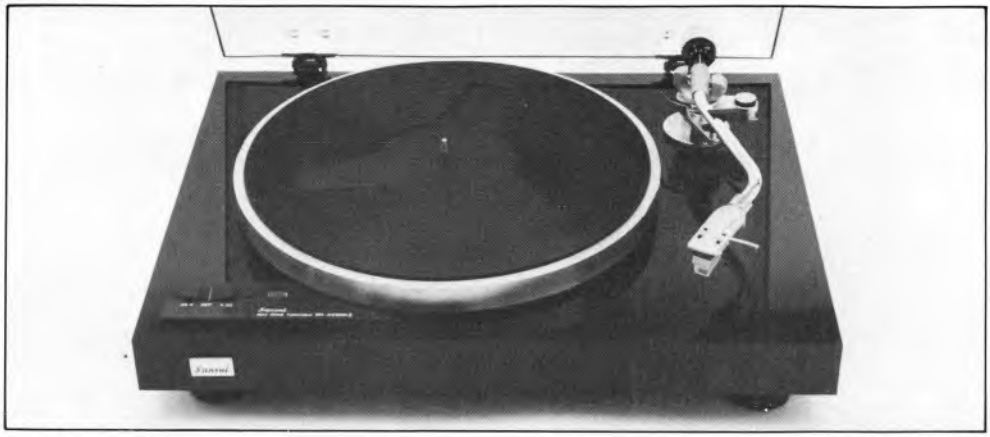


Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Sansui SR222 II

Sansui UK Ltd., Unit 10A Lyon Industrial Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel. 01-575 1133



Features facilities setting up and use

This model was reviewed in its Mark 1 version in the previous issue, but since then revisions have been made to the mechanics and styling; for example, the plinth finish in now in an immaculate deep black gloss.

A manually operated belt driven deck, power was supplied by a four pole synchronous/induction motor. Essentially simple in construction, plain non-adjustable feet were fitted to the hardboard base, the suspended resonance being high at 12Hz. The instructions recommend a periodic maintenance routine every three months if the deck is frequently used, this consisting of lubricating main platter and motor bearings, using oil supplied.

The arm description included mention of special steps that the namufacturers have taken to reduce coloration, comprising a low mass damping material in the arm tube and extensive use of rigid zinc castings for the pivot and pillar components. The detachable headshell carried the usual universal fittings, and general engineering quality was good for such an inexpensive deck, with well adjusted arm bearings as well as accurate arm alignment.

Lab performance

Very good readings were obtained for wow flutter and rumble, while speed accuracy was fine, load stability reasonable, and start up rapid at 0.8 of a second. The acoustic breakthrough curve was reasonable except in the 50-80Hz region, and hum levels were good even using a Supex moving coil (although admittedly this combination is unlikely in practice!) However feedback and vibration isolation were only just adequate.

The arm resonance curve was interesting as the basic range was rather well controlled, apart from three serious resonances at 220Hz, 700Hz, and 3.2kHz. The arm demonstrated excellent low friction accurate downforce calibration and sensible cue rates, although at the 1.5g bias setting, not only was lateral drift pronounced but the bias compensation was also erratic; correct at the inner groove it was too low at the outside record diameter. Effective mass was suprisingly low at 11g, placing it in the medium range and suited to 10-20 compliance cartridges.

Sound quality

Rated as above average — suprising in view of its feedback data — the *SR222 II* was characterised as offering a fairly well defined bass register, although some excessive fullness was noted. Stereo imaging was quite good, with fair depth presentation, the midrange being reasonably balanced if somewhat veiled, and no undue exaggeration or loss was apparent at high frequencies.

Conclusion

Recommended for a rigid shelf location at some distance from the speakers, the technical and subjective performances were both undoubtedly good for the price. This model is thus recommended, although it is hoped that the bias anomaly was simply an isolated sample fault.

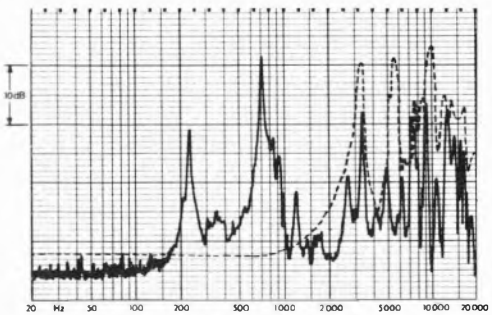
(revised & reprinted) **Sansui SR222 II**

RECOMMENDED

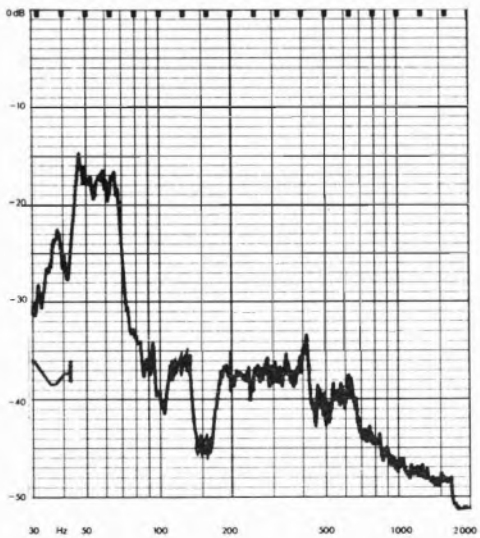
Update

This deservedly popular budget player will continue to be available for some time yet. We understand that the mat and headshell design will be replaced by those from the latest Sansui models in the near future.

GENERAL DATA	Integrated Player
Motor Section	
Type	manual belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/<0.06%
Speed accuracy/drift/variation under load	+0.1/synchronous/-0.3%
Start up time to audible stabilisation	0.8secs
Rumble (av DIN B wtd L/R)	74/72dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	11g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	<20mg/<20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/65mg/200mg
Cueing: drift/8mm ascent/8mm descent	poor/0.25secs/2.5secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45.2(w) x 37(d) x 14.5(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/adequate
Vibration or shock sensitivity	adequate
Ease of use	fairly good
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Sansui FRD3

Sansui UK Ltd., Unit 10A Lyon Industrial Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel. 01-575 1133

Features, facilities, setting up and use

This inexpensive turntable was supplied with a fairly modest Sansui *SC-50* cartridge, an induced magnet design tracking at a 2.5g downforce and fitted with a spherical tip. The motor was a direct drive type, possessing a platter rim stroboscope and fine variable speed control, in addition to the 33⅓ and 45rpm speeds. This auto-return model had fairly basic facilities, with the controls fitted on the front plinth edge, clear of the lid. The platter itself was quite lightweight at 1.3kg including the mat, the latter of plain form offering good platter and disc damping. Suspended on the usual resilient feet, the plinth resonances were not optimal, being placed at 10Hz lateral and 18Hz vertical; furthermore the lightweight polystyrene lid was directly hinged onto the plinth and was not decoupled from the arm or platter.

Fitted with a universal detachable headshell, the arm effective mass was high at 21g, and is really only suited to low compliance cartridges (that is from 9–14cu) while lead capacitance was low at 80pF and thus afforded some scope for optimum electrical matching. The rotary scale counterweight was fitted with a rubber bush to provide some mid frequency damping, and although the finish and engineering were very good overall, slight play was evident in the lateral arm bearing.

Lab performance

Very good results were obtained for all the wow readings, and coincidentally, the figures for all three measurements proved identical. On our first sample rumble was below par recording 66/71dB but a second unit gave a fine 72/73dB result; in fact the spectrogram refers to the first model and includes a number of electrical components at 50, 100, 150, 200 and 250Hz for example. Aside from these, however, motor noise is still clearly visible. Speed accuracy and drift were very good and slowing under load was moderate with torque about average; in view of the platter mass, start up was typical at 3 seconds. A trace of wow overshoot was noted with the motor but was not considered serious, particularly considering the unit price.

The arm effective mass has already been noted and the geometry was quite good although the clumsy overhang method of alignment was again specified. This partly accounts for the just 'fair' setting up comment, although an accessory gauge was at least supplied for the purpose. At 70mg lateral friction was only just satisfactory suggesting use at downforces greater than 1.5g, while the bias compensation was not fully effective until a 2g dialled setting was recorded. At 1.5g, the rim value of only 50mg revealed that the internal spring was only just engaging; however the downforce calibra-

tion was accurate and the cue operation very good. Rated as average on arm resonances, the graph showed some distinct features, notably a break of 16dB which occurred at the major shell/tube flexure, centred on 200Hz. The picture was then quite clear up to a couple of modes at 3.5 and 5kHz, above which frequency the trend was again back to normal.

Rated as average on acoustic breakthrough, a peak was present at 150Hz which disturbed the otherwise even trend. Vibration isolation was similarly classed as was feedback on the test location, though impact shock resistance was marginally better than average.

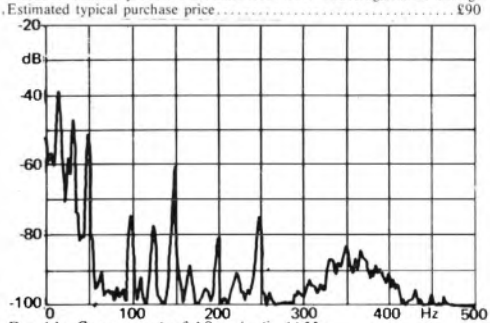
Sound quality

Receiving an average placing, the sound quality was in fact fair enough at the price. The bass registers showed a mild loss of firmness and extension, while the frequency balance was a trifle uneven and 'loud' with some sibilance and distortion emphasis at the higher frequencies. Stereo imaging was just average as regards depth and precision.

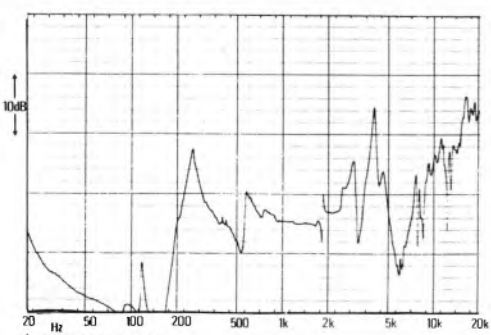
Conclusion

Judged by the second sample the rumble was good and wow and flutter fine, but the included cartridge was not of much interest, arm friction was only just satisfactory. However judged as a whole the *FRD3* produced sensible average results and as such might be worth considering, although it does not qualify for a recommendation.

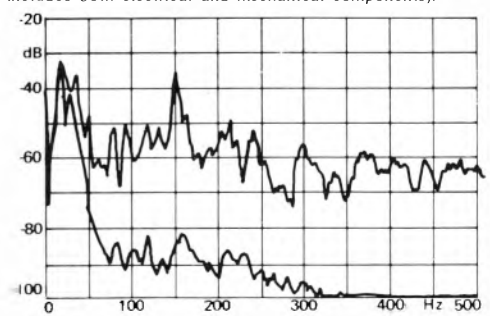
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, direct drive
Platter mass/damping	1.3kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.07%/0.07%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	<0.1%/−0.2%
Start up time to audible stabilisation	3secs
Rumble: DIN B wtd L/R av (see spectrum)	(2nd sample 72/73) 66/71dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	21g
Type/mass of headshell	universal detachable/8.5g
Geometric accuracy	good
Adjustments provided	overhang/lateral angle
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/fair/good
Friction: typical lateral/vertical	70mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	50mg/125mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.6secs/1.0sec
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	80pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	44.0(w) x 38.5(d) x 13.3(h)/3.8cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	satisfactory/average
Vibration sensitivity/shock resistance	average/above average
Estimated typical purchase price	£90



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Sansui FRQ5

Sansui UK Ltd., Unit 10A Lyon Industrial Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel. 01-575 1133

Features, facilities, setting up and use

Although physically similar to the *FRD3*, this quartz reference direct drive turntable was a fully automatic model, designated by Sansui as 'computerised'. A large scale integrated circuit with a central processor controls the automatic functions, the operating modes 'read' *via* electrical and optical sensors, with a separate motor to operate the arm cueing. The main motor used a superbly finished centreless ground main bearing, with a magnetic head tachogenerator speed control system *via* a magnetised stripe on the platter's inner rim.

The arm was unusual in some respects, and was described as a *DOB* type, being distinguished by the pair of massive weights located adjacent to and behind the pillar. It was designed so that the support point for the gravity balancing coincided with the nodal point for minimum excitation of the arm *via* the pillar and plinth vibration, while conversely vibration from the arm was not reflected into the pillar. The arm tube was also claimed to be internally damped in order to reduce resonances. The remaining arm features were straightforward, incorporating a universal detachable headshell of total effective mass at a high 19g, and suited the supplied Sansui *SC-50,* the same model as fitted to the *FRD3*.

Very low rumble was claimed by the manufacturers, and specified at better than 75dB DIN B. Our first sample in fact returned 68/70dB which was good but not to spec, and a second sample was accordingly delivered which achieved 71/75dB for left and right hand channels respectively. This was better but still not to spec, and did not equal Sansui's claims. However the *FRD5* was not unique in this failing, as several mid-priced direct drives in this edition seemed to suffer from the same mild rumble problem.

Lab performance

Weighted wow and flutter was very fine at 0.06%, though the linear wow at 0.15% was higher than expected. Speed accuracy and stability were predictably excellent with negligible dynamic wow or overshoot, and the high torque accelerated the 1.5kg platter to rated speed in approximately 1.3 seconds. The rumble spectrogram published was from the first smaple, with its averaged 69dB reading. On this graph only the 50 and 250Hz components were of electrical origin, the remainder being of a periodic nature, ascribed to the motor poles.

While in general well aligned and finished, the lateral arm friction was higher than we would have liked at 60mg. However bias was good although the values were about 30% high, while the cue operated well and the calibrated downforces were accurate. Lead capacitance was low at 75pF, providing full electrical matching flexibility. Despite the elaborate arm theory, the resonance

characteristic was classified as more or less average, with a serious jump in the energy trend of about 16dB present at the main flexural resonance at 180Hz, this effect balanced by the quite well controlled behaviour thereafter. The high mass was reflected by the low accelerometer output up to 150Hz, with the energy jump indicating when the high mass was decoupled from the cartridge through flexure.

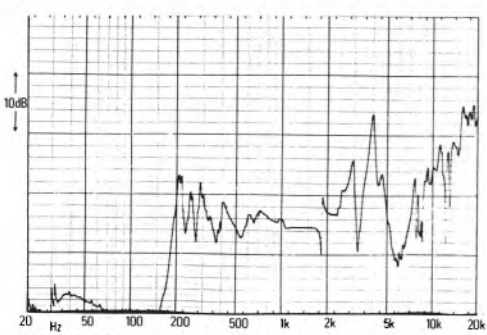
The plinth was not particularly well decoupled from the listening environment, the feet endowing it with resonances at 8, 12 and 20Hz, the lower two too close to the arm/cartridge mode. Classed as just average for both vibration isolation and acoustic breakthrough, the latter characteristic included an unwelcome peak at 150Hz. The impact shock resistance was better than average, with feedback susceptibility just average.

Sound quality

Ranked below average and not as good as its cheaper brother the *FRD3*, the *FRD5* was described as having a coloured midrange character with almost nasal vocal quality, as well as a flattened stereo perspective and an uneven bass register. On a comparative basis it sounded less pleasant than several other similarly priced decks.

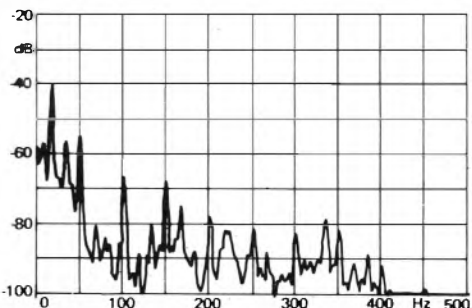
Conclusion

The sound quality rating precluded recommendation, but in addition we had reservations concerning quality control and lateral arm friction. Furthermore the included cartridge was not interesting enough to be classed as a bonus at this price level.

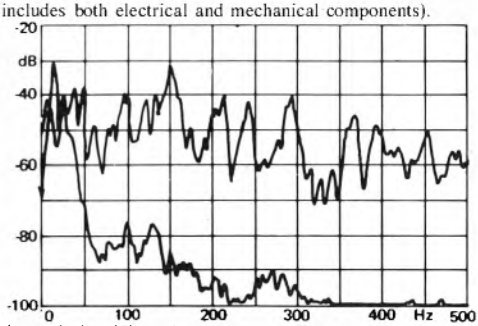


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	fully automatic quartz, direct drive
Platter mass/damping	1.5kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.14%/0.1%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.3secs
Rumble: DIN B wtd L/Rav (see spectrum)	42nd sample 71/75.6dB/70dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	19g
Type/mass of headshell	universal detachable/8.5g
Geometric accuracy	good
Adjustments provided	overhang/lateral angle
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/good/good
Friction: typical lateral/vertical	60mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	200mg/300mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/approx 1.0sec/1.0sec
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	75pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	44.0(w) x 38.5(d) x 13.5(h)/3.7cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/average
Vibration sensitivity/shock resistance	average/above average
Estimated typical purchase price	£165



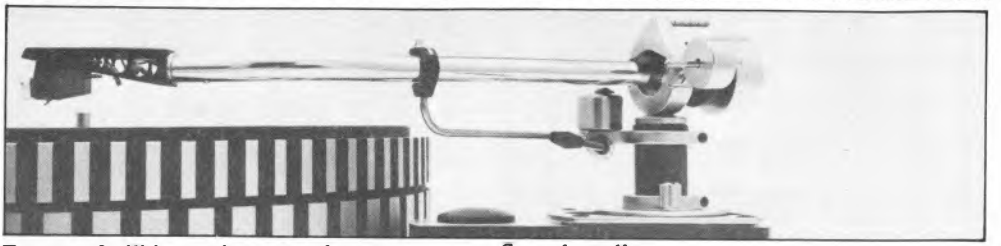
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

SME 3009 II (revised & reprinted)

SME, SME Ltd., Steyning, Sussex, BN4 3GY. 0903 814321



Features facilities setting up and use

The review of the SME *II* in the last issue was completed before the introduction of the *FD200* damper unit. This addition, plus a recent SME recommendation to use a quantity of mastic packing between cartridge body and headshell, together made a retest worthwhile. The more revealing measurement and auditioning techniques employed in this edition have resulted in greater descrimination between the fixed and detachable headshell versions, and also examined the effects of damping; the last issue recommended the model as a whole, albeit with some reservations concerning sound quality.

Engineering and finish were exemplary on this model, although some oddities were present, notably the excessive biasing and damping. This design uses a precision ball race for horizontal movement, with knife edges used in the vertical plane. The design was engineered for low mass, especially in the case of the non-detachable version. Full height, overhang and tilt facilities were present, and comprehensive instructions were provided.

Lab performance

Friction was excellent and downforce calibration accurate, with cueing satisfactory on drift and exhibiting sensible rates. The bias compensation introduced negligible extra friction thanks to the pulley, although the values were nearly double that required, and while the damping if arranged as instructed proved excessive, almost any degree could be attained by diluting the fluid, (special accessory) or using the different paddle sizes. Effective mass was low at 6g for the fixed shell and medium (9g) for the detachable — the latter still a pretty low result. The arm resonances were notably different for the two models, with the non-detachable showing a superior result up to 3 or 4kHz, having better 'Q' control, together with a more evenly distributed high frequency range.

Sound quality

In the context of this report, both the Mark II fixed and detachable arms were rated as only 'average'. The general characterisations included the presence of a brashness, a lack of bass definition, with impaired stereo image depth and precision plus a slightly 'loud' quality. However, the non-detachable version was definitely superior to the detachable, especially using the cartridge fixing mastic. The *FD200* damper provided a significant improvement, the stereo image now better stabilised, with more bass depth and precision apparent, this final combination being classed as 'good'.

Conclusion

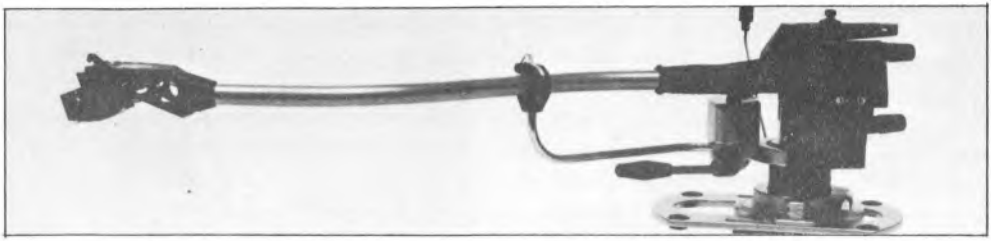
Of the *3009 II* versions tried, on grounds of engineering and sound quality, low effective mass and optional versatile damping, the non-detachable version would appear to offer the best value and be worth considering, though the cost of the damper takes the total price close to the *IIIS*.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	9g(D)/6g(ND)
Type of headshell	Universal detachable (or ND)
Headshell mass (inc screws)	6g
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	pulley, thread & weight 280mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1sec/4secs
Downforce calibration error 1g/2g	−0.075g/0g
Amount of damping	none/variable (FD200)
Arm resonances	see text
Subjective sound quality	good (ND & FD200)/satisfactory (D)
Motor recommended	TD160 etc
Estimated typical purchase price	£60 (damper £20)

RECOMMENDED

SME 3009 IIIS (III)

SME Ltd., Steyning, Sussex BN4 3GY. Tel. 0903 814321



Features, facilities, setting up and use

This amounts to a full reassessment of the *3009 III* reviewed in the previous issue, but in addition also covers the new *S* economy version. Essentially the *S* is very similar to the standard *Series III*, with the vital components of carrier arm, bearings, pillar etc all identical. The differences concern the lack of the rack and pinion on the baseplate slide of the economy version, together with the omission of both a fluid damper assembly (available as an extra at £10), as well as the 'lead screws' for easy adjustment of bias and downforce.

Turning to the features both arms have in common, the side entry detachable cable provided a total lead capacitance ranging from 75 to almost 300pF, depending on the presence of an optional capacitor in the gold plated plugs. The arm effective mass was very low at 4.5g. Mass 'padding' is however possible when required if using a low compliance cartridge, and the SME will thus match virtually any model, particularly when the variable subsonic damping facility is taken into consideration.

While the finish and engineering were very fine, with admirable instructions and a comprehensive range of optional fitting hardware, in our view the shell was too vestigial, and did not provide an ideal platform for cartridge fixing, while rear clearance in the shell was also small.

Lab performance

Geometry was excellent, and despite its complexity the SME proved easy to set up, mainly due to intelligent design and good instructions. Friction and downforce were fine, and the bias compensation was effective, although as usual with SME excessive, measuring double the required value for a 1.5g downforce elliptical stylus. Cue was drift free with a rapid ascent, but descent was too slow at 4 seconds.

On the new measurements arm resonances were still classed as good, and except for the quite well controlled breaks the energy trend was well maintained, with the counterweight/pivot system suspected to be responsible for the mode at 100Hz, and the tube torsion relevant at 250Hz. Tube bending was suggested at 450Hz, while the rest were gentle enough.

Sound quality and conclusion

The sound quality was in the top bracket, and can best be described as self effacing. While it did not excell anywhere, it nonetheless produced a pleasant, slightly softened and relaxed balance, with a subdued treble range – the reverse of the *Ittok*. Stereo depth and detail were fine, with the damper only felt necessary in the case of cartridges showing extreme liveliness at the subsonic resonance. Whereas the full price model is still worth considering, the 'S' clearly merits an unreserved recommendation.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	4.5g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, overhang, height, damping
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	good/good/very good
Friction: typical lateral/vertical	25mg/<10mg
Bias compensation method	pulley, thread and weight
Bias force: rim/centre (set to 1.5g elliptical)	275mg/355mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.6secs/4.0secs
Arm resonances	good
Subjective sound quality	very good
Lead capacitance/damping method	75/300pF/fluid damping optional
Estimated typical purchase price	£85 (damper £10) (model III £110)

Arm resonances

Sony PS-T15

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874

Features, facilities, setting up and use

Costing well under £100.00, this Korean made direct drive turntable came complete with a Sony *XL15* cartridge, the latter of reasonable quality and fitted with the usual spherical stylus, tracking at around 2g. The cartridge as supplied proved to be quite well aligned and was also compatible in terms of compliance with the medium/high 16g effective mass of the tonearm. Fitted with a universal detachable headshell, the arm carried the ubiquitous sliding scale calibrated rotating counterweight. Some play was however apparent in the bearings, but the lead capacitance was quite low at 95pF, and will not produce any electrical matching restrictions.

An automatic arm return mechanism was inbuilt, powered by the main motor. The latter in common with the other Sony models utilised a magnetic stripe on the inner platter rim for the tacho-generator speed control. Here the usual type of magnetic head had been replaced by a less expensive comb type pickup, not unlike that on the now defunct Strathearn models.

The platter was of good finish and reasonable engineering quality, but was rather light at just 1.0kg; however it was quite well damped by the rubber mat. The light plinth was supported by the usual soft feet which resulted in a rather high 16Hz resonance, with unspectacular isolation. The polystyrene lid was also light and resonant, and was potentially poor with regard to acoustic feedback.

Lab performance

Very good wow and flutter results were recorded, with the powerful stable motor showing no dynamic wow or overshoot. Startup was rapid at 1.3 seconds, while speed accuracy and stability were both very good. Rumble was sufficient to ensure near inaudibility under most conditions, and was rated as fairly good. On the spectrogram only the 150Hz and 200Hz components were identified as electrical, the remainder including the 50Hz line being mechanical in origin. The last mentioned was either transformer rumble or alternatively the result of mains ripple on the motor power supply, while pole harmonics were also apparent, though at quite low levels.

Arm downforce accuracy was very good and the cue worked well, while the friction was satisfactory at 50mg (adequate for tracking down to 1.5g or so). The bias values were effective, but the bias compensator was found to introduce additional

friction, and thus downforces below 2g are not recommended. Classed as average on audible arm resonances, the *PST15* graph showed a reasonably maintained energy trend despite some significant breaks. At 50Hz the counterweight was responsible, while the headshell/tube join was active at 150Hz, further resonances being of a more complex nature.

Acoustic breakthrough was clearly below average, with noted peaks at 50Hz and 150Hz, but the mean trend was above the reference centre line. Vibration sensitivity was about average, again showing a minor peak at 150Hz, while hum induction was very good, with shock resistance and feedback both classed as average.

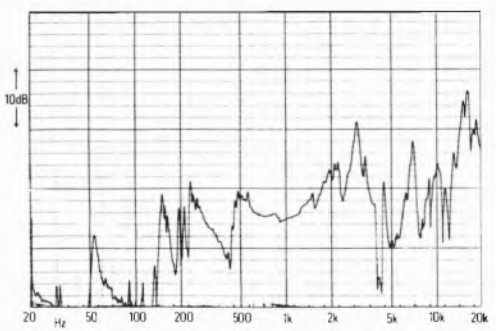
Sound quality

The *PST15* sounded better than we had anticipated, scoring an average rating, which is quite reasonable at the price. Essentially of a pleasant rather than accurate nature, some veiling of detail was observed, with stereo depth masking and a softened bass register.

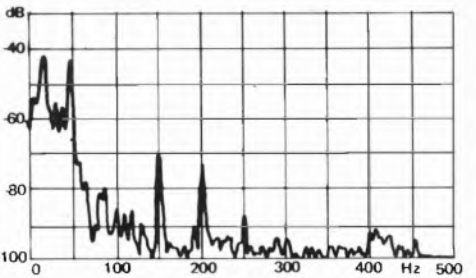
Conclusion

This model was on the borderline of being recommended, and is certainly well worth considering. The main reservations concerned the highish levels of total arm friction, as well as the rumble, which was not particularly good. The cartridge represented a small bonus at this price level, but I would expect many purchasers to fit a new and more sophisticated type, probably with an elliptical tip.

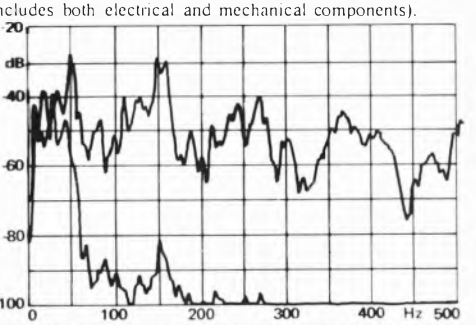
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, direct drive
Platter mass/damping	1.0kg/good
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.07%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	−0.35%/−0.1%
Start up time to audible stabilisation	1.3secs
Rumble: DIN B wtd L/R av (see spectrum)	67/69dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	16g
Type/mass of headshell	universal detachable/9g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up	good/good/very good
Friction: typical lateral/vertical	50mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	approx 150mg/200mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/2.0secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	95pF/—
System as a whole	
Size/clearance for lid rear	44.5(w) × 37.0(d) × 13.5(a)/5.2cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£90



Arm resonances



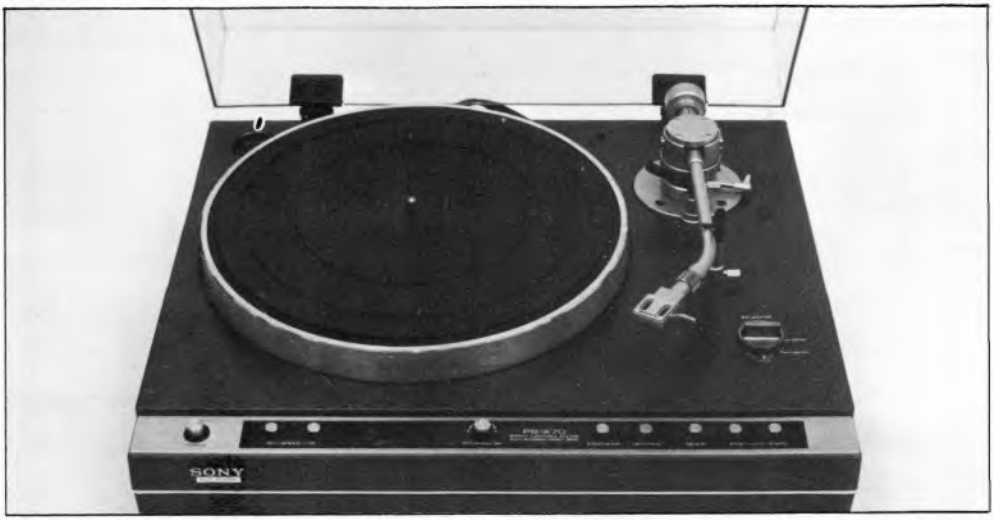
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Sony PS-X70

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874



Features, facilities, setting up and use

While the Sony *PXS70* is the main subject of this review, the *PSX60* was also examined, as the two models were very similar. The main differences concerned the fact that the cueing was not powered by a separate motor on the *'60*, while the variable speed pitch control was also omitted and the motor specified as possessing marginally lower torque. Otherwise the two models were essentially the same, and although the comments and results specifically refer to the *'70*, they can clearly also be taken as relevant to the cheaper *PSX60*. A substantially built deck, this fully automatic design incorporated a high effective mass arm (25g) with a heavy 12g die cast universal detachable headshell. Touch button powered cueing was built-in, and a vertical arm height adjustment was incorporated into the pillar, an unusual feature to find on an automatic deck.

The platter weighed 2.1kg and a well damped sensible mat was fitted. The powerful motor used the platter rim magnetic stripe tachogenerator system for speed sensing, while the quartz lock reference oscillator was also synthesised to offer fine variable speed control. The plinth was sufficiently heavy to produce fairly low suspension resonances of 6.3Hz lateral and 9.8Hz vertical, although in view of the high arm mass they were unlikely to be much displaced from the arm/cartridge resonance. The value of the loading in the plinth assembly was offset by the rather resonant lid, while low compliance cartridges – preferably less than 12cu – are clearly required to extract a good performance. Levelling was accomplished *via* adjustable feet, and in general the engineering quality and finish were excellent, although we were not entirely happy with the internal design and operation of the bias compensator.

Lab performance

Superbly accurate in speed under all conditions, the motor exhibited very high torque, providing an 0.8 second start up time. Wow and flutter was excellent as was the rumble measurement at 77/78dB, such readings at the residual of the test arrangements. The spectrogram contained three significant static electrical components at 50, 150 and 300Hz, while the remainder comprised motor rumble of a low order.

The arm geometry was very good although a headshell tilt facility was not provided. Bearing play was minimal despite the excellent friction results, but the bias compensation suffered from two problems: first the values were too great, some 40% higher than required; and secondly the bias appeared to add significant lateral friction which could impair cartridge trackability. This frictional component was difficult to measure in the presence of the compensation force, but was estimated to be over 150mg, and this, plus the high effective mass,

virtually rules out tracking at below 2g downforce. Downforce calibration and cueing were both excellent. Rated as average on audio range arm resonances, the reasonably well maintained energy trend was marred by some quite serious resonances, with that at 250Hz identified as the shell/arm join, though it was more rigid than is usually encountered. The counterweight decoupling was shown by the peak at 24Hz, at the commencement of the curve.

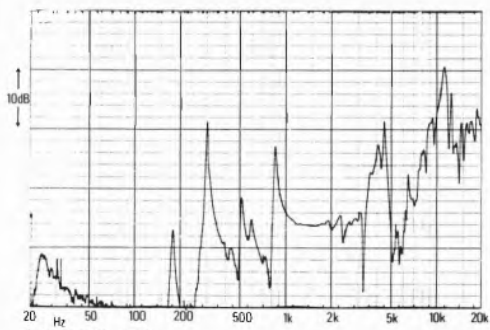
The acoustic breakthrough curve rated as above average, despite peaks at 35 and 300Hz, with the vibration isolation disappointing although still above average. Shock immunity was good, with feedback only average and first appearing in the bass.

Sound quality

Scoring somewhat above average the *PSX70* did not produce totally secure stereo imaging, and the bias problem could well be responsible here. Mild mid coloration was also apparent although the frequency balance was fairly neutral, but the low bass reproduction was somewhat disappointing at the price.

Conclusion

With an average arm of excessive effective mass, and possibly possessing a bias compensator design fault, the motor performance of this model was nonetheless truly excellent. However this does not make up for the indifferent acoustic and vibration isolation experienced. Notwithstanding the automatic facilities a recommendation is impossible, and the same must apply to the less expensive *PSX60*.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

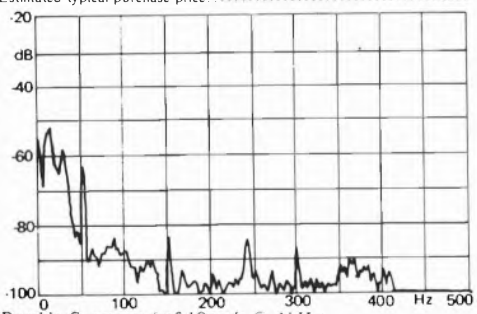
Type	fully automatic, quartz direct drive
Platter mass/damping	2.1kg/good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	3 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.07%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	0.8secs
Rumble: DIN B wtd L/R av (see spectrum)	77/78dB

Arm Section

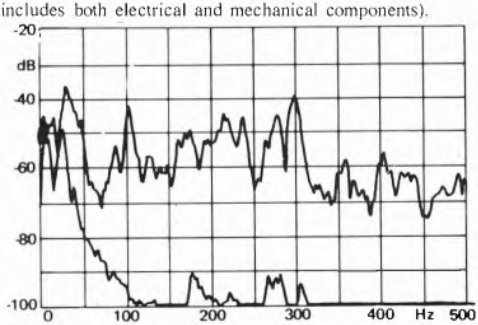
Approximate effective mass inc screws, excl cartridge	25g
Type/mass of headshell	universal detachable/12g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang, height
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	very good/very good/excellent
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	approx 250mg/300mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.5secs/0.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	approx. 100pF/sonic c/wt decoupling

System as a whole

Size/clearance for lid rear	47.5(w) x 41.5(d) x 16.0(h)/6.0cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£220



Rumble Spectrum (ref 10cm/s @ 1kHz: includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Sony PS-B80

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874

Features, facilities, setting up and use

This extraordinary turntable has received much advance publicity largely because of its tonearm. The latter, although conventionally pivoted and fitted with a standard Sony universal detachable headshell, employed electric force motors to control counterbalance, downforce, bias compensation and subsonic damping. Upon switch on, the arm balance was automatically set with the downforce under the control of a knob on the plinth front. The setting was then displayed on a digital readout, and could be varied during play. Equipped with fully automatic arm control with servo operated cue lift and traverse (for track sensing), an automatic stylus cleaner was also incorporated! This involved touching the appropriate button, which directed the arm to a small box unit and started up a set of revolving brushes, simultaneously cueing the stylus into position!

Effective arm mass was estimated at 20g implying the use of low compliance cartridges, although the inbuilt subsonic damping did expand the allowable range to up to 20cu. Lead capacitance was low at approximately 100pF. A 'microcomputer' controlled the arm and sequences for the arm setting up and the auto mechanism, and it was also able to memorise a user programmed record section, which could then be repeated up to 15 times in succession.

The mat was pierced to allow light from LED lamps below the platter to illuminate a sensor post adjacent to the arm in order to detect record size. The motor section comprised a two speed quartz-referenced direct drive with the Sony magnetic stripe speed detection system. The whole assembly was fitted with a thick polystyrene lid and suspended on resilient feet, the latter overdamped and offering 6.3Hz lateral and 16Hz vertical resonances.

Lab performance

Little need be said about the motor parameters, namely wow and flutter, speed accuracy and speed stability, load tolerance, torque and rumble – for they were all excellent. With a reasonably heavy platter at 2.1kg, start up was rapid at 0.6 seconds, and wow-overshoot undetectable. However the rumble spectrogram was not as clean as we expected (it also included contributions from the arm servo system), and while very little appeared in the 300Hz DIN B weighting band, spurious noises were in fact present below 200Hz (the 50Hz components representing electrical hum). In perspective, the worst component was that at 150Hz, which was 70dB below 10cm/sec reference, and since a similar motor on the *PSX-70* was 'clean' in this region, I personally suspect the arm electro-mechanics.

The arm proved to be excellently aligned and very well finished and engineered, but the downforce calibration was in error by +15% at 1g, and +25%, 2g – rather a lot for an £800 player. Bias proved difficult to measure due to the servo control, but was estimated at 275mg for the rim and 225mg for the centre – both excessive and in the reverse ratio. Friction was also hard to measure but appeared to be more than satisfactorily low, while the power cueing was nicely

judged. The below average rating for arm resonances was however a setback. The breaks recorded on the graph were serious, starting at a low 120Hz and again present at 480Hz and 960Hz, while two more occurred at 3.3 and 4.9kHz, with the treble range none too even.

Acoustic breakthrough was also disappointing, only just managing an average rating, and peaks at 130Hz and 230Hz were reflected in the better than average vibration isolation. The sheer mass of the unit helped to produce a good rating for feedback, while impact shock was also well resisted.

Sound quality

Overall the *PSB-80* only just scored above average, a finding which did not justify its price. The low frequencies lacked definition and transient attack, while the midrange was mildly coloured with a masking of stereo depth information, and the treble showed a 'splashy' quality apparently mildly distorting sibilants.

Conclusion

Clearly considerable effort has gone into the 'automatics' of this design, in particular to produce the elaborate *Bio-tracer* arm. However other crucial factors appear to have been neglected, such as environmental isolation, together with arm resonances and coloration, and finally effective mass and high compliance cartridge compatibility. In addition, the sound quality only just scored above average. Interesting though it was, the *PSB-80* does not qualify for recommendation.

GENERAL DATA Integrated Turntable

Motor Section

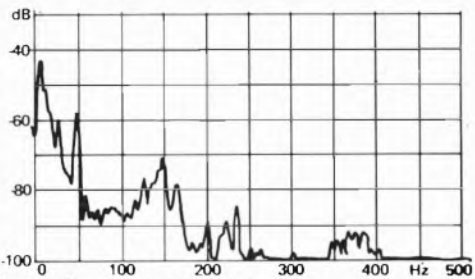
Type	quartz, fully automatic direct drive
Platter mass/damping	2.1kg/very good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd signal)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.05%/0.06%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	approx. 0.6secs
Rumble: DIN B wtd L/R av (see spectrum)	79/77dB

Arm Section

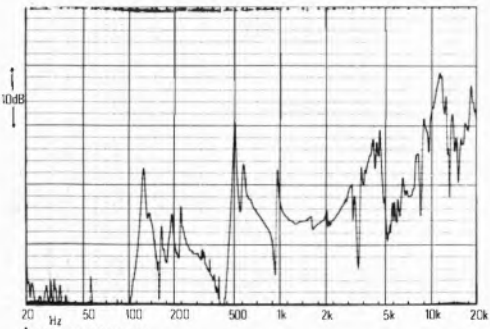
Approximate effective mass inc screws, excl cartridge	20g
Type/mass of headshell	universal detachable/12g
Geometric accuracy	very good
Adjustments provided	lateral angle, height, overhang
Finish and engineering	excellent/excellent
Ease of assembly/setting up/use	very good/excellent/excellent
Friction: typical lateral/vertical	<30mg/<20mg
Bias compensation method	electronic internal
Bias force: rim/centre (set to 1.5g elliptical)	approx. 275mg/approx. 225mg
Downforce calibration error: 1g/2g	+0.15g/+0.50g
Cue drift/8mm ascent/descent	negligible/0.5secs/0.8secs
Arm resonances	below average
Subjective sound quality	average
Lead capacitance/damping method	approx. 100pF/electronically controlled

System as a whole

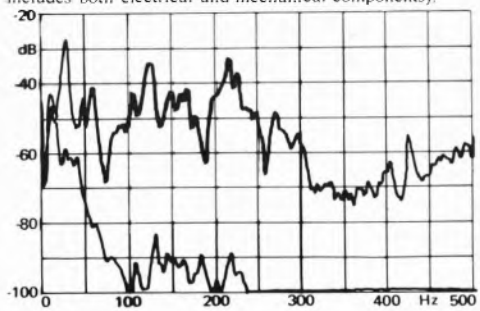
Size/clearance for lid rear	50.0(w) x 42.3(d) x 17.5(h)/6.0cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£800



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

The Hi Fi magazines have recently been praising one particular turntable very highly...

"The Sansui SR 222 Mk. II is so exceptional for its price that there's very little point in suggesting anything else." – 'Practical Hi Fi'

For the price we doubt you'll find anything to beat it. And the people who listen to Hi Fi for a living agree.

"The outstanding budget turntable" in November,– 'Practical Hi Fi'

And when a **'Popular Hi Fi'** reader asked for comments on his intention to buy a British competitor's turntable, this was Chris Frankland's advice:

"The recently introduced Sansui SR 222 Mk. II is vastly superior, both in its quality of construction as a whole, and in its sound quality."

If you're wondering why it's so impressive, back to **'Popular Hi Fi'–**

"At this price level we know of none better than the Sansui SR 222 Mk. II. It is well made, looks attractive in its black lustre plinth, and has a particularly good pickup arm . . . "

"Sound quality from this inexpensive deck is quite superb for such a unit, and it provides a firm building-block upon which to build a well matched budget system."

So far the experts have done all the talking, but we'll let you into one secret ourselves – the SR 222 costs less than £70.

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...the Sansui SR 222 MK.II

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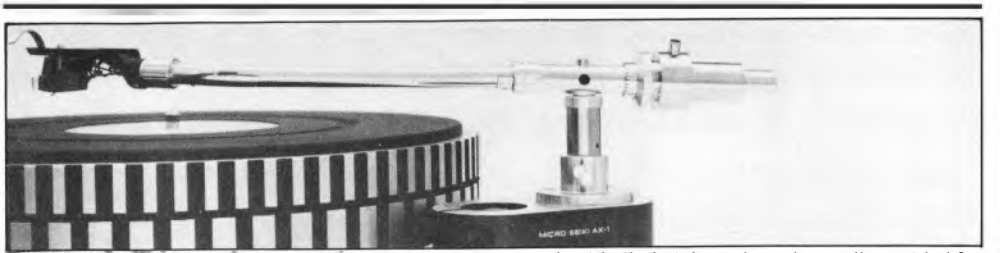

Features facilities setting up and use

This arm has been available for some time now in conventional alloy tube form, but recently another and more expensive version has been introduced, featuring a carbon fibre arm tube, and as this model also includes the alloy tube as an accessory, both the *UA7CF* and *UA7M* (alloy versions were tested.

Interestingly enough, no mass advantage accrued from the use of carbon fibre in this instance, both arm tubes weighing 13.5g. If anything, the aluminium alloy version was more rigid than the CF tube, although the latter was fitted with an unusual double pin version of the SME socket to improve socket/plug rigidity.

The socket/plug pins on the CF tube were all found to be gold plated but this was only true of one end of the alloy version. Tube interchangeability is achieved by duplicating the socket system at both the headshell and at the pivots; unfortunately this inevitably results in a reduction in overall rigidity. The crosslinking cartridge mounting screws were a little fiddly, and did not fit cartridges with thin mounting plates such as the Ultimo, the headshell fixing arrangements using removeable plates being considered rather a nuisance. In contrast a superb bias compensation mechanism was fitted, a needle roller minimising friction in between the moving level parts, while the suspension was a jewelled unipivot, rubber mounted for shock protection and so stabilised by a lateral ball race that one is hardly aware of its presence. Construction and finish were both to the usual high standard.

Lab performance

Comparing the two arm tubes for resonances, there did not seem to be much to choose between them, with the first break on the alloy tube only marginally higher in frequency than that of the CF version, and neither was rated as better than average. Friction was excellently low, biasing quite accurate with downforce error negligible and cue operation fine. Geometrical alignment was very good, with tilt, height and overhang all provided for. The moving mass at 16g was however a rather high, and low compliance cartridges are thus to be recommended.

Sound quality

A difference was observed in sound quality between the two models, sufficient under our test conditions and using reference cartridges, to rate the alloy as 'good' but the CF as only 'above average'. The former possessed a fairly neutral and transparent sound with good bass quality but a false 'air' was present in the upper mid, verging on coarseness, while the upper treble showed a touch of distortion emphasis or 'splash'. By comparison the CF tube possessed worsened 'splash' with a harder and apparently more coloured mid band; marginally less transparency was also noted.

Conclusion

Our latest information is that this arm is now only available with the (preferred) alloy arm tube as standard at £135, the *CF* tube being an optional £39 extra. Although still on the expensive side, the high standard of finish and 'good' alloy sound quality remain points in its favour.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	Universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	fairly good
Ease of use	above average
Friction lateral/vertical (typical)	<= 10mg/ <=15mg
Bias comp: type/force rim/centre (1.5g ell set)	weighted lever/ 150mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible
Downforce calibration error 1g/2g	-0.1g/-0.05g
Amount of damping	none
Arm resonances	average
Subjective sound quality	above average (good)
Motor recommended	TD160 etc
Estimated typical purchase price	£135 (*CF* tube £39)

IDEAS + IDEALS

An ideal cartridge would weigh nothing. Its stylus would have zero effective tip mass and infinite compliance.

An ideal arm would have zero effective mass and infinite compliance.

These are properties of a ray of light and movement towards this goal has continued since the earliest days of reproducing machines with their massive sound boxes and tone arms.

The extent of departure from these ideals is the measure of unwanted mechanical energy reacted in the record, turntable and pick-up arm.

The effective mass of the Series III precision pick-up arm is a mere 5.25 grams and it will deflect under a force of less than 20 milligrams applied at 9" radius.

A pick-up arm has physique but not personality. It is as happy with a moving coil as a moving magnet or moving iron but mass and compliance are another matter.

With a high mass arm you are permanently committed to a low compliance cartridge, with a Series III you always have freedom of choice. Its mass can be raised by the addition of a neat weight which we can supply to place in the shell and lowered again when desired by removing it or using another interchangeable CA-1 carrying arm.

Low compliance cartridges can be thought of as high compliance cartridges in an earlier stage of development. History and design logic establishes this as progress, anticipate it with

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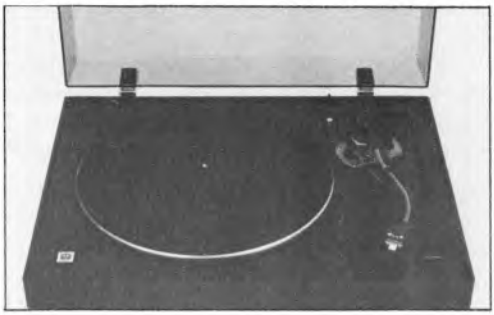


After 15 months or so of producing the now established *305M* turntable, STD have launched a new economy version called the *305S*. Both use a floating sub-chassis and belt drive, with a rather elaborate level of trim and a fabricated alloy plinth on the *M*. By substituting a heavy moulded plinth and eliminating the unnecessary trim, the price has been reduced by more than 30% on the *S*! The only other significant changes concern the substitution of a thin felt mat for the original Lux type composition one, while the adjustable feet and steel bottom plate of the *M* are replaced by a board panel with rubber feet. All essential mechanics were the same including the main bearing and motor etc., but the arm mounting arrangements have been revised to give greater clearance and allow the SME type fixing bracket to point correctly towards the platter spindle. Internally the steel subchassis carried bituminous damping and was mounted on coil springs for good isolation.

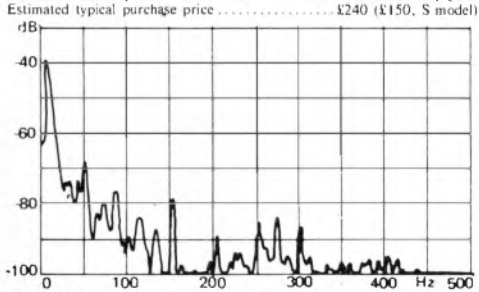
The lab results for both models were virtually identical, those printed here relating to the cheaper *S* model. Wow and flutter was fine at 0.1% weighted with a low separate flutter reading and moderate wow. Absolute speed was slightly slow, with the speed reduction under load moderate and the speed stability locked to the mains supply via the synchronous motor. Platter mass was average at 1.6kg as was the 3.5 second start up, while rumble was excellent at an average 75dB, with very little electrical breakthrough; few other components showed on the spectrogram. Acoustic breakthrough was very good but possibly limited by the light mat and moderate platter weight. Vibration resistance was however in the top class, and the deck resisted impact shock fairly well, proving extremely good on acoustic feedback and producing little hum. The subchassis resonances were respectably low at 3.5Hz lateral and 6.3Hz vertical.

Both STD models produced a sound which although very good in the context of this report, nonetheless lacked some of the bass extension and authority of the heavyweight models such as the *RD11S, LP12* and *Systemdek*, for example.

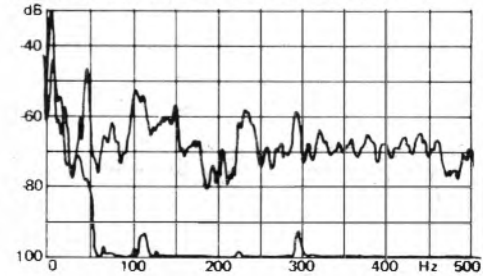
Conclusion

While the *M* did not merit a full recommendation, at £150.00 the *S* certainly does, and may be regarded as a close competitor to the Thorens *TD160S*, but British made. Moreover, despite its price, the *M* is still well worth thinking about.

GENERAL DATA	Motor Unit
Type	manual belt drive
Platter mass/damping	1.6kg/very good
Finish and engineering	both very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	manual belt change, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.13%/0.06%
Absolute speed error	−0.25%
Speed drift 1 hour/load variation	synchronous/−0.25%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	76/74dB
Size/clearance for lid rear	47.5(w) x 37.9(d) x 15.6(h)/6cm
Ease of use	fairly 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	£240 (£150, S model)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

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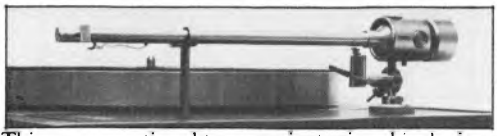


This unconventional tonearm just missed inclusion in the previous issue, and shows some superficial similarities to the *Ittok*, at least in some of the theory behind its design. Both these arms are rigid structures with massive low friction bearing assemblies, and the ability to securely bolt the cartridge onto the arm. The *PU2* tube was a substantial component in aluminium alloy, slightly 'cigar shaped' and tapered in sections from the substantial bearing housing. A gimbal array of four precision ball race bearings provided great strength and undetectable play, while the tube line continued straight through to a threaded steel rod which carried the counterweight. After adjustment using an auxiliary balance (not provided) a substantial internal grub screw is tightened to lock the counterweight in position. A falling weight and thread bias compensator was employed which was uncalibrated and capable of forces much greater than actually required. Unfortunately the vestigial cartridge mounting block clamped the cartridge back against the curved portion of the arm tube and distorted the body of some models: not all models have a solid back, the Mission *773* being one example. The block fit was deliberately tight but this resulted in some inevitable surface damage to the tube when aligning for the best geometry, the fixing screws also proving difficult to fit, as the bore was too small for most types. Our sample came built onto a Linn arm board, the design lacking the usual detachable cable and fixing arrangements, though we understand a more universal version is being made available now.

Lab performance

Early on during the testing we discovered the importance of the manufacturer's warning that this arm was sensitive to levelling, and it became apparent that a very firm foundation is required. Relatively small level adjustments to the subchassis produced strong out of balance forces at the cartridge due to poor dynamic balance of the arm, and if great care is not taken, these could easily exceed the required bias compensation. The balance was also found to affect the tracking of warps as well as the susceptibility to shock and vibration, both of which were poorer than usual. The effective mass was low at 8g and the arm possessed excellent geometry*, reasonable finish and good engineering, exhibiting superb bearings and virtually frictionless bias. The latter, though uncalibrated was at least in the correct ratio, while the cue worked well and lead capacitance was quite typical at 120pF.

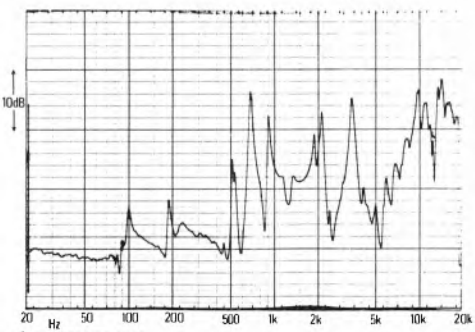
The arm resonance characteristic was considered good, and in fact the small modes at approximately 100 and 200Hz cannot be ascribed with any certainty to the arm itself, as they and others in the same range were much worse before the suspended arm board was temporarily clamped up to the plinth. The first major break occurred at a favourably high 500Hz, and the trend was quite well maintained despite further disturbances.

Sound quality and conclusion

On sound quality grounds, this arm was in the top category, with the bass, the stereo imaging and its detail and depth all fine. The treble was a little less bright than for the *Ittok* and although it is well worth considering, the balance problem and the lack of any calibrations result in a reserved rather than full recommendation.

**Note that the design places the vertical pivot axis significantly above the stylus, which can degrade trackability.*

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	8g
Type/mass of headshell	essentially fixed/N/A
Geometric accuracy	excellent
Adjustments provided	overhang, tilt, height
Finish and engineering	good/very good
Ease of assembly/setting up/use	fairly good/fairly good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	weighted lever and pulley
Bias force: rim/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g/2g	N/A/N/A
Cue drift/8mm ascent/descent	negligible/0.8secs/1.5secs
Arm resonances	good
Subjective sound quality	very good
Lead capacitance/damping method	120pF/—
Estimated typical purchase price	£198



Arm resonances

Technics SLB2

National Panasonic UK Ltd., 107–109 Whitby Road, Slough, Berks SL1 3DR.
Tel. 0753 34522

Features, facilities, setting up and use

Two models are covered by this review, namely the auto-return *SL-B2*, and the fully automatic *SL-B3*, costing around £15.00 more. The measurements actually refer to the *'B2*. Both came fitted with a Technics *270C* cartridge which is a modest affair which was reasonably well aligned, using spherical stylus and tracking at 2g. A DC servo-coupled motor was employed, coupled *via* a belt to the rather light 0.7kg platter. The mat was rather thin, and only offered just acceptable damping.

The finish and feel of the controls was very good considering the price level, and no play was evident with the main bearing, although some was noticed in the arm. A strong plastic headshell of universal fitting was provided, the arm effective mass at 13g just qualifying it for the medium category. Lead capacitance was high at 275pF, and this will need consideration with some systems. Overall the player was rather light and the plinth resonances on the rubber feet were too high for comfort at 16Hz lateral and 25Hz vertical, but at least they did not coincide with the likely main arm/cartridge resonance.

Lab performance

Linear wow was high at 0.3%, but the total weighted wow and flutter was just satisfactory at 0.14%; just on the threshold of audibility for sensitive listeners. Speed accuracy was very good, drift low, and load tolerance good, while overshoot was absent, and in view of the light platter, start up was reasonable at 1.4 seconds. The weighted DIN rumble figure was fine at 71/72dB, although the spectrogram revealed a fair distribution of motor noise, and in this instance none of the components charted could be attributed to breakthrough of an electrical nature.

Arm geometry was fairly good with the supplied cartridge, but could be improved by using a proper protractor, while lateral friction was disappointingly poor; I hope Technics achieve better than this on subsequent production, for as it stands, tracking forces below 2g cannot be recommended. Bias correction was excessive – almost double the required value at the platter centre, while cueing was fine, and the downforce calibration quite accurate. Arm resonances were classed as average, the graph displaying the almost inevitable headshell/tube flexure, in this case at a low 160Hz, with a 12dB displacement in the energy trend. At higher

frequencies however the resonances were well controlled.

The acoustic breakthrough was above average with an even, balanced character, but vibration isolation was poor, with serious transmission even at 200Hz. In consequence feedback was poorer than average, as was the susceptibility to impact shock.

Sound quality

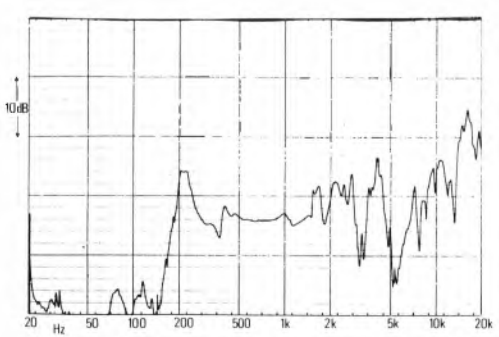
This deck sounded quite reasonable and scored in the upper range of the 'average' category. Low frequencies were somewhat lifeless and boomy, and some 'splash' occurred in cymbal and sibilant transients, while mid coloration was also evident, together with a loss of stereo depth. Motor noise was generally inaudible.

Conclusion

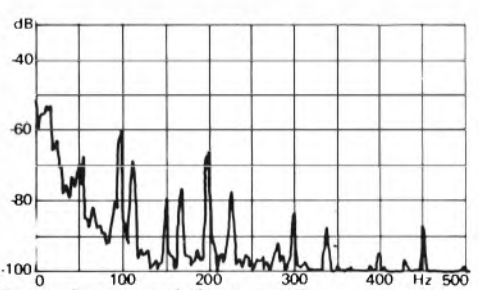
It is difficult to estimate to what degree the sound quality was impaired by the high lateral arm friction, and it is possible that an improvement would result from a better sample, as Technics arms are not usually as poor as this. The feedback and bass quality would also be subject to improvement if the deck were suitably sited on a more rigid shelf.

In conclusion, bearing in mind the price and facilities offered, it is fair to suggest that the *SL-B2* and *SL-B3* are worthy of consideration, but the supplied cartridge should not be taken too seriously.

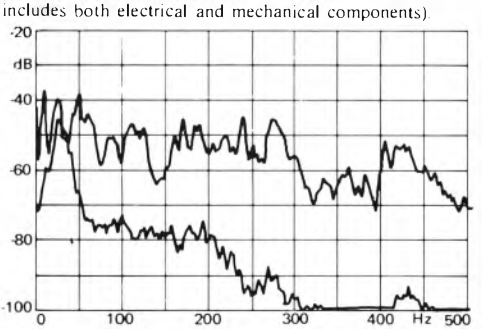
GENERAL DATA	Integrated Turntable
Motor Section	
Type	belt drive, servo control, auto-return
Platter mass/damping	0.7kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.14%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.3%/0.09%
Absolute speed error	variable, <0.1%
Speed drift 1 hour/load variation	−0.2%/−0.3%
Start up time to audible stabilisation	1.4secs
Rumble: DIN B wtd L/R av (see spectrum)	71/72dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	universal detachable/9g
Geometric accuracy	fairly good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	125mg/50mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	approx. 225mg/350mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.9secs/1.3secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	275pF/—
System as a whole	
Size/clearance for lid rear	43.0(w) x 37.0(d) x 13.0(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/below average
Vibration sensitivity/shock resistance	poor/below average
Estimated typical purchase price	£69



Arm resonances



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components)



Acoustic breakthrough (upper) and vibration breakthrough

Technics SLQ2

National Panasonic UK Ltd., 107–109 Whitby Road, Slough, Berks SL1 3DR.
Tel. 0753 34522

Features, facilities, setting up and use

As with the *SL-B2* and *'B3* the *SL-Q2* review also covers an automatic version, not surprisingly designated the *SL-Q3*. In this case however the price differential is less at £9.00, and although the model actually tested here was the manual version, at £149.00 odd I suspect most buyers will go for the *SL-Q3*. As the *Q* in the title implies, the turntable was a quartz-lock direct drive, operating at two speeds, namely 33⅓ and 45rpm. A stroboscope was of course redundant, but one was fitted anyway.

The arm was of the 'universal' detachable head type, and demonstrated an effective mass of 13g – just in the medium category and suited to compliances of between 10 and 18cu. The lead capacitance was quite typical at 140pF. Proving quite well aligned, a Technics cartridge was included in the price, namely a *207C*, tracking at a 1.7g downforce. While not very sophisticated, it did at least sport an elliptical stylus and would provide a reasonable start if cartridge purchase needed to be deferred.

The plinth was moulded from a low resonance plastic and supported on the usual resilient feet. Vibration analysis placed the resonant modes at 10 and 16Hz, both vertical, while the horizontal resonance proved difficult to excite. An acrylic type lid was fitted, exhibiting less resonance than usual. The platter was of reasonable mass at 1.5kg and was fitted with a good quality mat affording useful damping of both the platter and record.

Lab performance

The superb performance of this quite inexpensive motor was such as to defy criticism, for by *Choice* standards, all parameters were excellent. The astonishing 78/79dB DIN rumble reading was analysed *via* the spectrogram only to find that the bulk of the displayed components were of a static electrical nature, in other words at 50, 100, 150, 200, 250 and 300Hz, but just a trace of motor noise was also apparent.

Unfortunately arm lateral friction was only just satisfactory at 60mg and I would not recommend tracking below 1.5g unless this were to be improved in future production. Bias compensation was on the low side at about 30% down, but showing the correct ratio at least and adding no extra friction. Downforce calibration was fine and cueing well judged. Rated average on arm resonances, the breaks present were few in number but not well

controlled, with the counterweight responsible at 70Hz and the headshell/tube mode occurring at 250Hz. The latter was higher and hence better than usual, but further modes were present in the upper range.

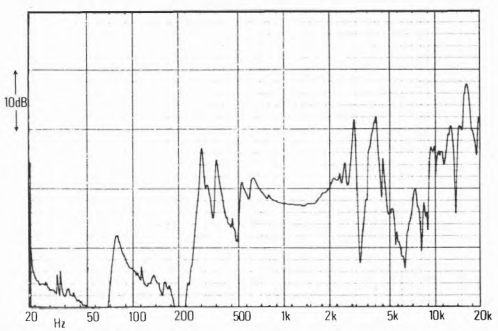
On acoustic breakthrough it scored a little above average, though not without some problems at 60Hz and 290Hz, while vibration isolation was just average as was impact shock resistance and the tendency to feedback at the listening test location.'

Sound quality

Overall the sound quality was a little better than average. The effect was quite pleasant and smooth, and the treble range was free of sibilant effects. However the bass lacked some definition and stereo image depth was reduced, ambience also being muted. Lateral positioning was fine, and the overall effect reasonably detailed.

Conclusion

The superb motor was insufficient to qualify this model for a recommendation in the accepted sense, for the breakthrough performance was only typical, and the arm should have been better adjusted for lateral friction at this price level. The standard attained was however promising, and both the *SL-Q2* and *Q3* are worthy of consideration.



Arm resonances

GENERAL DATA Integrated Turntable

Motor Section

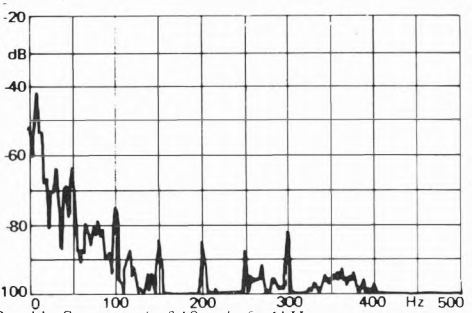
Type	quartz direct drive, auto-return
Platter mass/damping	1.5kg/good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.09%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.0sec
Rumble: DIN B wtd L/R av (see spectrum)	78/79dB

Arm Section

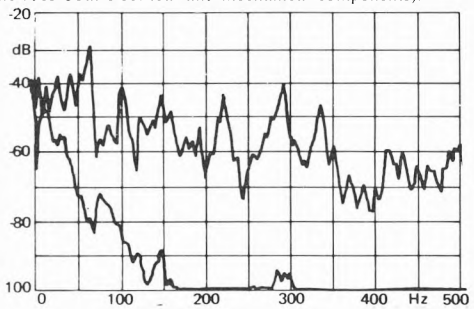
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	universal detachable/8.5g
Geometric accuracy	good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	60mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	100mg/125mg
Downforce calibration error: 1g/2g	+0.05g/+0.15g
Cue drift/8mm ascent/descent	negligible/1.0sec/1.3secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	140pF/—

System as a whole

Size/clearance for lid rear	43.0(w) x 37.2(d) x 13.2(h)/5.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	average
Vibration sensitivity/shock resistance	average/average
Estimated typical purchase price	£140



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Technics SL1700II

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522

Features, facilities, setting up and use

The 'Mark I' version of the *SL1700* appeared as a recommended model in the first turntable issue of *Choice*, a position which it maintained in the second edition. Now we have a new *Mk II* version, which appears simultaneously to update the *1700* as well as supercede the more costly *1400* group, previously reviewed. In fact, this new group of models range from the manually operated *SL1800II* (£175), the auto-return *1700II* tested here (£198), and the fully automatic *SL1600II* (£225). Once again product similarity means that the results for the *1700* will hold substantially true for the other two models in the group as well.

This comprehensively equipped unit uses a quartz-locked direct drive motor fitted with a fine variable speed synthesiser and referenced stroboscope markings for ±3% and ±6% deviation from nominal. The controls were micro-switch touch buttons on the plinth front edge, clear of the lid. The plinth itself is an alloy die-casting incorporating two stages of decoupling: firstly isolator feet, and secondly a fairly stiff coil spring subchassis, the latter giving less than ideal resonances at 11Hz laterally and 16Hz vertically. The substantial 2.2kg platter was well damped by a good mat above, and by further absorption below.

Unusually, the arm came fitted with a convenient helical adjustment for height, the effective mass being in the medium category at 13g, with a low 85pF capacitance cable. All bearings were well adjusted with negligible looseness, and the engineering and finish were both to an excellent standard. A retractable cue light was built into the plinth, as well as electronic braking to facilitate rapid speed change and stop.

Lab performance

No further comment was necessary on the motor performance save to say that the excellent results reflect the limits of test rather than those of the motor! The rumble spectrogram was dominated by static electrical components, the only significant motor noise being that at 200Hz, lying some 88dB below the reference level! The start up time was rapid at approximately 0.7 seconds, despite the platter mass.

The arm offered very good geometry especially when optimised by using a proper accessory protractor, while the friction was negligibly small, and bias compensation was both frictionless and in the right ratio, if about 15% low. Both downforce and cueing were fine. However, the arm resonance characteristic could have been better, considering the obvious care taken elsewhere, and a just 'average' rating was considered appropriate. Something was happening at 75Hz (probably the counterweight) while the first flexural mode at the arm/headshell junction was severe at 250Hz; however the remaining midband was well con-

RECOMMENDED

trolled up to 2.5kHz above which a fairly typical behaviour was observed.

The *1700's* reaction to vibration was rated as 'average' or perhaps slightly above, as the 'lumpy' graph shows. Acoustic isolation was however much better, and despite some unevenness was rated as good; furthermore both shock rejection and acoustic feedback were better than average.

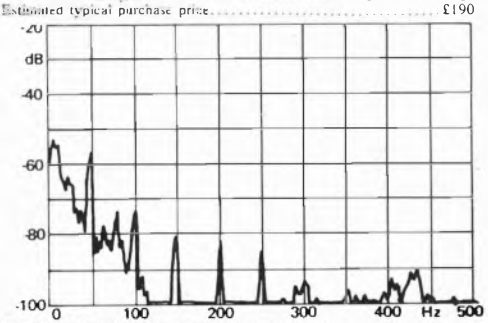
Sound quality

Just reaching the 'good' category the *SL1700II* was one of the very few integrated models in its price range to do so. While clearly not in the same subjective class as a good subchassis deck with a selected component tonearm, the Technics did provide a pleasant, well balanced sound, with reasonably good bass, fair midrange detail, as well as a good proportion of stereo image accuracy and depth. Not unexpectedly, no rumble or wow were audible.

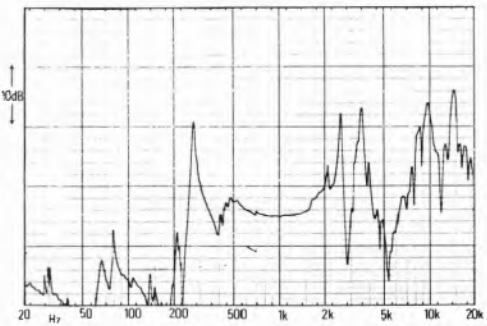
Conclusion

The promising sound quality, versatility, generous features, as well as top class engineering and technical performance, clearly combined to merit recommendation, this also holds true for the other related Technics models in the series. They represent a 'de luxe' alternative to the rather austere 'audiophile' combinations also recommended in this price range, with the manual *1800II* clearly the best value. However it must be up to the individual purchaser to weigh up the relative importance of auto-return at 10% extra or fully automatic facilities costing an additional 15% or so.

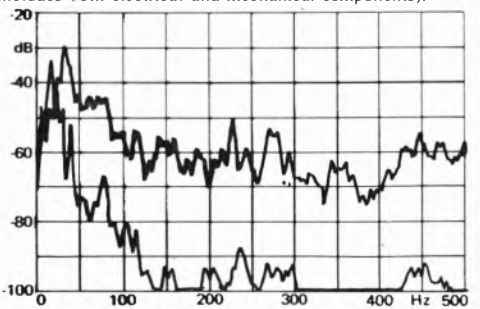
GENERAL DATA	Integrated Turntable
Motor Section	
Type	quartz, auto-return, direct drive
Platter mass/damping	2.0kg/good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.07%/<0.05%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	approx. 0.7secs
Rumble: DIN B wtd L/R av (see spectrum)	78/79dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	13g
Type/mass of headshell	universal detachable/8.5g
Geometric accuracy	very good
Adjustments provided	lateral angle, height, overhang
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/very good/very good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/175mg
Downforce calibration error: 1g/2g	<0.05g/+0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.2secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	85pF/—
System as a whole	
Size/clearance for lid rear	45.2(w) x 39.8(d) x 15.0(h)/5.0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/above average
Vibration sensitivity/shock resistance	average/above average
Estimated typical purchase price	£190



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances

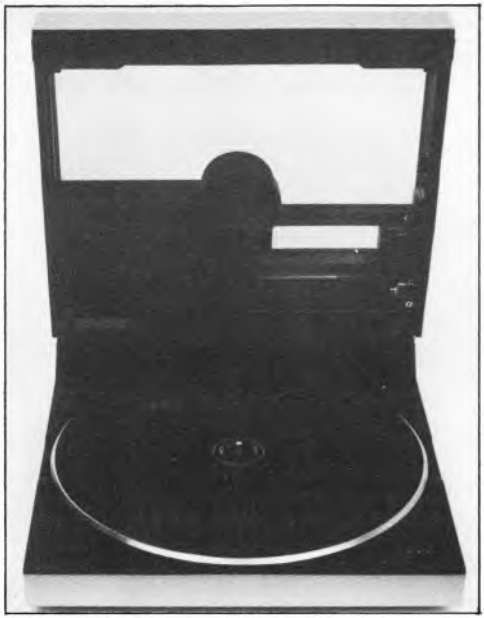


Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Technics SL10

National Panasonic UK Ltd., 107–109 Whitby Road, Slough, Berks SL1 3DR.
Tel. 0753 34522



Features, facilities, setting up and use

I must confess to finding the *SL10* the most interesting and attractive new model in this issue, and its qualities were also appreciated by my family and friends alike. Not really believable until seen in the flesh, the surface area of this ultra compact unit was exactly the size of an LP sleeve, although of course the depth was rather greater, and it could be used, albeit with certain inconvenience, in a wall-mounted (vertical or angled) location, as well as in the conventional horizontal position.

An automatic design with record size detection and automatic speed selection, the *SL10* offered power cueing and traverse, at two speeds, all controlled via micro-switch touch-buttons. The motor was a quartz lock direct drive with a well damped platter and a flat mat; a spring loaded record clamp was also incorporated. The body was made of die cast alloy and was non-resonant, and instead of a conventional lid, the entire top half of the unit hinged back from the rear, and carried a parallel tracking arm as well as the record clamp. High quality and well adjusted gimbal bearings were employed for the tonearm, and a special version of the top Technics moving-coil cartridge was rigidly and permanently clamped in place, proving to be perfectly matched and providing a 12Hz resonance with reasonable damping. This uses a hollow boron cantilever together with a top class elliptical stylus; a good quality head amplifier which may be switched out if desired was also included.

Such was the performance of the parallel tracking arm that a 1.25g downforce was recommended and in fact gave excellent results; normally 1.75g would be typical for this cartridge in more conventional tonearms. The only area of weakness concerned the low frequency isolation which relied on steel coil spring feet with stiff rubber cores, resulting in a suspended resonance at a high 15Hz – rather too close to the arm/cartridge mode. The full dynamic balance of the arm however helped to reject low frequency vibrations. It was also noted that after prolonged use the interior of the unit warmed up by several degrees, producing strong static upon disc removal.

Lab performance

Tricky to measure, the player had to be partially dismantled to obtain some readings. (It is normally operated with the case shut and is thus almost childproof.) Wow and flutter was excellent, with undetectable dynamic wow and substantial torque, while start up was a fast 1.2 seconds, and due to the quartz reference, speed accuracy and stability were predictably excellent. The rumble 'bridge' could not be used, but the lacquer disc alternative indicated a reading of better than 75dB DIN B, and aside from static electrical breakthrough, showed more lacquer noise than motor rumble.

Arm effective mass was estimated at below 4g, while the geometric accuracy was excellent, as would be expected with a good parallel-tracker. Friction could not be directly measured owing to the absence of a 'free balance' condition, but it appeared satisfactorily low, while the power cueing was fine although it needed slight adjustment to give a straight lift. The built-in cartridge was used for the arm resonance tests – a valid measurement as the mechanical impedance of the special version Technics model was quite similar to the Dynavector *10X* used on the other arms. Rated as good, the first flexure was deferred until 250Hz and is likely to be the counterweight or balance assembly rather than the arm proper, the latter's first mode appearing at 590Hz. Although a few breaks followed, thereafter the arm was reasonably well behaved, particularly at high frequencies.

RECOMMENDED

The double shell construction assured very good isolation from acoustic breakthrough with minor peaks at 50, 150 and 380Hz. The vibration isolation was considered to be above average but was not as good as expected below 70Hz. Impact shock resistance was very well resisted, the *SL10* proving comparable to the legendary B&O *4002* and Revox models in this respect, while feedback was also highly rated.

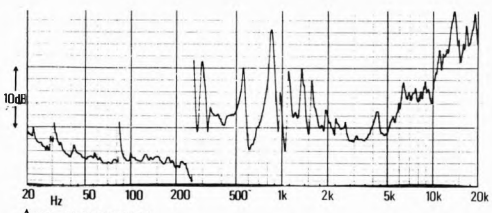
Since the *'310* cartridge was a fixture, it was also checked out, and found to be fully comparable with the models costing around the £100.00 mark. Response was better than ±0.3dB 40Hz–11kHz, with separation excellent as installed at better than 30dB, 100Hz–10kHz, and still measuring 20dB at 20kHz. Trackability and distortion were also good, while the preamplifier was entirely flat but could in our view have done with a subsonic and supersonic rolloff, which could then have equalised both the 2dB lift towards resonance at 20Hz, and also the +3dB lift at 20kHz on this cartridge.

Sound quality

For true comparison a matched Technics cartridge was used in the reference player. The *SL10* was rated as good, demonstrating a pleasantly musical upper mid and treble, despite the cartridge treble response lift, while the stereo imaging was convincingly stable with fine definition and good depth. A slight weakness was noted on subtle ambience effects while the bass was slightly soft and less than ideally extended. If anything the balance, while 'open' in a neutral sense, was rather 'sweet' in the upper registers, and slight treble cut above 15kHz on the accompanying amplifier readily tamed the extreme treble lift.

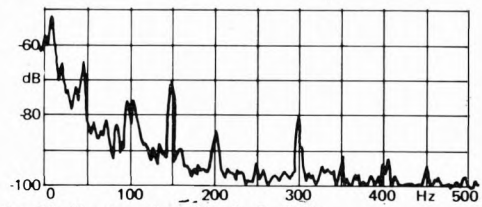
Conclusion

Costing around £300.00 or a little less, this player incorporated some £100.00 worth of cartridge and may offer the purchaser an additional £50–£60.00 worth of head amplifier. Thus at less than £200 for the player alone, it is clearly good value and a recommendation is assured in view of the fine motor, fully automatic facilities, good parallel tracking arm, fine overall feedback properties, plus a good sound quality. Its visual and operational attributes are a further bonus.

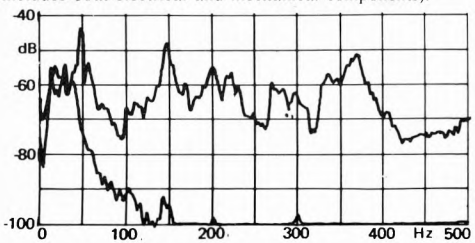


Arm resonances

GENERAL DATA	Integrated Player
Motor Section	
Type	direct drive, quartz, parallel tracking
Platter mass/damping	N/A/good
Finish and engineering	both excellent
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.045%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.16%/<0.048%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz lock/none
Start up time to audible stabilisation	approx. 1.2secs
Rumble: DIN B wtd L/R av (see spectrum)	75dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	4g
Type/mass of headshell	none/N/A
Geometric accuracy	excellent
Adjustments provided	downforce
Finish and engineering	both excellent
Ease of assembly/setting up	excellent/excellent
Friction: typical lateral/vertical	N/A/N/A
Bias compensation method	not required
Bias force: rim/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g/2g	N/A/N/A
Cue drift/8mm ascent/descent	good/1.0sec/1.2secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	N/A/none
System as a whole	
Size/clearance for lid rear	31.5(w) x 31.5(d) x 8.8(h)/none required
Ease of use	excellent
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	above average/very good
Estimated typical purchase price	£300 (inc. cart. & head amp)



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Technics motor units

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522

SP15 *(see photo; EPA500 arm fitted)*
This new turntable was a very late arrival and has only been briefly examined, so a complete report is not possible at this time. Basically a 'down-market' version of the professional *SP10*, the *'15* can be supplied with a massive plinth system, which is mounted on compliant feet and fitted with a thick low-resonance acrylic lid. This plinth is one of the few available which will accommodate Technics' new high performance tonearm, the *EPA 500*; the latter was used for this brief assessment of the *SP15*'s performance.

The upper plinth section was finished in rosewood, with the lower part in matt black. As the arm fitted was independent of the motor the system offered no automatic functions, but the motor did incorporate some interesting features. As with the *SP10II*, 33⅓, 45 and 78rpm quartz-referenced speeds were available, and the high torque and electronic braking ensured that start up and speed changes were almost as rapid as for its more costly brother. Synthesiser speed control was also provided with +/– variations in 0.1% steps, and an almost instant reversion to rated speed when desired. The separate power unit and remote control of the *10* is dispensed with on the *SP15*, thereby reducing costs.

A sensibly flat, fairly hard rubber mat covered the oversized platter, with the overall engineering accuracy closely approximating that of the *SP10 II*. On test, the performance of the two decks was also found to be broadly comparable, both returning excellent results with the exception of feedback and vibration isolation, where the limitations of a solid plinth and foot system control matters.

A similar sound quality was attained for both, due to the closely related nature of the mat, plinth, feet and lid; in fact, the superior quality of the new tonearm actually provided a marginally superior rating overall for the new system compared with the *SP10 II* fitted with the older *EPA 100* tonearm. Despite a 'good' quality rating, the *SL1000 II*'s (*SP10 II/EPA 100*/plinth) high price as well as certain minor arm deficiencies precluded recommendation in the previous edition of *Choice*. The better value represented by the less expensive *SP15* plus *EPA 500* combination suggests that a recommendation is due to this system, although this will need further investigation before it can be fully confirmed (perhaps in a future edition). In addition, it is important to note that the *SP15* vibration isolation was not outstanding, and the best results will only be obtained with the deck on a heavy shelf, preferably bonded to a structural wall.

SL1000 II (SP10 II/EPA100/SH10B3)
In addition to the new *SP15*, there are several other Technics motor units and a component arm

that have been reviewed in one form or another in past issues. The professional **SP10 II** is very much the forerunner to the *SP15*, and has won widespread acceptance in broadcast studios where its high torque and 'instant' start and stop are particularly useful. The unit reviewed was the **SL1000 II**, which comprises the *SP10 II* motor, *SH10B3* plinth, and the **EPA100** tonearm. Much of the data is contained in the accompanying chart, which shows that the motor performed extremely well, but was limited to some extent by the plinth (though above average, this did not offer coloration levels comparable with the best subchassis models). The arm suffered a slight (uncorrectable) headshell misalignment and (correctable) bearing slack which was disappointing at the price. A resonator damping system is incorporated, and assuming proper alignment the arm would probably attain a 'very good' sound quality rating. The system as a whole merited a 'good' sound quality rating, but is very expensive, and suffers in value terms by comparison with the *SP15/EPA500* combination which is its natural and much more reasonably priced successor.

SL150

The cheapest Technics motor is the **SL150**, which was tested as the now obsolete *SL1700* integrated unit. As can be seen from the accompanying data, the motor performance was generally very good, and the subchassis construction, though not optimally tuned, helped to give above average isolation. The sound quality rating with the fitted arm was only average, though presumably alternative arms would improve this rating somewhat. Careful siting is essential to obtain the best results.

SL150 II

Rather more expensive than the *150* is the **SL150 II**, which despite its name is derived from a completely different series of Technics models, reviewed as the integrated *SL1400 II* in the last issue. The performance showed a slight improvement over the *150* in most areas, though shock immunity was worse. Added refinements were present including quartz control, touch operated front mounted controls, and digital speed read-out. The unit with its integral arm achieved an average sound quality; like the 150 it might benefit from a specialist arm, and certainly benefits from a careful location. It remains on the expensive side, particularly when compared to new integrated models such as the reviewed *1700 II*.

GENERAL DATA SL 1000 II — Integrated Player

Motor Section

Type	manual quartz direct drive
Platter mass/damping	3.0kg/very good
Finish and engineering	very good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45; 78rpm/no
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.1%/ 0.06%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	0.25secs
Rumble (av DIN B wtd L/R)	78/77dB

Arm Section

Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	good
Facilities for adjustment	damping,height,overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	<10mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/5secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	moderate

System as a whole

Size/rear clearance for lid	56(w) x 46.5(d) x 17(h)/6cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£1000

GENERAL DATA SL150 — Integrated Player

Motor Section

Type	auto return direct drive
Platter mass/damping	1.55kg/good
Finish and engineering	very good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/<0.06%
Speed accuracy/drift/variation under load	adjustable/ 0.1%/0
Start up time to audible stabilisation	1 sec
Rumble (av DIN B wtd L/R)	74/73 dB

System as a whole

Size/rear clearance for lid	45.7(w) x 35.6(d) x 12.6(h)/5.2cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/excellent
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£155

GENERAL DATA SL150 II — Integrated Player

Motor Section

Type	quartz direct drive
Platter mass/damping	2.55kg/good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45 rpm/yes, digital display
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.07/<0.07
Speed accuracy/drift/variation under load	quartz/quartz/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	76/77dB

System as a whole

Size/rear clearance for lid	45.3(w) x 38.7(d) x 14.5(h)/5cm
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	satisfactory
Ease of use	very good
Estimated typical purchase price	£240

Naturally we agree!

That's why we at Ellis Marketing (cough!) appear to be right again! We have stocked the new Dual range from its introduction, and the CS506 and CS606 have consistently been our best sellers; and without problems. They audition superbly, are fuss-free and with the combination of the new Concorde type cartridge weighing in at ½ of a standard cartridge, trackability is 1st class. We and our customers are very satisfied. We also stock a wide range of other top turntables and individual arms including their brilliant new Technics EPA500, which is a system in itself, and must be seen!

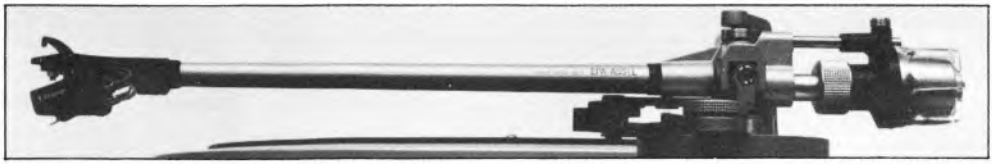
Ellis Marketing

SUPPLIES (ELECTRICAL) LTD.

5/7 Arlington Parade, Brixton Hill, London SW2 1RH. Tel: 01-733 6708
79 High Street, Sough Norwood, London, SE25 6EA. Tel: 01-653 4224

Technics EPA500

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522



Features, facilities, setting up and use

A remarkable new Technics tonearm which outperformed its more costly conventional headshell predecessor, the *EPA100*. Built on a massive pillar assembly (not many motor units are capable of accepting it!) it incorporated a helical gear height control. Interchangeable tonearm assemblies are available, complete with counterweights, and these are made to various strengths with different effective masses in order to accommodate most cartridges, and include matched seismic damping of the subsonic resonance. The tonearm clipped neatly into the gimbal bearing assembly, with the electrical connections made automatically and a clamp wheel finally securing the tube in position. An electronic stylus balance of good accuracy was included as an accessory, while bias compensation was built into the bearings and set by a dial. No bearing play was detectable, and excellent attention had clearly been paid to detail and engineering aspects, except for the fit of the shell on the tube, which was not really tight enough on two of our five tonearm samples.

This arm has a longer effective length than usual and in consequence a reduced offset angle, so the bias compensation required was less than with most models. The effective mass range varied from 7.5 g for the *H* version (a tapered titanium tube with a reinforced plastic headshell), to 11g for the *L* (resembling the rigid Syrinx and *Ittok* arm tubes, this was the heaviest *EPA500* version available, being proportionately stronger than the *H*, and possessing an alloy cast headshell.)

Lab performance

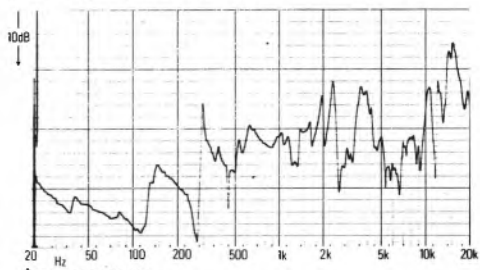
With a choice of effective mass from 7.5 to 11g, and with corresponding gains in rigidity, this versatile arm had a low 80pF lead capacitance. Friction was negligible and biasing good if slightly low, while the elegant downforce balance was fine and fun to use, and the cueing worked well. The seismic counterweight was the first design of this kind which was genuinely effective in controlling the subsonic resonance, taming a 16dB rise to a much lower 8dB.

Rated as good on resonances, the graphs for the *H* and *L* tubes were quite similar in character and only that for the *H* is reproduced here. Breaks were well controlled with a promisingly even energy trend (see SME III), with the shell/tube flexure probably responsible for the mode at 280Hz, while the well damped resonance at 130Hz could have been the counterweight; the remainder were too mild to identify.

Sound quality and conclusion

The sound quality of this arm was considered very good, being neutral, slightly 'soft' and well balanced, and with no area calling for specific criticism. However with moving-coil models, it was felt that the *L* tube offered a mild improvement in definition and transient clarity in comparison with the *H*. In view of its rapid arm tube interchangeability, the operating excellence, favourable sound quality and versatility, the *EPA500* is certainly worth considering despite its high price, and provided of course that the desired motor unit can accommodate it.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	7.5g
Type/mass of headshell	special detachable arm/N/A
Geometric accuracy	very good
Adjustments provided	height, overhang, lateral angle
Finish and engineering	excellent/excellent
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	120mg/120mg
Downforce calibration error: 1g/2g	approx. +0.05g/+0.07g
Cue drift/8mm ascent/descent	negligible/2.5secs/2.0secs
Arm resonances	good
Subjective sound quality	very good
Lead capacitance/damping method	80pF/seismic counterweight, 10Hz
Estimated typical purchase price	£180 (inc. gauge)



Arm resonances

Thorens TD105

Metrosound Audio Products Ltd., 4–10 North Road, Islington, London, N7.
Tel. 01-607 8141

Features, facilities, setting up and use

Two models are covered by this review, namely the *TD104* and *105,* the latter being the model actually assessed. This is as usual the result of two versions of the same basic design, the only difference being that the auto-return facility has been omitted from the *104*, at a saving of some £15.00. The engineering was to a generally good standard, although arm bearing play was evident in both planes. The platter was of good quality, if rather light at 1.3kg, and was fitted with a thin rubber mat which did not damp it well, nor offer good disc suport. A belt drive model, powered by a DC motor under servo-control, two speeds plus fine variable control were available, correction being facilitated by an unusual stroboscope whereby the platter rim was slotted and illuminated from within. The small main bearing was nonetheless well finished and showed no play, while the lid was cunningly counterbalanced by concealed hinge springs.

The essential components were mounted on a reinforced moulded top deck suspended on damped coil springs, the main lateral mode being acceptably low at 5.5Hz with no other observable. The *Isotrack* arm used a similar fibrous shell/carrier to that on the *TD126*, but for some reason it was not interchangeable with that on the *'115*. Cartridge installation was awkward to say the least, as Thorens persist in using non standard, and too small, cartridge fixing screws, the only observable reason for this being to conceal the screw heads for cosmetic reasons. The main operating controls comprised touch-sensitive pads comparable with those on the older Philips models. A separate power supply was provided in a small plastic box moulded on the mains cable.

The arm was a low mass model at 8g, suitable for medium and high compliance cartridges, but the total lead capacitance was on the high side at 300pF, and depending on the matching amplifier, this could well exceed the recommended value for some cartridges. A possible though inconvenient way round this would be to shorten the cable length or rewire with a lower capacitance cable.

Lab performance

The specification modestly quoted 65dB for DIN rumble, which was comfortably exceeded on test by a very good 75/73dB. Due to the remote power supply transformer the spectrogram revealed little electrical breakthrough apart from that at 50Hz, but some motor noise was present as the graph shows (compare with *TD160S*). Wow and flutter was simply excellent, speed accuracy good and both load and time stability satisfactory. The start up was typical at 2.5 seconds, and in contrast to the *'115*, it did not produce any wow overshoot.

Arm geometry was very good with many adjustments provided. Lateral friction was satisfactory at 40mg although this nonetheless represents a fair proportion of the bias compensation required at our nominal 1.5g downforce test. In fact the bias was on the low side at 125mg, with no increase at the centre, ideal values being between 175 and 225mg. Downforce calibration was quite accurate and the cue worked well. The arm resonances were classed as just average, for while the energy trend

was more or less maintained, numerous breakups were present. The counterweight mode appeared at 80Hz, with the tube system at 400Hz or so, and the damping as referred to the cartridge body was clearly none too good from 1.5kHz onwards.

While acoustic breakthrough was just about average, with a peak at 100Hz, the vibration isolation was disappointing, for although this model freely vibrated at its natural resonance, it did not successfully prevent the energy coupling at higher frequencies. Acoustic feedback was still above average and impact shock was well handled.

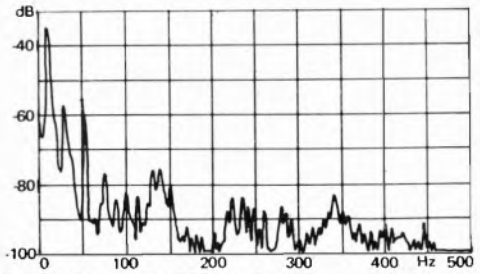
Sound quality

Rated as average, the *TD105* gave reasonable bass definition with quite good stereo detail, depth and definition. However some mild midrange coloration and roughness was present (probably arm derived) while the reproduction was slightly 'loud' – not a good sign.

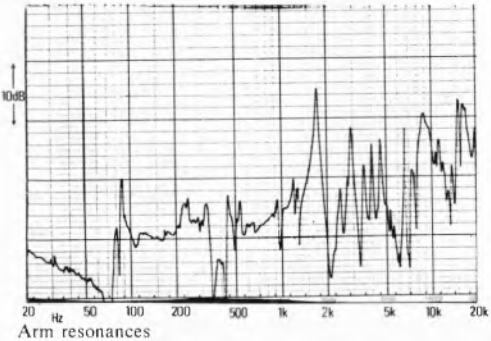
Conclusion

The performance overall was sufficient for the *TD105* to be worth considering at £115.00, and this is even more true of the *TD104* costing some £15.00 less. It is however difficult to understand how the decade old expertise reflected by the *TD160* suspension could have been sidestepped here and in the *'115*, to the disadvantage of both.

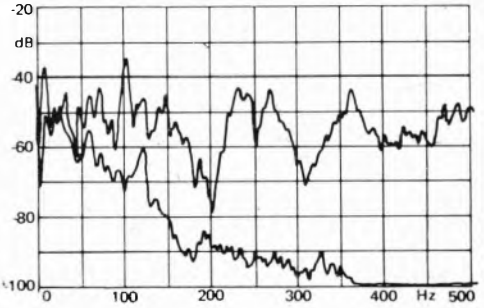
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	1.3kg/fair
Finish and engineering	good/very good
Type of mains lead/connecting leads	2 core line cord detch. pwr unit/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (DIN peak wtd 0.2–2Hz/2–200Hz)	0.09%/0.06%
Absolute speed error	variable, <0.2%
Speed drift 1 hour/load variation	−0.3%/−0.3%
Start up time to audible stabilisation	2.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75/73dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	8g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	very good
Adjustments provided	tilt, overhang, lateral angle
Finish and engineering	fairly good/fairly good
Ease of assembly/setting up/use	very good/good/good
Friction: typical lateral/vertical	40mg/15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	125mg/125mg
Downforce calibration error: 1g/2g	−0.05g/−0.05g
Cue drift/8mm ascent/descent	negligible/1.5secs/1.5secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	100pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	43.4(w) x 35.6(d) x 13.0(h)/4.4cm
Ease of use	very good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	below average/good
Estimated typical purchase price	£125



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



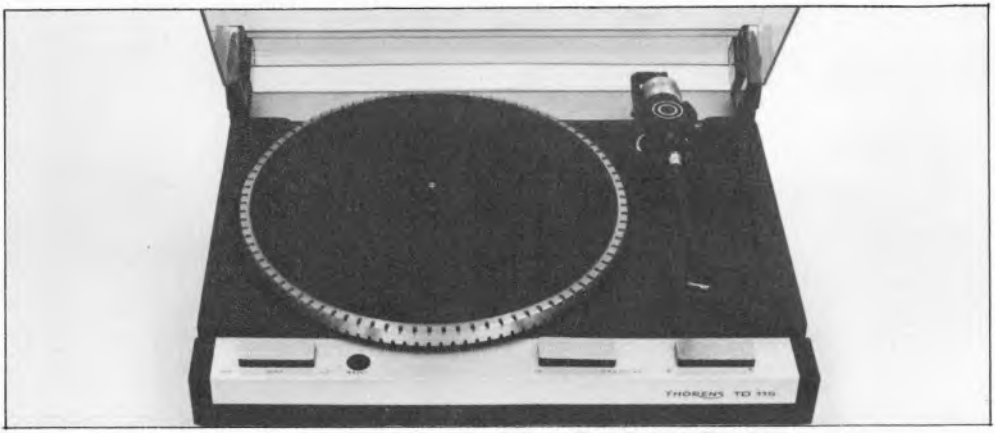
Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

Thorens TD115

Metrosound Audio Products Ltd., 4–10 North Road, Islington, London, N7.
Tel. 01-607 8141



Features, facilities, setting up and use

Two very similar models are covered here by this review, namely the *TD115* which we actually tested and the *TD110*, which is a manually operated version at a reduced cost. In early form the *TD115* was the subject of a full report in the previous edition of *Choice*, but the importers since informed us that improvements had been made, notably to the chassis damping. However, on examination one of the minor criticisms made of the previous sample, namely slow wow overshoot on load recovery, appeared as yet unresolved. Questioned closely on the subject, Thorens have so far sidestepped the issue, by claiming in good faith that the deck shows a very good steady state stability. This happens to be true, but the dynamic wow remains unchanged: as an example, the removal of a 3g dust bug resulted in a linear wow peak of 0.4%, although the steady state DIN weighted readings were excellent in themselves.

This two speed belt drive model provided fine variable speed control *via* a recessed knob which was difficult to use. The light platter used an unfavourably thin mat, offering little record support and not much platter damping either. Powered *via* a DC servo motor, auto-return arm facilities were incorporated with a special Thorens double spring unit to decouple the chassis from the plinth and lid, offering a remarkable 6Hz lateral resonance, but a much less favourable 20Hz vertical mode.

A version of the *Isotrack*, the arm utilised a detachable shell/carrier tube; the fixing has now been improved, with a full threaded locking collar now used instead of the offset pin and spiral groove of the first design. However we found the plastic locating strip rather fragile and easily broke one by accident, while the care taken to ensure rigidity at this point was negated by the arm mounting, which was of a loose rubbery nature.

Lab performance

Wow and flutter was particularly good, especially flutter, although the slow wow overshoot on load variation was still present (see above). Both speed drift and accuracy were good, and the steady load stability excellent, while start up was slow at 4.5 seconds despite the light platter; this is also a function of the wow overshoot and the time taken to stabilise. More imbalance of rumble figures was shown than usual, reading 77/73dB for left and right channels respectively, but the spectrogram revealed a pretty clean characteristic, especially since the 50 and 150Hz components were of static electrical origin.

Arm effective mass was low at 8g, although the lead capacitance was high at a total of 300pF, and will need taking into consideration with a number of cartridge/amplifier combinations. Cartridges were difficult to install, although Thorens do provide a convenient alignment cradle. Arm frictions were excellent and the magnetic biasing provided near perfect compensation with no added friction. Downforce calibration was fine, being much improved over the previous sample, but slight lateral drift occurred during cueing, and the descent was too slow at 3.7 seconds. Arm resonances were classed as just average in severity. Overall the arm did not appear very rigid, with the counter-

weight mode believed to correspond to the feature at 25Hz. Those at 150, 350 and 610Hz were probably the arm tube/shell, while the fibre composition did not appear to have helped at higher frequencies, as here the resonances were poorer than average and quite numerous.

Acoustic breakthrough was very good, being of an even and well suppressed nature, while vibration isolation was not quite as good but was still above average, and again free of peaks. Good shock immunity was demonstrated, but the feedback resistance was only just average, with the more serious effects in the bass.

Sound quality

Despite a trace of pitch instability on critical program, the *TD115* scored above average. Some flattening of stereo depth perspective was apparent, while imaging was not very precise, but detail was quite well presented and most of the bass register was well defined. The arm appeared 'louder' than usual, with a slightly 'peaky', 'forward' character.

Conclusion

Though we still have reservations concerning dynamic wow, arm resonances and arm pillar looseness, if viewed dispassionately, the performance level suggests that the *TD115* is worth considering. The arm mass was low, while the styling and neat lid construction may well appeal. But at this price level, the more attractive version could well be the *TD110*, which sacrifices facilities rather than performance to achieve a price saving.

GENERAL DATA Integrated Turntable

Motor Section

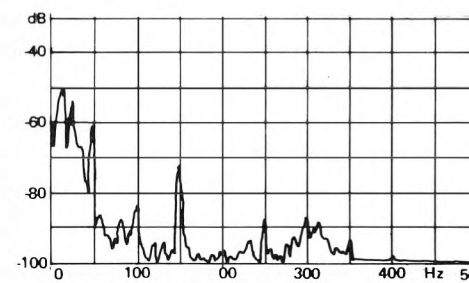
Type	manual belt drive, auto return
Platter mass/damping	1.3kg/fair
Finish and engineering	good/good
Type of mains lead/connecting leads	detach 2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.12%/<0.05%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	+0.5%/<0.05%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (see spectrum)	77/73dB

Arm Section

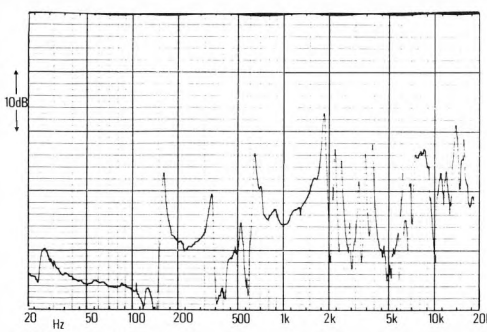
Approximate effective mass inc screws, excl cartridge	8g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	very good
Adjustments provided	tilt, overhang, lateral angle
Finish and engineering	fairly good/fairly good
Ease of assembly/setting up/use	fair/fair/very good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	magnetic
Bias force: rim/centre (set to 1.5g elliptical)	180mg/210mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	slight/1.2secs/3.7secs
Arm resonances	average
Subjective sound quality	above average
Lead capacitance/damping method	300pF/decoupled counterweight

System as a whole

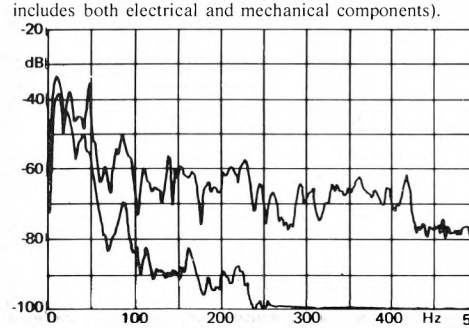
Size/clearance for lid rear	44.4(w) x 35.8(d) x 13.4(h)/0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£145



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

Thorens TD160S

Metrosound Audio Products Ltd., 4–10 North Road, Islington, London, N7.
Tel. 01-607 8141

Features, facilities, setting up and use

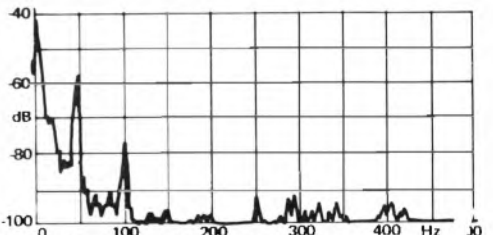
Following the interest in the *ATR* version of the *'160*, as well as in other modifications both official and unofficial, an importer guaranteed version of the existing *TD160BC* has now been released. For those familiar with the existing standard *'160*, the improvements made for the *S* version were as follows. The platter balance and centration were to a closer tolerance, both components in die-cast zinc alloy, while the main bearing was of selected quality. The subchassis was acoustically damped by a bituminous laminate, the spring isolation efficiency was increased by removal of the foam cores, while a reinforced arm mount was also supplied. The plinth was much heavier in construction, manufactured from a wood composition with a massive bottom cover, and the lid was fitted with friction stop hinges. A flat rubber mat offering improved disc and platter damping was supplied, but in all other respects the two decks were identical, and comprised two speed synchronous motor designs, driven via a flat belt.

The measured performance showed a distinct improvement over the previously reviewed standard *160BC*, and strong gains were also apparent in acoustic terms. Wow and flutter was very good – particularly flutter (actually this was one of the best results for a quality belt drive motor that we measured). It ran slightly fast at a moderate +0.3%, but showed little slowing under load, while the fairly heavy 2.5kg platter reached speed in 3.5 seconds, and the rumble reading was also excellent at 78/79dB. The spectrogram was one of the cleanest in the report, particularly when the electrical nature of the 50 and 100Hz lines is taken into account. The mechanical resonance was satisfactorily low at 3.1Hz lateral and 6.3Hz vertical, although it was not very well balanced and on our sample required careful adjustment. Despite a small peak at 160Hz, the acoustic breakthrough was very good, and vibration isolation was similarly rated, while feedback and hum were very good and shock resistance reasonably good.

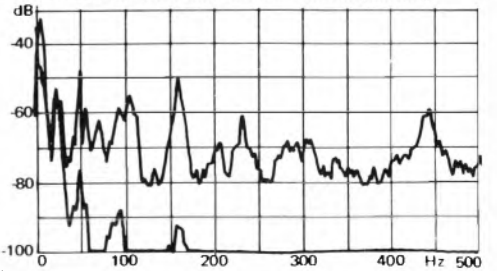
Clearly in the top turntable group on our tests, we could make few criticisms of this model's sound quality.

Although it was not as well finished or as substantially engineered, the *TD160S* delivered about 95% of the overall performance of the highly rated models in the £250 to £350 price range in my estimation. A recommendation is thus mandatory. The *160S* is clearly good value for money at its typical purchase price of around £150.

GENERAL DATA	Motor unit
Type	manual belt drive
Platter mass/damping	2.5kg/very good
Finish and engineering	good/very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.065%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.11%/<0.05%
Absolute speed error	+0.3%
Speed drift 1 hour/load variation	synchronous/—0.25%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	78/79dB
Size/clearance for lid rear	43.7(w) x 36.0(d) x 16.5(h)/7.5cm
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/very good
Vibration sensitivity/shock resistance	very good/good
Estimated typical purchase price	£152



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

(revised & reprinted)

Thorens TD160BC

RECOMMENDED

Metrosound Audio Products Ltd., 4–10 North Road, Islington, London, N7.
Tel. 01-607 8141

In the last edition, the *TD160* was reviewed in two versions: the standard basic Thorens model, and a German-modified version fitted with Hadcock or Mayware arms which was imported by some dealers: known as the ATR, this version is no longer available in the UK, and is in any case usurped by the new *'160S* (see review). In point of fact, the dealers who handle the *TD160* frequently offer their own similar modifications to the basic '160 (mat change, removal of foam spring cores etc.) while carrying out the necessarily skilled and time consuming process of properly fitting an arm.

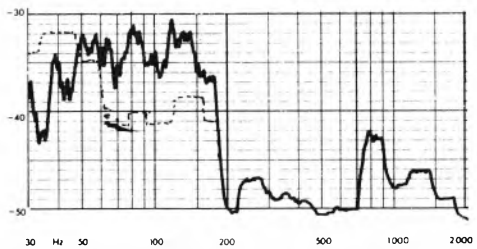
In mechanical terms, the *TD160BC* is a synchronous motor two speed belt drive turntable, with massive main bearing and a die cast balanced outer platter mounted on an effective, low working resonance, suspended sub-chassis. Engineering was to a high standard as the measured data confirmed, and even without the simple mat substitution it remains the best choice of motor unit at this as well as much higher price levels.

Rated as very good on both wow and rumble, slowing under load was acceptable; no overshoot was of course present due to the synchronous drive and dynamic wow was thus negligible. A reasonable 3 second start-up was demonstrated, but absolute speed proved a trifle fast at +0.6%. Acoustic breakthrough was however very good and improved further with ATR's better mat and its removal of the foam cores from the springs.

Rated as good for the standard Thorens version and as very good with the ATR style modifications, the subjective performance attracted very little criticism. The mat change resulted in a significant improvement in midrange detail and stereo depth, similar to the *LP12* in terms of neutrality, low frequency depth, eveness and ambience.

In both forms, very good value is offered, and a strong recommendation holds.

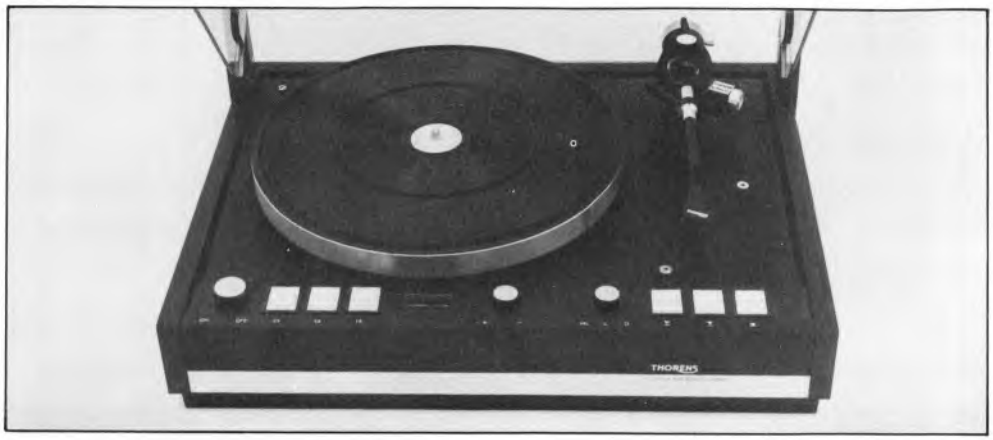
GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	2.5kg/good
Finish and engineering	very good
Type of mains leads	2 core
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.11%/0.08%
Speed accuracy/drift/variation under load	+0.6%/none/-0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	73/74dB
Size/rear clearance for lid	43(w) x 34(d) x 15(h)/9.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/very good
Vibration of shock sensitivity	very good
Ease of use	straight forward
Estimated typical purchase price	£108



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Thorens TD126 III

Thorens, Metrosound Audio Ltd., 4-10 North Road, Islington N.7. 01-507 5141



Features facilities setting up and use

The *Mark II* version of this large turntable was tested in the last issue, but the deck has been redesigned since then. It is perhaps strange that the new arm used for the *TD115* has not been fitted here, the *126* instead employs a modified version of the established *TP16 Isotrack* detachable tube (unfortunately the fittings are not interchangeable). This *TP16* is actually designated a *TP63,* as there have been changes made to the earlier clumsy cartridge mounting procedure, but in our opinion, this still leaves a lot to be desired, with a pile of spacers and washers needed to install many cartridge models.

The original massive die-cast sub-chassis has been retained, together with the effective coil spring support which offers sufficient freedom in all planes with a 3-4Hz vibration rate. The deck used the same tacho-generator servo motor found in the *115*, with a just audible whine and a slow 1-2 second speed overshoot characteristic. I would have thought that for this class of player a 2nd order servo was essential; $33\frac{1}{3}$, 45 and 78 rpm were all provided, with the original reflection-derived mains strobe for checking. The arm board was easily removed from the chassis to aid installation, but the auto stop and isolated touch button cueing facilities of the complete *126* are of course absent on the motor only version, the latter simply possessing an on/off control.

Lab performance

Rumble was exemplary — one of the best in the whole report, thus confirming Thorens claims. Wow and flutter on steady state measured very well, but there still remains some doubt over the servo response under transient conditions, for example, when responding to changes in dynamics, particularly using higher tracking weight cartridges. Drift, as with the *115*, was on the high side for the 30 minute test period, but shock immunity was superb, and feedback and hum levels excellent. Acoustic breakthrough was above average — in fact better than the *115*, especially at low frequencies.

The arm response graph was certainly different from that of the *TP70* arm fitted to the *115*, the first resonance being beneficially higher at 350Hz, although some 10-12dB more severe in amplitude. Similar characteristics were demonstrated to 5kHz, but above this point the *TP63* possessed considerably less high frequency energy. Friction was excellent, bias compensation about right but with the ratio reversed, and downforce excellent, cue operation was fine, and geometry very good.

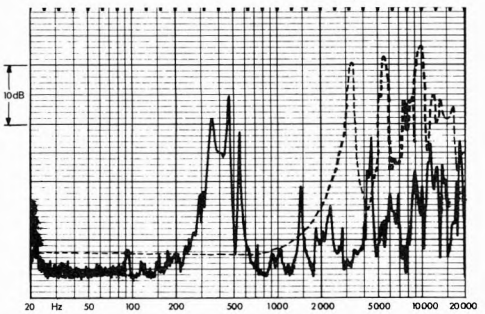
Sound quality

Rated as 'good' overall for both the complete *126* system as well as the separate motor unit, the former sounded quite well balanced with reasonable stereo stability and depth. Bass quality was undoubtedly good, but some hardened forwardness was apparent on female vocal passages. The motor unit alone could well partner more expensive arms.

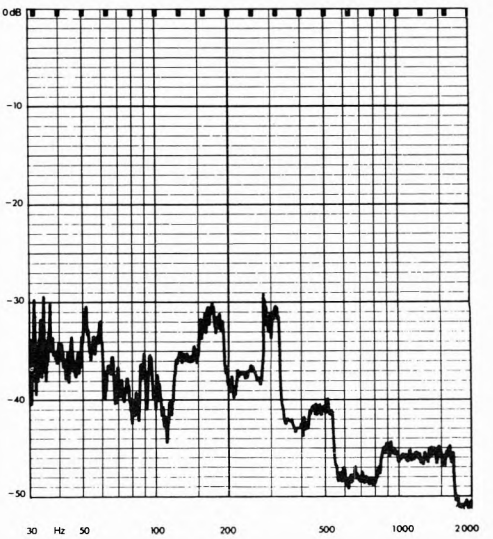
Conclusion

A good mat would provide a significant improvement at minimal extra cost. This matter aside, the *126* nonetheless demonstrated a good standard but with minor reservations still remaining about the servo overshoot — personally I was happier with the older *Mk II* performance in this respect.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto stop belt drive
Platter mass/damping	2.3kg/good
Finish and engineering	good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	≺ 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	≺ 0.07/≺0.06
Speed accuracy/drift/variation under load	adjustable/+0.3%/–0.1%
Start up time to audible stabilisation	2 to 5secs
Rumble (av DIN B wtd L/R)	77/78dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	8g
Type of headshell	special arm detachable
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	very good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	≺ 15mg/≺ 10mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/ 190mg/180mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/1.0secs
Downforce calibration error 1g/2g	0g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	50.3(w) x 38.8(d) x 17(h)/none required
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	excellent/excellent
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£260 (BC motor £220)



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Toshiba SRF440

Toshiba House, Frimley Road, Frimley, Camberley, Surrey. Tel. 0276 62222

Features, facilities, setting up and use

This inexpensive direct drive turntable is usually supplied complete with a modest Toshiba cartridge whose specification quotes a sensibly low compliance, although the value of 8cu given would indicate a curtailed tracking ability at the recommended 1.7g downforce. A shank mounted spherical diamond stylus was fitted, and the clumsy overhang method for cartridge alignment again specified. Overall the *'440* was quite lightweight at 5.5kg, and was fitted with a rather lively polystyrene lid. The platter mass was on the low side at 0.9kg, complete with mat, the latter affording reasonably good damping.

As the fitted cartridge is likely to be upgraded by most purchasers, arm compatibility factors remain important. The effective mass of this detachable headshell design was high at 18g, indicating the use of a low compliance cartridge, preferably one below 15cu. Lead capacitance was about average at 155pF, and taking into account a minimum amplifier value of 60pF or so, the total of 220pF should be suitable for most cartridges; in any case extra capacitance may always be easily added by means of plug-in adaptors.

A fully automatic model, the controls were laid out on the plinth front edge and could be operated with the lid shut. Two speeds were available plus fine variable control, with a normal platter rim strobe to aid resetting of the nominal speed to the accuracy of the mains supply frequency. Examination of the plinth/foot resonance revealed a lateral mode at 12.5Hz with a more serious vertical resonance at 16Hz, and although both were above the likely arm/cartridge range, they remain a potential source of disturbance.

Lab performance

As a linear reading, flutter was worse than average, but the weighted combined wow and flutter measurement was nonetheless very good. Speed accuracy was fine, slowing a reasonable 0.2% under the 3g extra loading. Drift was low, start up faster than average at 1.5 seconds, while rumble was in the very good category. The spectral analysis showed some motor noise, which appeared to be magnified in the 250Hz region; this was later traced to a dominant resonance in the structure of the turntable itself. The spectrogram also revealed some static electrical breakthrough, notably at 100 and 150Hz.

The bias mechanism worked well, adding no appreciable extra friction; although in the inverse ratio, the bias levels were of the right order, and the compensator was fully effective at low dialled settings. Friction was just satisfactory at 50mg

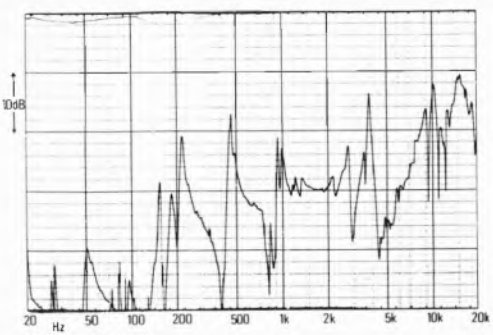
lateral and 20mg vertical, while downforce calibration gave 10% high readings – not excessive but nevertheless a simple fault to correct. Cueing was fine. In the context of this report the arm resonances were quite poor. The trend was shattered by severe modes beginning at 50Hz (probably the counterweight), the first shell/arm tube resonance appearing at 160Hz with another at 210Hz, and its harmonic at 420Hz. Further modes were also present. Vibration susceptibility was below average, peaking at 200–250Hz and again at 25Hz, while acoustic breakthrough was distinctly poor, with severe peaks in the response trace at 225 and 55Hz. Impact shock was fairly well resisted, but acoustic feedback in the test location was also poor, appearing first in the midband – an unusual effect.

Sound quality

Rated below average, the *SRF440* was unrewarding (using the test Mission *773* and not the supplied Toshiba model). Some confusion of the midband was apparent, with suppressed depth and ambience, and the overall effect was a trifle 'loud'. Arm coloration was also evident, with a rougher treble than usual.

Conclusion

While the motor and arm were essentially of reasonable quality and measured performance, the audio range resonant behaviour of the plinth system and the tonearm itself was disappointing, and undoubtedly impaired the final result. A recommendation is clearly not in order despite the 'bonus' cartridge and the automatic facilities.



Arm resonances

GENERAL DATA — Integrated Player

Motor Section

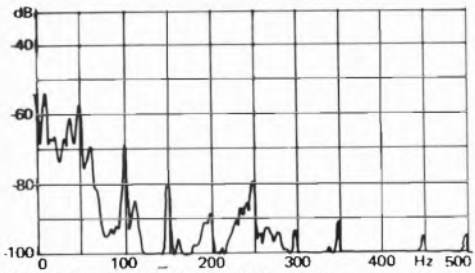
Type	direct drive automatic
Flutter mass/damping	0.9kg/fairly good
Finish and engineering	good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/0.1%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	+0.1%/−0.2%
Start up time to audible stabilisation	1.5secs
Rumble: DIN B wtd L/R inv (see spectrum)	73/72dB

Arm Section

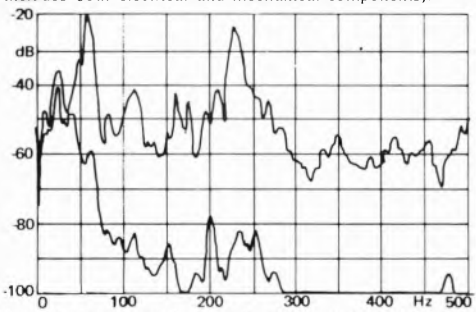
Approximate effective mass inc screws, excl cartridge	18g
Type/mass of headshell	universal detachable/9g
Geometric accuracy	fairly good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	50mg/20mg
Bias compensation method	internal spring mechanism
Bias force: rim/centre (set to 1.5g elliptical)	200mg/175mg
Downforce calibration error: 1g/2g	+0.1g/+0.2g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.5secs
Arm resonances	poor
Subjective sound quality	below average
Lead capacitance/damping method	155pF/slight c/wt decoupling

System as a whole

Size/clearance for lid rear	42(w) × 32.2(d) × 12.5(h)/7.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	very good/poor
Vibration sensitivity/shock resistance	below average/fairly good
Estimated typical purchase price	£104



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components)



Acoustic breakthrough (upper) and vibration breakthrough

Toshiba SRF225

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey.
0276 62222

Features facilities setting up and use

The least expensive in this line of related Toshiba models, the *225* was a fully automatic belt drive deck costing around £90, supplied ready fitted with a Toshiba *C-290* cartridge. Rather lightweight, the die-cast aluminium platter was powered by a four pole mains synchronous induction motor, with moderately effective flexible decoupling from the main mounting board. The internal mechanics were built to a good standard with the quality of the overall engineering higher than usual for this price level.

Easy to use, the *225* was designed with an array of front-mounted controls which allowed operation with the lid down. These all worked well although the cue lever was a little stiff in action. Toshiba have tried to isolate the deck from the environment using a form of coil spring in the feet, but the total mass suspended was rather low for the spring rate, and the resulting resonance at around 11Hz was too high in frequency. The 0.5m signal leads proved rather short, which restricts the flexibility of location relative to the amplifier. Poorer than average record surface contact resulted from the mat and platter design, which left little plane surface for the record to rest on.

Lab performance

While the high torque ensured a rapid 0.8 second start up and a freedom from speed overshoot, the wow and flutter readings were none too promising and may well be audible on music by many listeners. On measurement, rumble was fairly good, but motor breakthrough was audible on the listening tests. Speed accuracy was very good, as was stability under load, while acoustic breakthrough was considered typically 'average'. Shock immunity was just adequate but both hum and feedback margins were rather better.

Effective mass was estimated in the medium range at 14g, suited to 10-20cu cartridges, although the highish lateral friction measured suggests that tracking below 2g is inadvisable. Bias compensation carried the right ratio but was some 50% higher than required, while the cue and downforce were satisfactory. The arm resonance curve was about average; little comment can be made except to indicate the ubiquitous headshell/socket breakup at 240Hz, and the generally dissected appearance at higher frequencies.

Sound quality

Rated as 'below average', the basically reasonable musical balance was marred by the audible drive defects, namely rumble and wow. If the latter were cured, an upgrading to an 'average' rating would probably result.

Conclusion

Despite offering good facilities and a potentially good sound quality, the measured performance of this model was insufficient for a recommendation.

GENERAL DATA Integrated Player

Motor Section

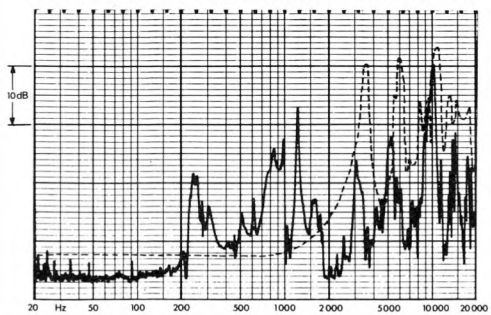
Type	automatic belt drive
Platter mass/damping	0.85kg/poor
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.14%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.22%/0.12%
Speed accuracy/drift/variation under load	synchronous/–0.20%/0.80%
Start up time to audible stabilisation	0.08secs
Rumble (av DIN B wtd L/R)	66/68dB

Arm Section

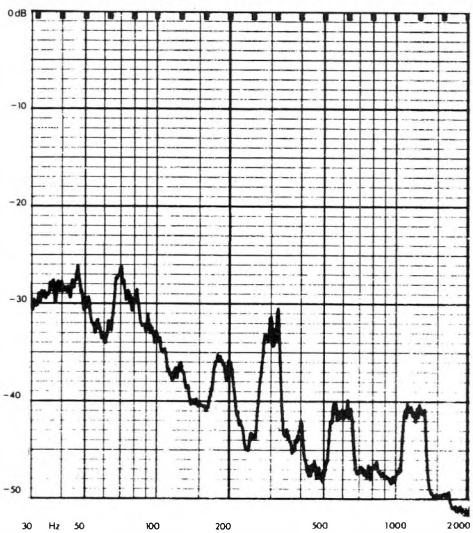
Approximate effective moving mass (excl cart. inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	adequate
Ease of assembly	very good
Friction lateral/vertical (typical)	180mg/25mg
Bias comp: type/force rim/centre 1.5g ell set)	spring/230mg/275mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.5secs/4.0secs
Downforce calibration error 1g/2g	–0.075g/–0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.2(w) x 35.9(d) x 13.9(h)cm/5.5cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Toshiba SRF325

Toshiba, Toshiba (U.K.) Ltd, Toshiba House, Frimley Road Frimley, Camberley, Surrey, 0276 62222

Features facilities setting up and use

A slightly more expensive version of the *225*, the *325* incorporated a strobe and fine speed control, this made possible by the replacement of the *225* AC motor by an electronically controlled DC type having a tacho-generator servo system to maintain constant speed.

Again a fully automatic deck, in common with the other two Toshibas, the *325* incorporated an infinite repeat function, whereby the deck will continue replaying the same record indefinitely until either the disc wears out, or the user disengages it! Coil spring feet were fitted, but in this case the resonance was rather high and overlapped that of the arm/cartridge subsonic range. The same Toshiba cartridge as was fitted to both the *225* and *530* was also installed here, but this sample was unfortunately supplied 2° out of alignment in the lateral plane. In addition, the headshell socket tilted the assembly by 1-2° in the vertical plane, and no provision for tilt readjustment was provided.

Lab performance

Start up was reasonable at 2.3 seconds, the torque available together with the absence of speed overshoot proving quite sufficient to negate the possibility of dynamic wow. The DIN wow and flutter reading was fine at 0.09%, although somewhat high 0.14% linear wow was recorded — poorer than average. Rumble levels were satisfactorily low, but marred by residual motor vibration breakthrough into the plinth, and thence to the arm. Speed stability and accuracy were to a good standard with acoustic breakthrough about average, shock resistance just adequate, and feedback quite good, and as found with the *530*, better with the lid down. Hum levels were not really sufficient to permit the use of a moving-coil cartridge, however.

Arm performance in general parallels that obtained from the *225* and *530*, particularly as regards resonances. On this sample lateral friction proved to be rather high, and biasing some 80% excessive at the 1.5g setting.

Sound quality

Despite mildly audible motor drone breakthrough at realistically high listening levels, the sound quality was judged quite pleasant and thus warranted an 'average' rating — quite good for the price level.

Conclusion

Although not in the recommended class, the *325* remains a reasonable performer, with good facilities marred on our sample by some problems of motor breakthrough, arm friction and bias compensation. As with the other Toshiba models, best subjective results will be obtained when the unit is mounted on a strong rigid wall-mounted shelf, as far from the speakers as possible, though preferably not in a corner.

GENERAL DATA Integrated Player

Motor Section

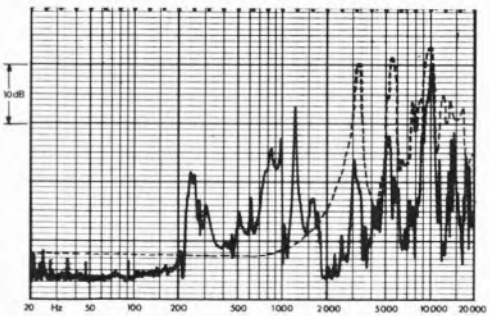
Type	automatic, belt drive
Platter mass/damping	1.25kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd $\sigma 2$)	0.09%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.14%/0.08%
Speed accuracy/drift/variation under load	-0.2% (adjustable) -0.1%/-0.2%
Start up time to audible stabilisation	2.3secs
Rumble (av DIN B wtd L/R)	72/68dB

Arm Section

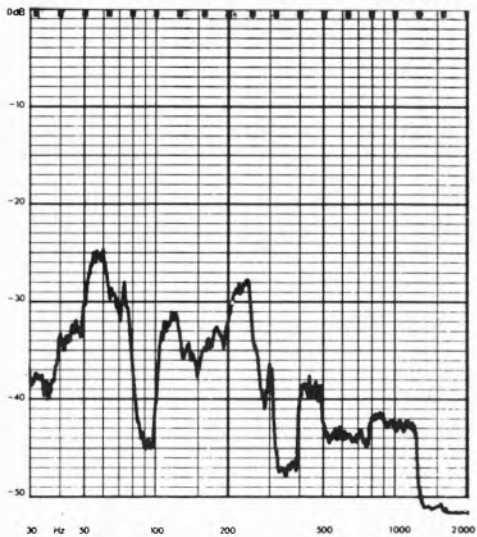
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.0g
Geometric accuracy	adequate
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly	very good
Friction lateral/vertical (typical)	160mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/270mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.0secs/3.5secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.2(w) x 36(d) x 14(h)cm/4.6cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Toshiba SRF530

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey.
0276 62222

Features facilities setting up and use

While the *530* was the most expensive of the Toshiba models reviewed, its price of around £120.00 is in fact quite low for a fully automatic direct drive model with cartridge included. In this model range, total mass appeared to increase in proportion to the rising price, thus tending to impart the better feedback properties to the *530*, the heaviest Toshiba of the three decks reviewed. Concealed coil spring feet were fitted to the plinth, giving fair vertical plane freedom albeit with a rather high 11Hz vibration frequency. Lateral freedom of movement was however restricted and hence shock isolation was not optimised.

The general configuration of the front-mounted controls was similar to that for the other two models, with engineering quality to quite a high standard. The motor is of the Toshiba's own design — a low profile type with a flat ceramic magnet rotor, and self-supporting flat overlapping windings with a clear adhesive binding. The headshell proved to be of average weight at 8g inclusive, resulting in a medium rating for effective mass which is best suited to cartridge compliances in the 10-20cu range. The friction was low enough to consider 1.25-2g tracking forces, if the cartridge will permit this.

Lab performance

While the loaded speed stability was just adequate, the low level of overshoot generated on recovery should ensure an absence of dynamic wow (see sound quality). Both wow and flutter and rumble measurements gave very good results, while start up was fairly quick at 1.8 seconds, but hum levels were barely satisfactory using a moving-coil

cartridge, and conventional types are thus recommended. Feedback and shock resistance were quite good, the former some 10dB worse with the lid raised. As mentioned above, acoustic feedback proved superior to its smaller brothers, and is probably a little better than average in this respect.

Friction was reasonable in both planes, and cue operation excellent, with downforce quite accurate and bias compensation in the right ratio, if some 40% high. Geometrical alignment was good, although only adjustment for overhang was available via a gauge rather than the preferred protractor. Arm resonance behaviour was classed as 'average' and closely paralleled that of the other two models — essentially the same arm was fitted to all three.

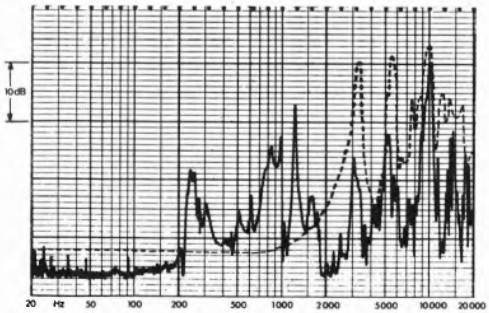
Sound quality

With inaudible wow and rumble, and a pleasant overall quality (lid down), the *SRF530* was rated as 'above average'. The usual slight loss of low bass was noted while the midrange was both a trifle 'loud' and forward, with some veiling of depth and detail. Nevertheless a satisfactory balance was achieved.

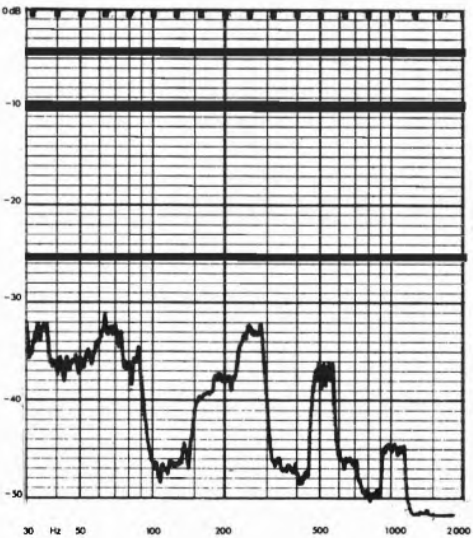
Conclusion

With its fully auto facilities, pleasant sound quality and supplied cartridge (the latter not to be taken too seriously at this price level by a hi fi enthusiast), even by the revised and tighter standards of this new edition, the *SRF 530* is clearly well worth considering.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic direct drive
Platter mass/damping	1.25kg/fairly good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.065%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.082%/0.09%
Speed accuracy/drift/variation under load	adjustable/<0.05%/–0.5%
Start up time to audible stabilisation	1.8secs
Rumble (av DIN B wtd L/R)	70/75dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.0g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	50mg/10mg
Bias comp: type/force rim/centre	spring/210mg/230mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.0secs/2.5secs
Downforce calibration error 1g/2g	–0.05g/–0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.2(w) x 36(d) x 13.8(h)/5.3cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	satisfactory/good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Trio KD1500

Trio, B. H. Morris & Co. (Radio) Ltd., Precision Centre, Heather Park Drive, Wembley, Middx. HA0 1SU. 01-902 9422

Features, facilities, setting up and use

The *KD1500* is an inexpensive belt drive deck from Trio costing around £70.00. In contrast to the earlier *1033* with its steel top deck mounted on coil springs, the *'1500* uses a fabricated plinth mounted on the usual rubber feet. Unfortunately these were too stiff on our sample and resulted in a lateral resonance at 12.5Hz with the vertical mode at an alarmingly high 31Hz. However, this is still likely to prove 'subsonic' with the limited low frequency bandwidth of the speakers likely to accompany this low-priced deck.

The straightforward tonearm had the usual universal headshell, the latter moulded in plastic and none too rigid. A high 20g effective mass was measured, which is suited to low compliance cartridges. An auto-stop and arm-lift device is included. The lead capacitance was a typical 150pF, and again the essentially correct but nonetheless clumsy overhang method of cartridge alignment was specified; an alignment protractor will give better results. The total platter mass was low at 0.75kg, with the mat offering good damping. But the light resonant polystyrene lid was not decoupled from either the plinth or the arm.

Lab performance

Wow and flutter was satisfactory at 0.13% DIN peak weighted, although linear wow was on the high side at 0.25%. Speed accuracy was satisfactory, slowing under mild load, and startup was rapid at 0.8secs. A reasonable 68/70dB rumble was recorded, the spectrum showing some electrical components, notably at 50Hz, but the remainder were motor generated. A repeated line also appeared at 25Hz intervals, and this related to the motor periodicity.

The arm showed acceptable lateral friction at 50mg, this is about average for this price level, but it could have been lower. The bias compensation was nearly correct but operated in the inverse ratio, although it was in its favour that no additional friction was induced. The cue operated well and the downforce calibration was quite accurate. Arm resonances were classed as above average owing to their infrequency, although the shell itself was in flexure at a comparatively low 160Hz. Clean from 200Hz to 2kHz, the response was also well behaved above 5kHz.

Vibration isolation was quite poor, the breakthrough at 200Hz for example being 30dB worse than average, while that at 100Hz was about 15–

20dB worse, this breakthrough continuing right up the band and still significant at 500Hz. Acoustic breakthrough was also below average with serious peaks at 65Hz and 150Hz, resulting in an average rating for acoustic feedback, although impulse shock was coped with well.

Sound quality

Scoring below average, a trace of motor noise was evident on quiet programme but it was not considered serious. Stereo imaging appeared to lack precision, the overall character being less pleasant than usual, with the bass register almost verging on the boomy at the test location. Some mid coloration was also apparent while stereo depth was masked.

Conclusion

Forced to use that word again, the overall performance of the *KD1500* was just too 'average' for a recommendation to be made, even though it had no significant flaws apart from its vibration isolation, and of course many other models suffer from the same problem.

GENERAL DATA Integrated Turntable

Motor Section

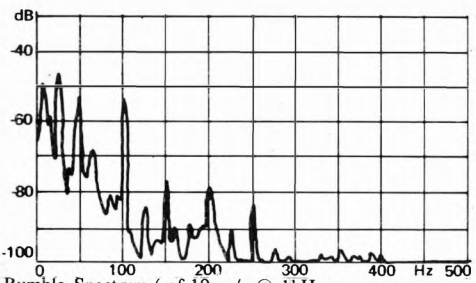
Type	auto-stop, belt drive manual
Platter mass/damping	0.75kg/fairly good
Finish and engineering	very good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.13%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.25%/0.06%
Absolute speed error	+0.5%
Speed drift 1 hour/load variation	synchronous/−0.2%
Start up time to audible stabilisation	0.8secs
Rumble: DIN B wtd L/R av (see spectrum)	68/70dB

Arm Section

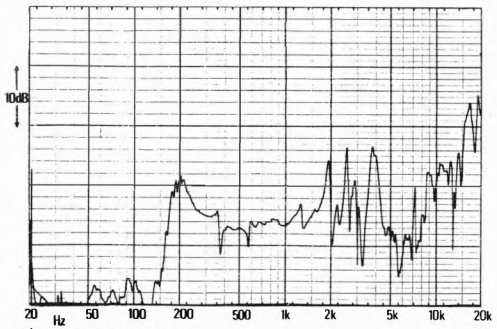
Approximate effective mass inc screws, excl cartridge	20g
Type/mass of headshell	universal detachable/7.5g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	50mg/30mg
Bias compensation method	thread and weight, no pulley
Bias force: rim/centre (set to 1.5g elliptical)	175mg/150mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.0sec
Arm resonances	above average
Subjective sound quality	average
Lead capacitance/damping method	150pF/slight c/wt decoupling

System as a whole

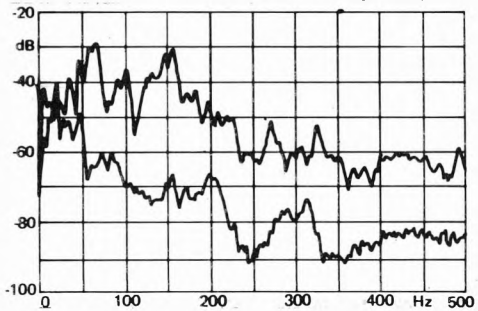
Size/clearance for lid rear	46.8(w) x 36.3(d) x 14(h)/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	poor/above average
Estimated typical purchase price	£70



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Arm resonances



Acoustic breakthrough (upper) and vibration breakthrough

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Features, facilities, setting up and use

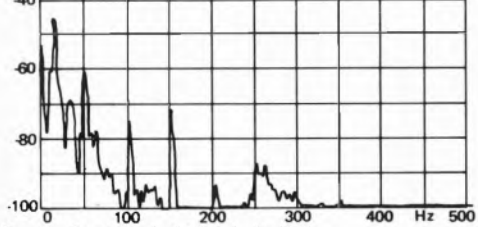
More or less a successor to the more costly *KD750*, the *600* motor unit is also available with a Trio arm, and is known as the *KD650*. The design was founded on a massive plinth moulded in Trio's mineral loaded resin – A.R.C.B. A thick and relatively dead lid was provided, but the usual ineffective rubber feet were used for isolation, the overdamped plinth resonances appearing at 8.1Hz lateral and 16.2Hz vertical and able adversely to affect a cartridge's tracking ability at its subsonic resonance. The powerful direct drive motor was quartz speed referenced, and the substantial 2.7kg platter was well damped by an effective mat. Two fixed speeds were provided (33⅓ and 45rpm) but the lack of metalwork on the plinth may have been responsible for the less than ideal level of acoustic breakthrough.

Wow and flutter was excellent with no wow overshoot. Interestingly the speed was 0.1% fast – a negligible error, but one which is unheard of in the case of an inbuilt quartz referenced oscillator whose spec accuracy should have been of the order of 0.002%! Stability and drift were excellent, start up was fairly quick and exactly to specification at 1.9 seconds, while rumble was very good at 75/72dB, if not quite to spec. Analysis of the spectrogram revealed the presence of some mild motor noise plus some mains related breakthrough, believed to be due to an inadequately decoupled power transformer. Rated as good on acoustic breakthrough peaks were nevertheless present at 55, 140 and 330Hz, while vibration isolation was merely average. Feedback was poorer than that, appearing first in the bass, though as is so often the case, shock was well resisted.

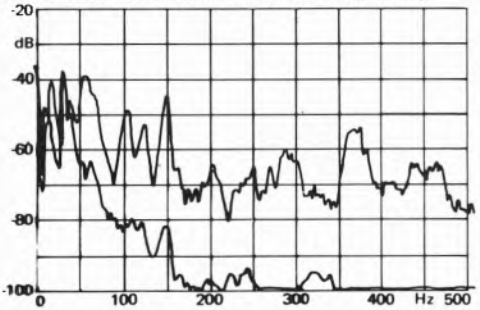
Rated just average on sound quality using a good quality tonearm (SME III), the low frequencies were not reproduced clearly enough, with a loss of extension and transient clarity. But matters did improve when the deck was moved to a substantial shelf location. The midrange however was pleasant and detailed.

Good isolation is a key factor as regards the more costly turntables, for without it they rarely make the grade. Offering good performance in the right location, the *KD600* was however too costly for recommendation in view of its overall performance.

GENERAL DATA	Motor Unit (650 with arm)
Type	quartz direct drive
Platter mass/damping	2.7kg/very good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	33⅓, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.05%/<0.05%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.8secs
Rumble: DIN B wtd L/R av (see spectrum)	75/72dB
Size/clearance for lid rear	49(w) x 40.5(d) x 16.7(h)/5.3cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/below average
Vibration sensitivity/shock resistance	average/good
Estimated typical purchase price	£260



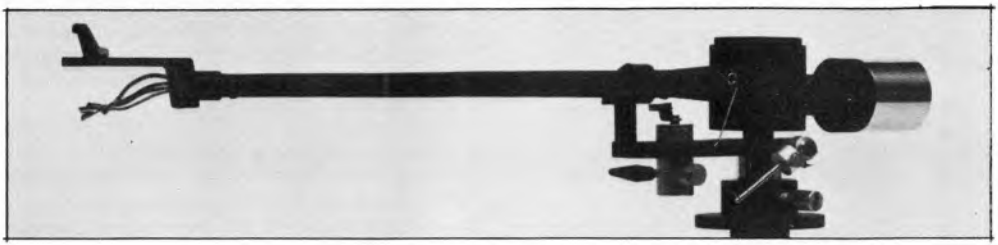
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Ultracraft AC30

J. Osawa & Co. Ltd., 10 Forge Court, Reading Road, Yateley, Camberley, Surrey GU17 7RX



Features, facilities, setting up and use

At a price reduction of some 30%, Ultracraft have ingeniously produced the new *AC-30* arm, which embodies the best of the *'300* series while adding further improvements. Treading a middle path between the very low and very high mass *'300* versions, the *'30* was a rigid structure with the tube/stem and headshell properly and permanently fixed, offering a modest 9g effective mass. The arm is finished entirely in black, though the same pillar unit as on the *'300* was used, including the variable damping unipivot. A rotating type calibrated counterweight was employed, and the arm was fitted with a good quality low capacitance cable measuring a total of 95pF. As with the *'300*, the same 15mm overhang geometry measurement was recommended instead of a sensible card protractor.

In general well engineered, we were slightly concerned over the lack of complete rigidity at the pivot, due to spring loading of the jewelled pin, presumably to prevent damage by shock; that on the *AC-300* appeared firmer by comparison.

Lab performance

This arm performed very well in the lab with fine geometrical accuracy and very low pivot frictions, offering effective damping as and when required. Effective mass was moderate at 9g – at the low end of the medium mass category – and in conjunction with damping was suitable for cartridge compliances in the 10–25cu range. Bias compensation was fine though the cue drifted a little on descent. A good rating was achieved for resonances, the arm exhibiting generally good control and a well maintained energy trend. The counterweight was apparent at 100Hz, but the break at 250Hz was not felt to be a true resonance – possibly it was movement at the pivot. The first flexural mode of the tube was masked, but probably lay at 500Hz.

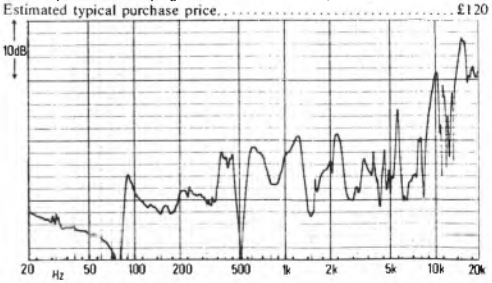
Sound quality

Felt to be of *'SME III'* character, the *AC30* sound was well balanced and neutral, showing a distinct lack of coloration and offering no emphasis of any spectral region. The sound was quite detailed and showed promising stereo depth and ambience, but the final degree of transient clarity and resolution of detail shown by the best arms was felt to be muted.

Conclusion

Ultracraft have, in the *AC30,* produced a superior tonearm capable of almost universal application, especially in terms of its sensible effective mass and the variable damping facility. The value and the sound quality was good, and the design is certainly worth considering.

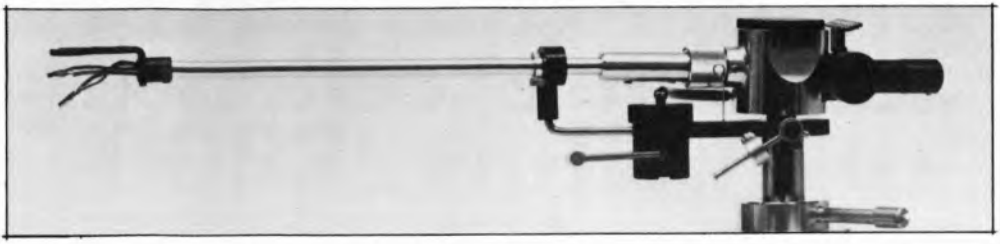
GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	9.0g
Type/mass of headshell	fixed/N/A
Geometric accuracy	very good
Adjustments provided	tilt, overhang, lateral angle, height
Finish and engineering	excellent
Ease of assembly/setting up/use	good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	140mg/220mg
Downforce calibration error: 1g/2g	+0.05g/+0.07g
Cue drift/8mm ascent/descent	fairly good/1.5secs/2.5secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	95pF/variable via fluid well
Estimated typical purchase price	£120



Arm resonances

Ultracraft AC300

Ariston Acoustics Ltd., 1 Society Street, Maybole, Ayrshire KA19 7BH. Tel. 0655 82424
J. Osawa & Co. Ltd., 10 Forge Court, Reading Road, Yateley, Camberley, Surrey GU17 7RX



Features, facilities, setting up and use

A well established tonearm, the *AC300MkII* comprised a family of models based on the same pillar, counterweight and bearing structure. The pillar was built with a well engineered interchangeable arm tube facility, the range developing via a variety of tube/shell types. That reviewed was the low mass *AC300MkII* with straight arm stem and fixed headshell, but as an accessory a higher mass version with an 'S' shaped tonearm and a more conventional detachable headshell was also available. The *400II* additional series represents essentially the same arm, but with the effective tube length increased from 237mm to 283mm. The supplied manual was both well written and helpful, and listed more accessories.

A unipivot design, the arm incorporated variable damping using a viscous fluid well. The bias compensator was a thread and lever type, with no pulley to relieve the sharp bend the nylon thread has to undergo, and despite the arm's obvious sophistication, the clumsy overhang method for cartridge alignment was suggested. Though well engineered, the headshell section was not as well secured to the tube as we would have liked. Effective mass was very low at 3.75g – suited to delicate high compliance cartridges – and the capacitance was also low at 100pF.

Lab performance

Using a protractor to set it up, the geometry was excellent and no problems were encountered; the end result was good for a unipivot. Some drift was apparent on the cue but the bearing friction was below sensible measurement levels. The biasing was close to the correct value and in fact added negligible additional friction. Downforce calibration was on the high side, but not unduly so.

Rated as above average rather than good on the arm resonance characteristics, the counterweight mode was apparent at 85Hz and numerous well damped breaks also occurred, suggesting inferior rigidity; in fact no really clean area existed. Conversely the overall energy trend was well reflected, implying a good frequency balance.

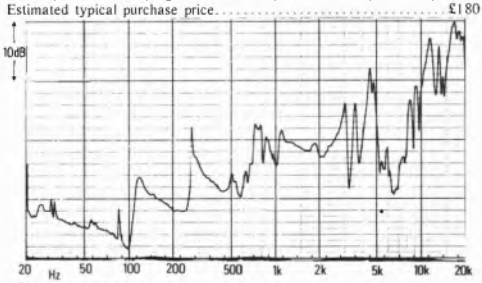
Sound quality

Rated as good, the character was pleasant enough with a smooth balance, quite good bass, plus promising stereo imaging and depth. Superficially it appeared similar to the SME *III,* but lacked some of the latter's precision and detail.

Conclusion

This versatile and interesting arm has not done badly and in the main was well engineered. High compliance cartridges are its *forte*, and with these the structural resonances will be less relevant. But in the context of this report, the price was too high for a recommendation on the version tested.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	3.75g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, height, overhang, slight lateral angle
Finish and engineering	very good/very good
Ease of assembly/setting up/use	fairly good/fairly good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	200mg/225mg
Downforce calibration error: 1g/2g	+0.06g/+0.08g
Cue drift/8mm ascent/descent	fair/1sec/2secs
Arm resonances	above average
Subjective sound quality	good
Lead capacitance/dampingmethod	100pF/vari. fld. unipivot + dcpld c/wt
Estimated typical purchase price	£180



Arm resonances

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J. Osawa & Co. (UK) Limited, 10 Forge Court, Reading Road, Yateley, Camberley, Surrey, GU17 7RX. Telephone: Yateley (0252) 875919.

Audio Technica AT1010
The UK availability of this model is currently a little uncertain, as the similar *1100*/Signet *TK45E* with its low mass detachable tube is considered more in line with British tastes. Moreover, our original review sample was from early production, and we understand that some detail changes have taken place.

The *1010* is a detachable headshell design with a highish 15g effective mass. Pillar construction shares some parts with the *1100*, but no viscous damping is provided. Engineering quality was very good, with extra care taken to improve the rigidity of the headshell fixing, giving above average resonance results and a similar sound quality rating.

B&O Beogram 4002
The *4002* shares the principles of an optimised cartridge-inclusive package, suspended subchassis isolation, and automatic operation, with its cheaper brethren, but unusually also includes a parallel tracking arm under photo-electric control. A *4004* model is also available which can be operated by remote control, but only when used with the Beomaster *2400* receiver. The overall sound quality was considered 'good', if similar to the cheaper models, and would perhaps have benefited from a mat which offered greater record support. With similar overall performance and price as the other parallel-tracker in this survey from Revox – albeit offering an alternative set of design compromises and greater cartridge choice – the *4000* series can be similarly recommended, but its price precludes a high 'value-for-money' rating.

ITT 8011
This direct drive auto-return player is fitted with a detachable headshell arm of fairly high mass (16g), and supplied with a compliant cartridge which is not strictly compatible, but is nevertheless of good quality. Most measured parameters gave respectably good results, though there was some arm misalignment. The sound quality was rated below average.

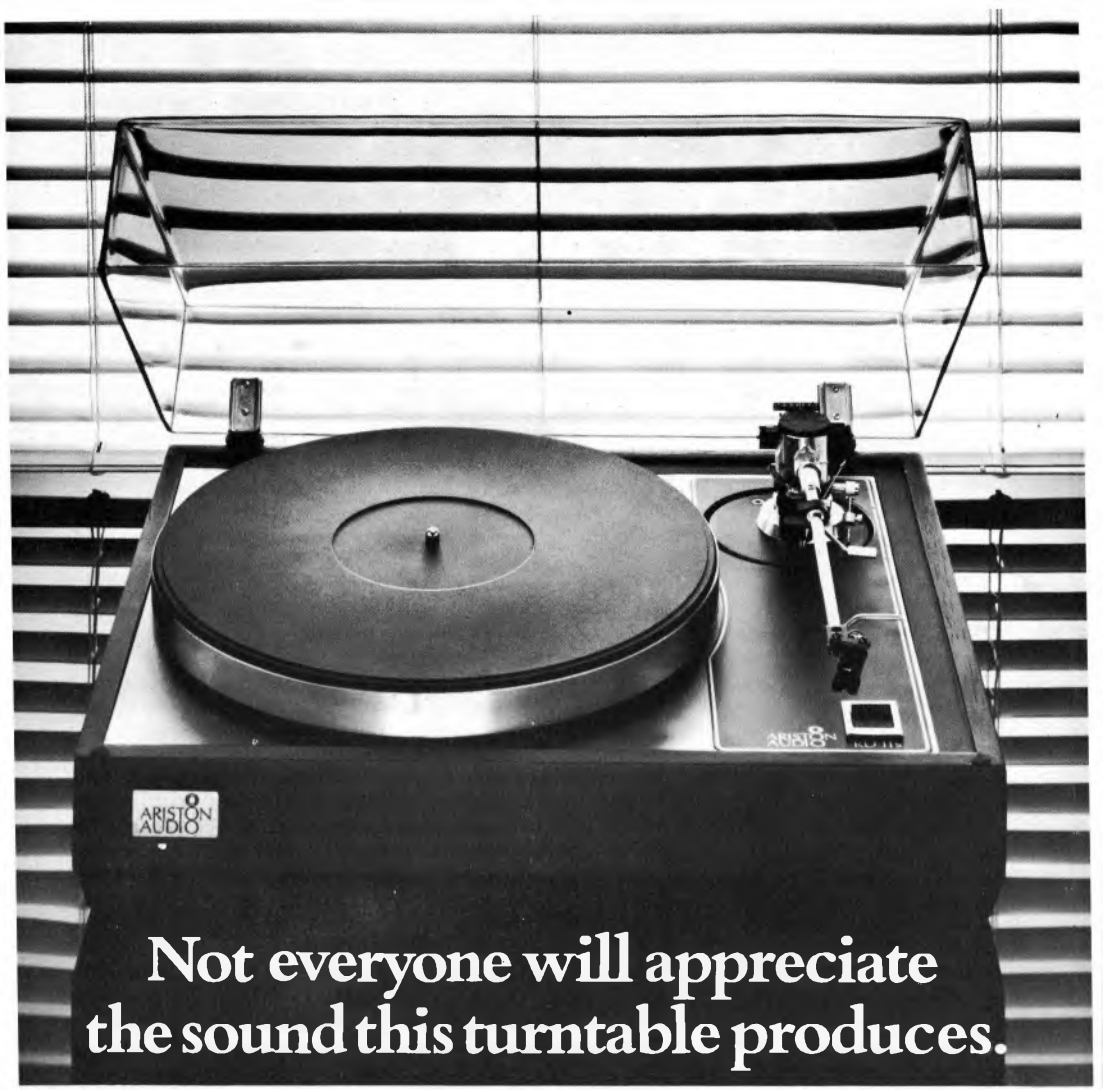
ITT 8012
Although quite different in appearance from the *8011*, this slightly more expensive model, which offered fully automatic operation and front-mounted controls, suffered similarly from a 17g arm effective mass with the same compliant cartridge and also alignment problems. Most of the measured parameters were slightly improved, though again sound quality rating was below average.

JVC QL7 series
Our data for the *QL7* manual player and *QL70* motor unit remains slightly incomplete, as we tested the automatic *QLA7* (now no longer available), which has a slightly larger plinth. Technical performance was generally to a high standard, though some motor pole noise was noted. The arm showed excellent adjustment and had useful subsonic damping, but the resonances were marred by the detachable headshell system. The overall sound quality rating was above average, but the fairly high price mitigates against recommendation, and the units need careful siting to give of their best.

Michell Electronic
This motor unit has a rather striking appearance with its elegant combination of black and clear acrylic and aluminium. The unconventional aluminium strip suspension gave good vertical isolation but permitted little horizontal freedom of movement. This belt drive model gave good results in all respects except load stability, and the ensuing slight pitch instability resulted in an above average sound quality rating. Some modifications have taken place, notably to the arm mounting arrangement, and these we have not checked. But the original came close to recommendation, and though the price is on the high side, if the unusual styling appeals it is clearly worthy of consideration.

Philips 777
This model is almost identical to the *677* (see review) apart from the inclusion of variable speed and full automatic operation – even down to the slight arm friction problem! The slightly improved 'average' sound quality rating suggests that this player merits consideration, rather than the original recommendation, under the revised standards of this edition.

Trio 1033B
This budget manual belt drive player has been established for a number of years, and although it has received much praise in other sections of the press, it has been less well received by *Choice*, with problems of motor noise breakthrough and high arm friction on our sample. However Trio are undertaking some modifications including extra damping materials in the immediate future, although samples were not available in time for us to carry out checks.



Not everyone will appreciate the sound this turntable produces.

Of course those who do understand the difference a high quality turntable can make to a system, will more than appreciate the RD11S.

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KA19 7BH. Tel: 0655 82424.

Shown above: Ariston RD11S Turntable. The Ariston Mat. Ultracraft Tone Arm. Plinth [illegible]

Fashion clearly plays a part in turntable design, but trends are nonetheless discernible from this wide range of products, and serve to illustrate the importance of certain aspects of design.

Design

In practice the most important factor appears to be the design of the plinth or chassis, and not, as one might expect, the type of motor drive or arm. While high performance versions of the latter components are the subject of much research and costly fine tolerance manufacture, aspects of the plinth/chassis design are relatively simple and inexpensive to execute; moreover, the successful elements have been known for years. It thus remains a continuing mystery why so few manufacturers have paid any attention to chassis design.

Importance of isolation

Analysis of the recommended models shows that no fewer than nine contain some elements of an effective spring isolation system in their plinth or chassis. In its simplest form, the key to an accurate subjective performance (assuming of course that both the arm and motor are sufficiently good) can be taken as a minimum of three steel coil springs. All that is required is for the parts associated with the record, namely the platter, arm, and connecting chassis, to be spring suspended at some suitable infrasonic low frequency, thus isolating the record from all the resonances and colorations present in the room, as well as in the lid, the plinth proper and not least of all, in the shelf on which the deck is mounted.

Influence of technology

While 'high technology' designs can achieve a good subjective performance, unless an effective isolation system is incorporated, the top grade subjective ranking cannot be attained, as once the obvious problems of wow and flutter, rumble and rigidity have been solved, those that remain relate to acoustic feedback margins and shelf-borne vibration coupling. No quantity of carbon fibre, quartz oscillators, stroboscopes, automatic mechanisms, synthesisers and the like can subjectively make up for inferior isolation.

Performance balance

The typical turntable represents a complex balance of many subjectively important factors. On the motor side, if wow and flutter is severe this may be a problem, particularly the insidious dynamic or programme wow, which can occur with both direct drive and belt drive decks when subjected to the differential drag caused by recorded modulation variations. Aurally excessive wow is interpreted as an uncertainty of pitch and a subtle unstable 'floating' effect, but it is of course acknowledged that many discs themselves have permanent wow, due to a displaced centre hole, mild warps or even wow in the original record cutting lathe. For example, it has been shown that many of the studio disc lathes in use suffer from significant programme or dynamic wow, and the interested reader may have noticed that some direct cut and 'super cut' records boast the use of cutting lathes fitted with low wow motors from such manufacturers as JVC and Technics. Poor flutter is less obvious subjectively, tending to produce a coarsening of the tonal quality together with a masking of detail, and can in fact be mistaken for other effects.

Rumble can appear in many forms, constituting as it does the unwanted noise, generally of mechanical origin, that is produced by the turntable. Hum from poorly mounted mains transformers is a common source, though the serious grinding and bumping noise from a poor platter main bearing are rarely encountered with modern designs. Motor vibration is more common: for example, as a result of out of balance rotational forces in belt drive systems, and in direct drives from the power pulses as the magnetic poles are energised during rotation. If severe, periodic rumble can be heard as a hum or drone on quiet recorded passages, while conversely pole switching rumble is often subjectively free of a recognisable tone, and can be detected as a mild clouding of detail in the programme. A number of direct drive motors did not produce particularly clean rumble spectra, but equally important, many belt drives exhibited motor vibration breakthrough. However, both systems are potentially capable of excellent results, as the figures for the recommended models amply illustrate.

Platters and mats

Platter mass is important in terms of the ability to soak up unwanted vibration in the motor and disc (the latter containing acoustic breakthrough plus stylus reaction induced resonances) as well as for adequate inertia to flywheel momentarily through load changes. Some turntables have very light platters – under 0.8kg including the mat – and are clearly more susceptible to resonances than the

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average 1.5kg platter would be. In general improvements were subjectively apparent with higher masses up to 4 and 5kg, as found on the top class subchassis designs. The mat was also important and ideally should offer a hard flat surface for record support. Many are either too soft, frail or poorly designed for adequate record contact, though it should be stressed that unless the existing mat is particularly poor, with the 'typical' turntable it will exert only a small influence on the final sound quality. However, when one is dealing with the finest systems where motor and tonearm colorations are acceptably low, the coloration from a poorly supported disc can audibly contribute to some 30–40% of the total player coloration, and materially affect frequency balance, stereo image depth, and transient quality, particularly at low frequencies.

Tonearm factors

The tonearm is also a critical component, in that both its electrical and physical characteristics – lead capacitance, structural weaknesses and resonances, effective mass and geometric properties – all influence the sound quality. One geometric aspect that *Choice* has only recently begun to investigate concerns the long established but little discussed relationship between the vertical pivot plane and the stylus. As noted in the *AT1100* review, a pivot position significantly above the stylus results in an upward directed force component which counteracts tracking downforce, particularly when the stylus undergoes increasing frictional drag from strong music modulations. Thus a momentary downforce reduction occurs, just when the maximum downforce may be required for optimum tracking, thereby reducing tracking stability. The majority of the arms examined suffered from this defect to a greater or lesser degree, and these included the Syrinx *PU2,* plus most of the unipivot types including those from Ultracraft, Mayware, Hadcock, Decca and Connoisseur, as well as the ADC *LMF* series, to name but a few. To our knowledge there are three tonearms which have been specifically optimised, namely the unipivot Michell *Focus*, the Audio Technica *AT1100,* and the SME *III* models. By placing the vertical pivot plane at the stylus the downforce does not vary with drag. Placing the pivot below the stylus produces an overpressure on loud sections momentarily aiding tracking, though the overpressure does not develop at a faster rate than the subsonic resonance risetime will allow, and tends to appear after some 100ms or so delay. Specifically the *AT1100* places the plane a little below the stylus for most cartridges. Warp wow is of course at a minimum at the 'mean warp height' position, though this effect is rarely of a worrying magnitude with most designs.

Audio band resonances

The resonance data in the audio band continued to show the weakness of the detachable headshell designs, with the exception of a few carefully executed types with a splined collet type fixing (*eg* F.R.). Mismatch and flexure at the socket/plug join produces serious resonance problems quite low in the band – generally around 200Hz. Counterweights are often decoupled on a guesswork basis, and the conventional rubber bush types are frequently betrayed by a fairly severe resonance in the 30–90Hz region, with consequences as regards bass coloration. A decoupled counterweight can be successfully taken out of the picture by effective absorption (*eg* Mission *774*), but if rigidly coupled can induce upper range resonances above 100Hz (*eg* Syrinx *PU2*, SME *3009 III*), with some attendant effect on the lower midband coloration. Some models also show a neglect of torsional strength in the main beam, this arguably the most important mode (*eg* Infinity *Black Widow,* Micro *MA707*). This results in audio resonances at frequencies octaves below that where they might be expected from a simple inspection of the rigidity against bending.

The mean energy level on the published arm resonance graph indicates the consistency of the reflected mass at the cartridge over the frequency range. Two distinct classes of breakup can be identified: the preferred behaviour is the one where the energy trend is more or less undisturbed in level or shape by the inevitable resonance modes, implying no great discontinuities in effective mass (*eg* Hadcock *GH228*); less' desirable behaviour produces severe jumps in the energy trend, implying that the effective mass is discontinuous with frequency (*eg* BIC *75*).

While the dominant structural resonances tend to occupy the range below 3kHz, the arms are by no means dead at higher frequencies, and show dramatic differences in resonant behaviour. Taking into account the rising trend, some reveal that the cartridge can produce a more or less uniform energy output over the final octaves above 5kHz

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(*eg* the Mission *774,* Ultracraft *AC30* or Technics *SL10*), while others clearly show a different and less uniform trend as regards both balance and resonance distribution (*eg* Thorens *115* and *105,* Fidelity Research *FR12,* and Michell *Focus*).

Lead capacitance
While of negligible importance where moving-coil models are concerned, lead capacitance is vital with many moving magnet models. Taking as an example a nominal amplifier input capacitance of 50pF, by adding the range of recorded lead capacitances, variations from 125 to 350pF result. The maximum value is too much for some cartridge models, resulting in a drop of several dB in the upper treble, with other cartridges the minimum value is insufficient to produce a flat response (*eg* some Ortofon and a number of Shure models). Ironically the overall sound quality of such cartridges can be more affected by electrical capacitance matching than by anything else, though fortunately it can be fairly easy to overcome, either by simply adding capacitor 'plugs' or variable matching units at the amplifier input, or (rather more difficult) where a reduction is required by shortening or replacing the audio cable.

Lateral geometry
The lateral geometry of tonearms is still a problematic area, with most models lacking sensible instructions for cartridge fixing, and the manufacturers generally not supplying any form of protractor. Several accessories for correct alignment are available: for example, a recent introduction from Elite Electronics proved useful, as did our own two point gauge from *Cartridges and Headphones* (see p. 38). Models with supplied cartridges all too frequently arrive poorly set up; a 3mm overhang error or equivalent 3° lateral misalignment can increase groove distortion at the inner radii from an ideal maximum of 0.6% to almost 2%, as well as degrading stereo separation.

Vertical geometry
On balance, the vertical geometry is less critical, though it is still preferable to align the cartridge back parallel with the disc. Comparatively few arms provide a variable height facility to achieve this. Even fewer allow for 'tilt' which aligns the cartridge when viewed from the front so as to be truly vertical relative to the disc surface. Those enthusiasts with access to test records will know that fully calibrated geometric adjustment with a given cartridge can improve distortion and separation by up to 20%, and it might be worth dealers providing such a service over and beyond the usual 'align it by the instructions' service.

Effective mass
While the majority of arms are of quite high effective mass – typically 15–20g with a few up to 35g – a welcome number of medium and low mass models are appearing, and several are included in this issue. At the high end of the medium mass range is the *Ittok*, which is compatible with 5–10g weight cartridges in the 10–20cu range. Very low mass arms, several of which have been appearing on integrated players such as those from Marantz and Rotel, are happy with lower mass cartridges with compliances of up to 40cu. However, the average 15–20g mass of most arms restricts the allowable compliance range to preferably 6–12cu. Mass/compliance matching is particularly relevant with the suspended subchassis motor units, where the suspension resonance is quite lively, and typically in the 3–7Hz range. The arm/cartridge resonance must then be sensibly higher than this, and hence low mass arms are most often fitted to such units.

Isolation problems
With the exception of one or two mechanically inert models, and of course the suspended subchassis types, most decks in this issue failed to effectively block external acoustic and vibrational energy. The tinted covers fitted are generally moulded in polystyrene or related plastics, noted for their highly resonant properties, and while most decks show different feedback resistances depending on whether the lid is up or down, nearly all gave a significantly better feedback margin with the lid removed entirely!

It remains a matter of concern that despite our present well developed understanding of good turntable design, so many basic mistakes are evident in the isolation techniques employed by manufacturers.

Quality and consistency
Quite a number of turntables (including some of the most expensive) required retesting due to the faults evident on the first review sample supplied. About 20% overall were substandard: for example, direct drive motors where unexpectedly

high wow and flutter and/or rumble was generated. One deck did not work at all!

Several showed incorrect arm geometry. This was rarely a design fault, but was usually caused by incorrect instructions, while several ready fitted cartridges were in fact incorrectly aligned.

Far too many tonearms possessed frail, poorly adjusted bearings with excessive slop and rattle. High lateral friction values of the order of 60–100mg were often recorded, and these are barely satisfactory. Bias compensation continues to be frequently a 'hit or miss' affair, with similar arms demonstrating rather different readings, while the compensators were poorly calibrated with a typical 50% error, and in many cases they added lateral friction due to poor design.

The worrying thought is that if these problems were present on 'official' review stock, how severe is the quality variation in the shops? One might well feel happier if the dealer were to check out your turntable before purchase, and any dealer who is appropriately equipped and prepared to carry out effective pre-sales service is clearly likely to be more than worth a full retail price.

In the last issue it was commented that turntables seemed rather primitive in engineering terms considering their cost, particularly so when compared with a good SLR (single lens reflex) camera, for example. For £150.00 or so, an SLR offers an array of high precision bearings in a fine state of adjustment, as well as complex and delicate mechanisms and gears. Sophisticated multi-element optics made to extraordinarily close tolerances are part of the package, which also includes an electronics content comprising LED displays, light metering and timing circuits, many of these on microchip processors. By comparison, most £150.00 integrated turntables appear to offer little for the money.

To meet the digital audio player challenge in the coming years, the conventional turntable will have to be more competitively priced and engineered, in order to offer a viable and less expensive alternative to the digital player. Inevitably the latter will be initially rather expensive during the early years of its manufacture, and will thus be inappropriate for many budget and medium priced hi-fi systems.

The following products have been recommended either on the basis of value for money, or alternatively as representing outstanding technical merit and/or sound quality. The fact that they appear on this list means that we have few reservations concerning their quality, or quality in respect of price.

RECOMMENDED INTEGRATED TURNTABLES

(In descending order of price)

Technics SL10 (£300.00)
An automated and elegant quartz direct drive deck, with a parallel tracking tonearm, and including a high performance m-c cartridge plus head amplifier.
Technics SL1700 II (£190.00) (Also *1600 II*, £225.00; *1800 II*, £175.00)
An auto return quartz direct drive with a well balanced overall performance, plus fine engineering and finish.
Michell Focus (£190.00)
An attractively 'technical'-looking turntable of good all round performance, fitted with a low mass arm of comprehensive geometric versatility. (Also available as separate motor unit/arm components.)
B&O 2200 (£160.00)
With an effective subchassis that is easy to set up, plus supplied 'recommended' cartridge and compatible arm, this model (and the related, cheaper **1500**) retain the firm recommendation from the last edition. However we do have some reservations on the quality of a new arm type that may be fitted to replacement models.
Rega Planar II (£99.00)
This deceptively simple manually operated design is carefully balanced in engineering terms to produce an above average subjective performance for the price.
Dual 506 (£100.00)
The rumble anti-resonator remains a cause for mild concern, but on the other hand the overall performance for the price is worthwhile, particularly in view of the low mass arm/cartridge combination with the modest Ortofon *ULM45E* cartridge. (The automatic version is the **522**.)
Pioneer PL200X (£95.00)
Of slimline form, this unit achieved a creditable performance for the price – better in our view than its more costly brothers. It offers auto-return, direct drive and a medium/high mass arm.
Sansui SR222 II (£69.00)
Recommended in the last issue and still available, this simple belt drive deck possesses an excellent finish and a good performance for the price.
Rotel RP300 (£65.00)
This auto-return belt drive model easily outperformed its more expensive brother, and with its low mass arm and 'bonus' cartridge is worthy of recommendation.
Hitachi HT324 (£65.00)
While arm mass is high, it was nevertheless well adjusted, and the overall performance was to a promising standard. Auto-return, and a bonus cartridge were included.
Pioneer PL512 (£55.00)
A straightforward manual turntable with a medium to high mass arm, the *PL512* did well compared with most similarly priced models.
Harksound HS210 (£50.00)
Just meeting hi-fi standards, this inexpensive turntable offers two bonuses, namely a low mass arm complete with Ortofon cartridge and an auto-return facility.

RECOMMENDED MOTOR UNITS

Linn Sondek LP12 (£345.00)
Single speed subchassis type.
Dunlop Systemdek (£260.00)
Two speed, manual change, subchassis type.
Ariston RD11S (£250.00)
Two speed, manual change, subchassis type.
Thorens TD160S (£150.00)
Two speed, lever change, subchassis type.
STD 305S (£140.00)
Two speed, manual change, subchassis type.
Thorens TD160 B/C (£108.00)
Two speed, lever change, subchassis type.
Rega Planar II (approx. £70.00, limited availability)
Two speed, manual change.

All the above, will in proportion to their price, give much better than average performance when properly fitted with a recommended tonearm.

RECOMMENDED TONEARMS

Linn Ittok LVII (£230.00)
An excellently finished, highly rigid, fixed headshell design of medium mass, this model has convenient calibrated controls, and highly accurate performance, and gave very good sound quality.

Mission 774 (£140.00)
Well engineered where it matters, this low mass, rigid arm offers a fine sound quality, a detachable cartridge carrier system, and variable subsonic damping.
Grace G707 (£140.00)
A low mass fixed headshell arm of good structural and bearing quality, providing a high standard of reproduction.
SME IIIS (£85.00)
A well equipped arm of fine subjective and objective quality; of low mass, it uses a detachable cartridge carrier system, and has an optional subsonic damper.
ADC LMF1 (£65.00)
A low mass fixed head arm, this unit was well made and finished, providing fine sound quality at the price.
Mayware Formula 4 III (£50.00)
This well made and versatile arm was recommended in the last issue at above the present price. It represents fine value, being a low mass unipivot type which includes moderate subsonic damping.
Rega (£35.00, limited availability)
This relatively inexpensive, conventional detachable headshell arm, offers moderately high effective mass; sound quality and resonance characteristics were better than average.

A number of other products were worthy of mention despite minor flaws or quality control problems, and fit in a category described as 'worth considering'. Units of above average but not outstanding value for money are also included here, as well as some older products brought forward from the last edition, which are still available sometimes at attractive prices.

'WORTH CONSIDERING'

1) Integrated Turntables

Revox B790 (£400.00)
This model is now largely supplanted by the comparable but much cheaper *B795.*
Revox B795 (£300.00)
The newest Revox introduction. These foolproof high performance turntables incorporate direct drive motors and parallel tracking low mass arms, complete with good quality cartridges.
B&O 40002/4 (approx. £350.00)
This long established turntable maintains its high standard by virtue of its effective subchassis isolation and its low mass parallel tracking arm, complete with a 'recommended' cartridge. Many functions are automated.
Micro Seiki DDQ500 (£300.00)
One of the few high calibre Japanese arm and motor combinations we encountered, a sturdy shelf is important for the best results. The arm is of low (also variable) mass, and is well calibrated and finished.
Sony PSX70 (£220.00)
A substantial model with many facilities, it gave a good all round performance but arm mass is on the high side. (**PSX60** is similar.)
Philips AF829 (£175.00)
Producing a good all round performance, the supplied cartridge was somewhat incompatible with the arm, though not disastrously so. Some complications arise when fitting a substitute cartridge.
Thorens TD115 (£155.00)
Wishing that this model could have done better, it is nonetheless worth considering. The arm is of low mass and is well calibrated, while the carrier is detachable; a similar but simpler version at reduced cost is also available, namely the **TD110.**
Pioneer PL400X (£145.00)
While this model did not do as well as the *'200X*, its overall rating suggests inclusion here (together with the cheaper and simpler **PL300X**). Arm mass is medium-high, and the mechanism automatic.
Dual 606 (£145.00) (also **626** automatic version)
This competent direct drive with a low mass arm comes complete with a worthwhile compatible cartridge from Ortofon; isolation was above average.
Technics SLQ2 (£140.00)
In normal terms this is a pretty good turntable. It just failed to make the top rank category due to its rather average isolation performance and unexceptional tonearm.
Toshiba SRF530 (£130.00)
Brought forward from the previous edition, this automatic direct drive deck gave a good all round performance and is still worth considering.
ADC 1700 (£120.00)
Featured on the cover this model succeeds despite our reservations, as the sum of quartz direct drive, plus low mass arm and 'recommended' *XLM III* cartridge does justify the price. (This also goes for the **ADC 1600** non quartz, with *QLM 36 III.*)
Thorens TD105 (£115.00)
While we were not entirely happy with this unit –

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for example the arm mount looseness built into the design – it did do quite well, and offers a carrier type low mass arm. (The **TD104** is similar, cheaper, and omits the auto-return.)

Marantz 6170 (£100.00)
Although belonging to the previous generation of Marantz turntables, this model is still available, and offers a reasonable overall balance of performance with a highish arm mass.

Philips AF777 (£100.00)
While the compatibility of the included Philips cartridge is borderline, the unit nevertheless provided reasonably good value. Acoustic isolation was above average, and the arm mass was just in the medium class.

Hitachi HT354 (£90.00)
An above average turntable at a realistic price, the high mass arm was fitted with a modest cartridge, and provided auto-return at end of side. (Also quartz **'356** at £110.)

Sansui FRD3 (£90.00)
An auto-return direct drive deck with a high mass tonearm and modest cartridge, this unit gave a well balanced performance and represented reasonable value.

Sony PST15 (£90.00)
A modest auto-return direct drive deck, the arm mass is fairly high. A 'bonus' Sony cartridge is fitted, and the consistent overall performance of this model qualifies it for inclusion.

Philips AF677 (£85.00)
Similar to the **'777** (above), it offers slightly better value for money.

Realistic (Tandy) Lab 250 (£85.00)
A reasonably good cartridge was fitted, and although the arm is a trifle high in effective mass, the performance of the ensemble justifies a continued commendation in this new edition.

Marantz TT2000 (£85.00)
This auto-return direct drive has a low mass arm, and offers reasonable value.

ADC 1500FG (£75.00)
Although mildly flawed by rumble, this model performed quite well. The above average tonearm was rather high in mass, but is well suited to the 'recommended' *QLM 34 III* cartridge fitted.

Connoisseur BD2A (£70.00)
Our reservations relate mainly to manufacturing quality; otherwise the performance and value for money are good for this belt drive design.

Technics SLB2 (£69.00)
Despite higher than average wow, the *SLB2* warrants consideration; a modest 'bonus' cartridge is included. The **SLB3** is a fully automatic version.

2) Motor units 'worth considering'

Technics SP15 (plus plinth £350.00+)
A superb quartz lock high quality motor, with 78rpm and synthesiser speed control, the performance was limited by its matching plinth's modest vibration rejection qualities; location/mounting is thus critical.

STD 305M (£240.00)
A good quality subchassis turntable which just missed the full recommended category; recent revisions make it somewhat easier to use than before.

Denon DP2550 (£220.00)
Another high quality motor unit, this design has inferior plinth isolation and needs careful siting to exploit its performance.

Technics SL150 II (£220.00)
A quartz direct drive with synthesised speed control. Technically excellent, this deck also offers reasonable acoustic and vibration isolation.

Thorens TD126 III BC (£223.00)
Whilst we have reservations concerning dynamic wow, this model can achieve undeniably good sound quality, its strength appearing to be in its effective acoustic and vibration isolation, and strong arm mount.

Michell 'Electronic' (£180.00)
An unusually styled British turntable, good sound quality is possible when fitted with one of the recommended arms.

Technics SL150 (£140.00)
A direct drive motor unit based on the earlier *SL1700* series (now superceded), it offered reasonable acoustic and vibration isolation; the performance thus remains competitive.

3) Tonearms 'worth considering'

Fidelity Research FR64S (£250.00)
Succeeding almost by virtue of its high 35g effective mass, this specialised arm was superbly manufactured.

Syrinx PU2 (£198.00)
Capable of very good sound quality, the potential instability and lack of calibration were worrying at this price level.

Technics EPA500 (£180.00)
A versatile arm of excellent design and finish, a good sound quality was delivered by this massive component.

SME 3009 III (£115.00)
A universal arm offering adjustable subsonic damping, low effective mass *via* detachable carriers; a full range of geometric adjustments is provided, and the sound quality is also fine.

Audio Technica AT1100/Signet TK50E (£110.00)
This low mass arm uses a detachable cartridge carrier and offers variable fluid damping. With a high standard of finish, the design offered good cartridge tracking and a good sound quality.

Decca International (£75.00)
A medium mass arm with good overall sound quality despite some resonance problems, this unipivot design was considered a particularly good match for Decca's own cartridges, and remains worth considering.

Hadcock GH228 (£65.00–£85.00)
The new 'D' version allows the arm top section with fitted cartridge to be switched, but at a significant increase in price. This low mass damped unipivot design has a fine arm tube that gives good sound quality, but remains tempera-mental to set up and use, and the engineering quality gives rise to some reservations. With the cheaper 'fixed' version clearly offering the best value, the *GH228* variants certainly merit consideration.

SME 3009 II ND (£60.00)
Although beginning perhaps to show its age, and indeed becoming rivalled on price in its damped version, by the latest *Series IIIS*, this classic low mass design offers a high standard of finish and versatility with above average sound quality in its fixed-headshell format.

ADC ALT1 (£35.00)
Clearly representing a low cost version of the *LMF2* (twice the price), the *ALT1* did not concede much in terms of performance. A low mass detachable headshell type, the sound quality was above average.

THE ORIGINAL RECORD CLAMP

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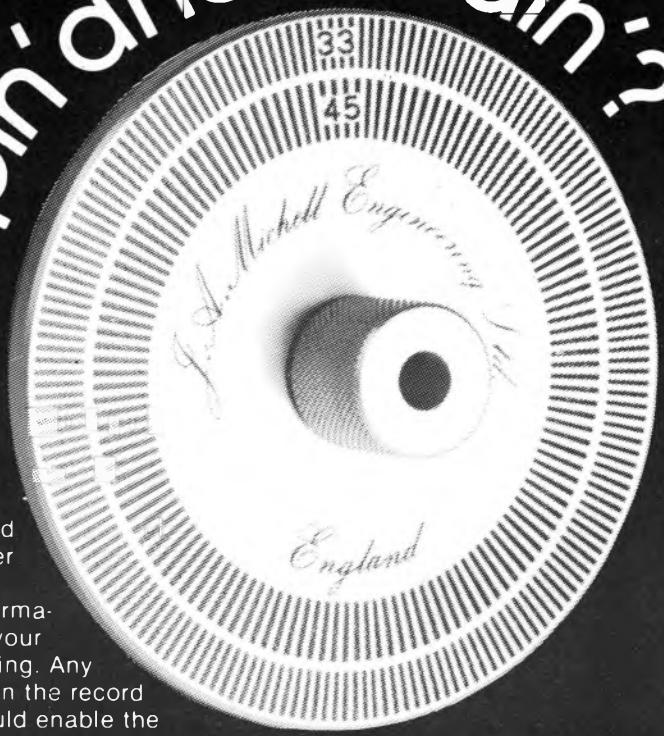

Place a record on your turntable. Without gluing it to the mat, any degree of unwanted movement, however slight, will introduce spurious information to the signal your cartridge is obtaining. Any air trapped between the record and the platter could enable the record to flex. Which will, of course, degrade the sound you will hear.

The Michell Record Clamp prevents any such problems. Constructed from plate aluminium machined to the highest tolerances, it is so light it will put no extra strain on the turntable motor or bearing. But it will lock your records as rigid as is possible against the platter, helping to flatten any warping and, more important, eliminate movement. And, because it clamps to the spindle it will not effect the suspension or the dynamics of your turntable.

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Overall Comparison Chart

*See Text	Type	Drive	Wow and Flutter	Rumble	Arm Eff. Mass	Arm Damping	Arm Resonances	Arm Bias and Friction	Arm General Alignment	Arm Lead Cap.	General Engineering Quality	General Sound Quality	Vibration and Acoustic Brkthrgh.	Set Up	Ease of Use (c= cart. inc.)	Price (typ inc)
			audible and measured		g					pF						£
ADC 1500FG	auto return	belt	good	satis.	21	little	average+	average	good	220	average	average	average	v. good	v. good c	75
ADC 1700DD	auto return	q.d.d.	good	satis.	6	little	average+	average	good	200	good	average	average	v. good	v. good c	120
ADC ALT-1	arm	—	—	—	6	little	average+	good	good	180	good	average+	—	v. good	v. good	36
ADC LMF-1*	arm	—	—	—	4	little	good	good	good	185	v. good	v. good	—	v. good	v. good	65
Aiwa LP 3000	auto +	q.d.d.	v. good	v. good	25	—	poor	excellent	excellent	250	v. good	average	average−	v. good	v. good	550
Aiwa AP 2300	auto return	direct	v. good	good	18	—	poor	poor	good	135	good	average−	average−	v. good	v. good c	120
Akai AP-B10C	manual	belt	v. good	satis.	13	little	average	average+	v. good	190	good	average−	poor	v. good	good c	55
Akai AP-206	auto return	direct	v. good	v. good	17	—	average−	average	good	75	good	average−	average−	v. good	v. good	85
Ariston RD11S	motor	belt	v. good	v. good	—	—	—	—	—	—	v. good	v. good	excellent	f. good	good	250
Audio Linear TD4001	motor	belt	adequate	v. good	—	—	—	—	—	—	v. good	average	average+	v. good	good	120
Audio Technica AT1005	arm	—	—	—	19	—	average−	good	v. good	75	v. good	average	—	good	good	35
Audio Technica AT1100*	arm	—	—	—	8	variable	average+	v. good	v. good	95	v. good	good	—	v. good	good	110
B&O 2200	auto	belt	excellent	v. good	4	—	average	average	good	—	good	good	good	excellent	excellent c	160
B&O 4002/4	auto	belt	excellent	excellent	3*	none	—	excellent	excellent	—	excellent	good	excellent	excellent	excellent c	350
BIC SP75	auto	belt	satis.	poor	12	—	poor	good	good	185	average	average−	average−	v. good	v. good c	160
BIC SP85	auto	belt	satis.	poor	12	—	average−	good	good	180	average	average−	average−	v. good	good c	200
Connoisseur BD2A*	auto stop	belt	adequate	satis.	13	little	average	average	good	140	average−	average+	average+	f. good	good	70
Connoisseur BD102*	auto stop	belt	v. good	satis.	13	little	average	average	good	140	average−	average	average+	f. good	good	85
Connoisseur BD103*	auto stop	belt	satis.	v. good	12	some	average	v. good	good	250	average−	average+	average+	f. good	fair	100
Decca London International	arm	—	—	—	12	some	average	average+	v. good	—	average+	good	—	satis	good	75
Denon DP2500*	manual	q.d.d.	excellent	excellent	10	little	average	v. good	v. good	—	excellent	average	average−	v. good	good	260
Denon 307	arm	—	—	—	10	little	average	good	good	—	v. good	average+	—	v. good	good	125
Denon 309	arm	—	—	—	13	little	average	excellent	good	—	v. good	average	—	v. good	good	115
Dual 506*	manual	belt	v. good	good	7	little	average	good	v. good	175	good	average+	average+	excellent	good c	100
Dual 606*	manual	direct	good	v. good	7	little	average+	good	v. good	175	v. good	average+	average+	excellent	good c	145
Dual 731Q	auto	q.d.d.	excellent	excellent	17	little	average	excellent	v. good	180	v. good	average+	good	excellent	excellent c	260
Dunlop Systemdek	motor	belt	good	v. good	—	—	—	—	—	—	v. good	v. good	excellent	fair	f. good	275
Dynavector DV505	arm	—	—	—	17/50*	some	average	average	v. good	—	v. good	average	—	good	good	230
Eagle 7500	auto return	belt	adequate	poor	14	none	average−	average−	average	—	average	poor	poor	good	good	70
Fidelity Research FR-12S	arm	—	—	—	22	none	average	v. good	v. good	80	excellent	average+	—	v. good	good	180
Fidelity Research FR-64S	arm	—	—	—	35	none	good	v. good	v. good	80	excellent	good	—	v. good	good	250
Grace G707	arm	—	—	—	7	little	average+	good	excellent	—	v. good	v. good	—	v. good	v. good	140
Hadcock GH228D*	arm	—	—	—	5.5	some	good	v. good	v. good	135	satis.	good	—	average−	average	85
Harksound HS210	auto return	belt	good	v. good	11	little	average	average+	v. good	80	satis.	average−	average	v. good	v. good c	50
Harksound HS510	auto return	direct	v. good	v. good	11	little	average	average	v. good	80	average+	average−	average+	v. good	v. good c	105
Hitachi HT32	auto return	belt	excellent	good	17	—	average−	good	v. good	155	good	average	average+	v. good	v. good c	65
Hitachi HT35	auto return	direct	good	v. good	17	—	average−	good	v. good	225	v. good	average−	average+	v. good	v. good c	90
Hitachi HT66	auto	q.d.d.	good	v. good	18	—	average	poor	v. good	155	good	average	average+	v. good	excellent	200
Infinity Black Widow	arm	—	—	—	4.25	variable	average	average+	excellent	65	v. good	average+	—	good	good	120
ITT 8011	auto return	direct	average−	v. good	16	none	average−	average	average	—	average	average−	average+	good	v. good c	96
ITT 8012	auto	direct	v. good	v. good	17	none	average−	average	average	—	average+	average−	average	good	excellent c	110
JBE Series III	motor	direct	average*	excellent	—	—	—	—	—	—	v. good	average+	average	v. good	good	200
JVC LA11	auto return	belt	satis.	satis.	18	little	average	average−	poor	250	average	average−	average	v. good	v. good c	77
JVC QL-A5	auto return	q.d.d.	good	good	14	little	average+	average	poor	75	average+	average−	average	v. good	v. good c	224
JVC QL-F4	auto	q.d.d.	good	v. good	14	some	average	v. good	v. good	—	good	average	average−	average+	excellent	165
JVC QL-F6	auto	q.d.d.	excellent	excellent	15	some	average	good	good	80	v. good	average−	average−	v. good	excellent	250
Linn Ittok LVII	arm	—	—	—	12	none	v. good	excellent	excellent	80	excellent	v. good	—	good	good	230
Linn Sondek LP12	motor	belt	good	excellent	—	—	—	—	—	—	v. good	v. good	v. good	average	good	345
Marantz TT2000	auto return	direct	v. good	good	6.5	little	average−	average−	v. good	135	average	average−	average	v. good	v. good	85
Marantz T 4000	auto return	q.d.d.	satis.	satis.	6.5	little	average−	average−	v. good	133	average	average−	average	v. good	v. good	115

Marantz 6170	auto stop	direct	v. good	good	14	none	average	good	good	—	good	average	poor	good	v. good	100
Mayware Formula 4 III	arm	—	—	—	4.5	some	average+	v. good	excellent	85	v. good	good	—	good	good	50
Michell Focus	mtr + arm	belt	average	good	5	some	average+	average−*	excellent	220	v. good	average+	good	good	good	190
Michell Electrcnic	motor	belt	good	v. good	—	—	—	—	—	—	excellent	average+	average+	good	good	185
Micro Seiki MB10	manual	belt	good	good	14	average	average−	average−	good	200	average	average−	average−	v. good	good *c*	75
Micro Seiki DDQ500*	manual	q.d.d.	excellent	excellent	6-16	—	average+	v. good	v. good	95	excellent	good	average+	v. good	good	300
Micro Seiki DQX1000	motor	q.d.d.	excellent	excellent	—	—	—	—	—	—	excellent	good	average+	v. good	good	450
Micro Seiki MA 505	arm	—	—	—	14.5	none	average	v. good	excellent	—	excellent	good	—	v. good	good	130
Mission 774	arm	—	—	—	5	variable	good	excellent	excellent	180	v. good	v. good	—	average	good	130
Monitor Audio ET500	motor	direct	average−	v. good	—	—	—	—	—	—	v. good	average*	average*	good	good	140
Optonica RP-5100	auto	direct	good	good	13	little	average+	poor	average	75	good	average−	average+	v. good	excellent *c*	100
Philips AF685	auto stop	belt	v. good	adequate	14	none	average	poor	average−	250	good	average−	average−	v. good	good *c*	65
Philips AF677	auto return	belt	v. good	good	12	none	average	average	average+	—	good	average−	good	v. good	v. good *c*	83
Philips AF777	auto return	belt	good	v. good	12	none	average	good	good	—	good	average	good	v. good	v. good *c*	100
Philips AF 77	auto return	belt	v. good	v. good	12	little	average	good	good	—	good	average−	good	v. good	v. good *c*	130
Philips AF829	auto	belt	v. good	excellent	12	little	average+	good	v. good	270	v. good	average	good	v. good	excellent *c*	175
Pickering FA300	auto stop	belt	good	good	10	none	average	good	average	150	good	average+	good	v. good	good	250
Pioneer PL512	manual	belt	v. good	v. good	18	none	average	average	average	150	good	average−	average+	v. good	good *c*	55
Pioneer PL200X	auto return	direct	excellent	excellent	17	little	average	v. good	good	150	v. good	average	average+	v. good	v. good *c*	95
Pioneer PL400X	auto	q.d.d.	v. good	excellent	17	little	average	good	good	150	v. good	average	good	v. good	excellent	145
Pioneer PLL1000	auto	q.d.d.	excellent	excellent	16	none	average−	excellent	excellent	200	excellent	good	average+	v. good	excellent	450
Realistic Lab 250	auto return	belt	average−	good	15*	none	average	v. good	average+	—	average+	average	average+	good	good *c*	85
Realistic Lab 510	auto return	q.d.d.	v. good	v. good	16	none	average	v. good	good	—	average+	average	average	v. good	v. good *c*	180
Rega Planar 2	mtr + arm	belt	v. good	good	16	little	average+	v. good	v. good	75	v. good	average+	average+	v. good	good	99
Revox B790*	auto return	q.d.d.	excellent	excellent	3*	none	average+	excellent	excellent	—	v. good	good	v. good	excellent	v. good *c*	400
Rotel RP300	auto return	belt	v. good	v. good	7	—	average	average	average	100	good	average	average	v. good	v. good *c*	65
Rotel RP6400	auto return	direct	v. good	good	7	—	average	average	average	75	good	average−	poor	v. good	v. good *c*	100
Sansui SR-222 II	manual	belt	v. good	v. good	11	none	average	good	v. good	—	good	average+	average	good	good	69
Sansui FRD3	auto return	direct	v. good	v. good	21	little	average	average−	good	80	v. good	average	average	good	v. good *c*	90
Sansui FRQ5	auto	q.d.d.	v. good	v. good	19	little	average	average	average	75	v. good	average−	average	v. good	excellent *c*	165
SME 3009 II ND*	arm	—	—	—	6*	variable	average	good	excellent	var*	excellent	good	—	v. good	good	60
SME 3009 IIIS*	arm	—	—	—	4.5	—	good	v. good	excellent	var*	v. good	v. good	—	v. good	good	85
Sony PST15	auto return	direct	v. good	satis.	16	—	average	average+	v. good	95	good	average	average	v. good	v. good	90
Sony PSX70	auto	q.d.d.	excellent	excellent	25	little	average	v. good	v. good	100	v. good	average+	average+	v. good	excellent	220
Sony PS-B80	auto	q.d.d.	excellent	excellent	20	electronic	average−	good	v. good	100	excellent	average+	average	excellent	excellent	800
Stax UA7*	arm	—	—	—	16	none	average	v. good	v. good	—	excellent	good	—	average+	average+	135
STD 305S*	motor	belt	good	excellent	—	—	—	—	—	—	v. good	v. good	v. good	good	good	150
Syrinx PU2	arm	—	—	—	8	none	good	v. good	v. good	120	v. good	v. good	—	average	average	200
Technics SLB2	auto return	belt	satis.	good	13	—	average	poor	good	275	average	average	average−	good	v. good *c*	69
Technics SLQ2	auto return	q.d.d.	excellent	excellent	13	—	average	average	good	140	v. good	average+	average+	v. good	v. good *c*	140
Technics SL1700II	auto return	q.d.d.	excellent	excellent	13	—	average	excellent	v. good	85	v. good	good	average+	v. good	v. good	190
Technics SL10	auto	q.d.d.	excellent	excellent	4	—	v. good	excellent	excellent	—	excellent	good	good	excellent	excellent *c*	300
Technics EPA-500	arm	—	—	—	7.5-11	some	good	excellent	v. good	85	excellent	v. good	—	good	good	180
Thorens TD105	auto return	belt	excellent	v. good	8	little	average	good	v. good	300	good	average	average	good	v. good	115
Thorens TD115	auto return	belt	v. good	v. good	8	little	average	excellent	v. good	300	good	average+	good	good	v. good	155
Thorens TD160BC	motor	belt	v. good	v. good	—	—	—	—	—	—	v. good	good	v. good	good	good	108
Thorens TD160S	motor	belt	v. good	excellent	—	—	—	—	—	—	v. good	v. good	v. good	good	good	152
Thorens TD126III*	auto stop	belt	v. good	excellent	8	none	average	v. good	v. good	300	v. good	good	v. good	v. good	v. good	275
Toshiba SRF225	auto	belt	average−	average−	14	none	average	average−	good	—	average−	average−	average−	v. good	good *c*	90
Toshiba SRF325	auto	belt	good	good	14	none	average	average−	average−	—	average+	average	average−	v. good	v. good *c*	100
Toshiba SRF530	auto	direct	v. good	v. good	14	none	average	good	good	—	good	average+	good	v. good	v. good *c*	120
Toshiba SRF440	auto	direct	v. good	v. good	18	little	poor	average−	good	155	good	average−	poor	good	excellent *c*	104
Trio KD1500	auto stop	belt	average	good	20	little	average+	average−	v. good	150	good	average−	poor	good	good	70
Trio KD600	motor	q.d.d.	excellent	v. good	—	—	—	—	—	—	v. good	average+	average+	good	good	260
Ultracraft AC30	arm	—	—	—	9	variable	good	excellent	excellent	95	v. good	good	—	good	good	120
Ultracraft AC300	arm	—	—	—	3.75	variable	average+	excellent	excellent	100	v. good	good	—	good	good	180

NOTE: Tonearms and motor units when assessed for sound quality are perforce used with the best available ancillaries, and may not achieve this potential under less optimum conditions.

Plattermats

It was originally intended to review turntable mats as a separate part of this issue, but closer investigation showed that relative judgments were impossible, because mat characteristics so often formed an integral part of a particular system; thus the substitution of a nominally 'superior' mat was no guarantee of improved sound quality.

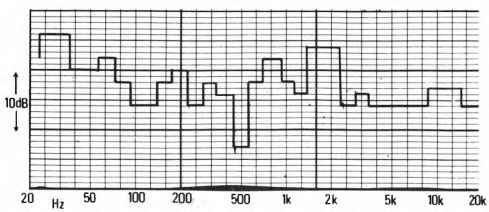
However a test was devised to analyse the frequency absorption properties of mats and so plot these graphically in a comparative fashion, thus permitting discussion of their differences and providing a data base with which to correlate subjective impressions. This test involved a normal standard record with a cartridge resting on the outer third of the radius, subjected to a nominally flat pink noise sound field, covering 30Hz to 20kHz. The cartridge output was equalised to the RIAA spec and plotted.

The reference curve (1) is that of the disc unsupported — that is lifted some 5mm clear of a metal platter by a thick washer at the spindle. The record was then tried on a number of available mat types, ranging from untreated plain metal to plate glass, felt, suede, and finally both hard and soft rubber. The effect of a typical label clamp was also checked.

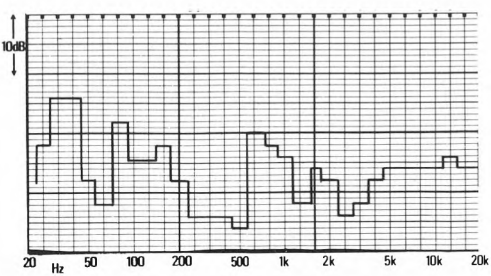
We found that the differences were surprisingly large. For example, as compared with light felt, the glass mat offered a typical 15dB of energy reduction over four octaves from 25Hz. Of course such differences will be diluted in a system context, as the mat's contribution to the sound overall sound quality and balance is probably only around 20% for a top class system, falling to as little as 5% for an average set up. In the latter instance, inherent colorations due to arm, plinth and lid will dominate the result.

Take the case of the Sondek and its well known felt mat. Suppose a system had been constructed around it whereby the mat, player, arm, cartridge, amplifier and speaker were all complementary and produced a satisfying sound balance. The substitution of the soft composition *'Dumpa'* mat would produce a change in sound quality but not necessarily for the better, despite a measured improvement in the 1kHz-4kHz as well as 50-500Hz band. Two reasons for this suggest themselves. The *'Dumpa'* (3) curve is notably uniform in overall distribution, but with the bass hump exaggerated at 30-45Hz, and with the prominence at 600-850kHz potentially audible as an increase in coloration. From the complete system viewpoint, however, the removal of any energy and coloration in areas of the response which previously formed part of the entire system balance could well result in a perceived deterioration of the balance, unless other parts of the system can compensate.

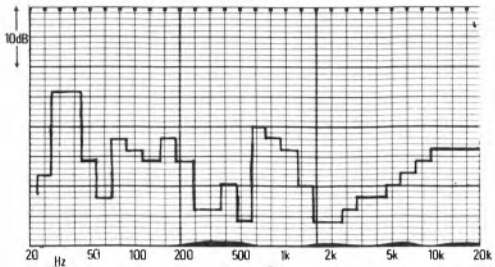
Perhaps dealers who stock and sell the more expensive 'special' mats (one glass mat currently costs around £50) could keep a loan stock and allow customers to try several at home before purchase?



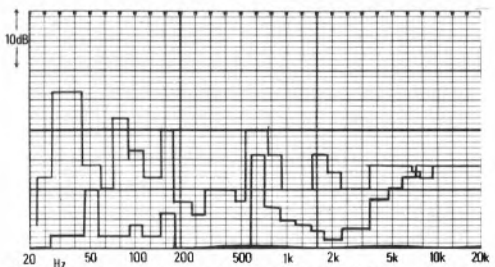
1) The reference trace for the unsupported record was taken and provides a nominal energy level at 64dB (all figures 'A' weighted.) In the circumstances the spectrum was remarkably even, although high 'Q' resonances were averaged and moderated by the $^1/_3$-octave analysis employed.



2) Placement of the record on a plain metal platter (the top surface of a *DQX 1000* without a 'label depression') provided a 6.8dB energy reduction, as well as improvements in the 1.2 to 5.0 kHz range. However contact was clearly imperfect, with the bass damping uneven and potentially more coloured.

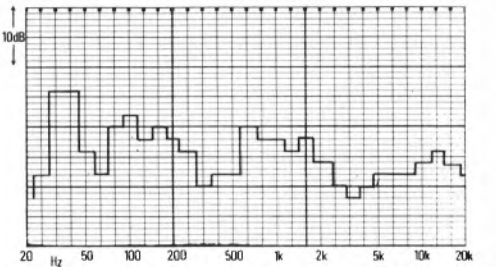


3) The addition of the soft composition *'Dumpa'* mat further improved the upper mid damping, although many of the mats used here were unable to deal with the 630Hz mode, which is thought to relate to the player or arm itself. Improved damping at low frequencies if anything further accentuated the 30-40Hz lift, while the overall noise level was 9.5dB down on the reference.

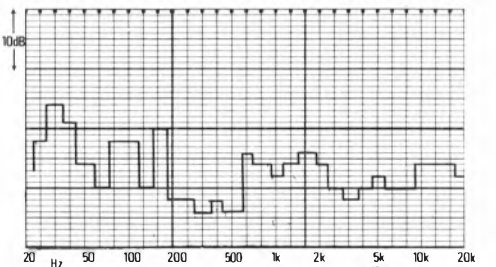


4) This comprised the original Linn type of radially ribbed rubbeer mat, as also used in Rega players for example, and here placed on top of a 10mm thick glass Rega platter. The reduction was 6.8dB with less absorption at upper bass frequencies than (3). (All tests still on *DQX1000*)

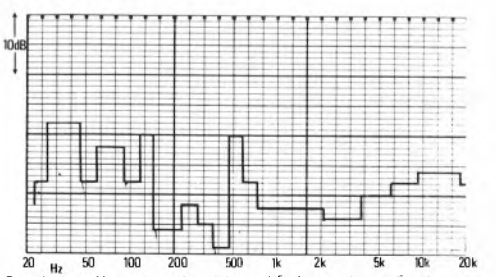
5) This strikingly good absorption result was achieved using a nominal glass mat, in this case a 10mm thick Rega platter, which approximates to the glass mats currently available. A reduction of 12dB was attained, with the 'A' weighting clearly not showing the full benefit at low frequencies. Compared with the rubber mat (4) the following improvements in ⅓-octave bands were noted, namely 12dB at 25Hz; 24dB at 30 and 40Hz; 4dB at 50Hz; 20dB at 80Hz and typically 10dB at higher frequencies of up to 2.5kHz. Disc support and contact was quite good, and the absorption was clearly less effective with imperfect contact on obviously warped discs.



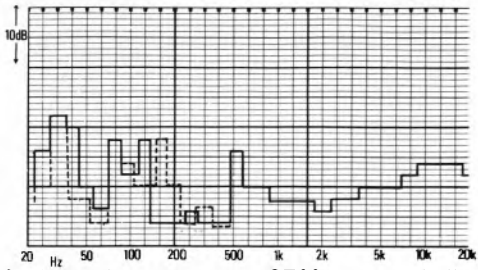
6) A Linn felt mat showed a fairly even 'neutral' character but with less effective absorption at 5.7dB.



7) The older 'Lux' mat — a thin suede covering on medium hard rubber composition — demonstrated quite good control and absorption in the mid and treble with an 8dB reduction, but by comparison with (6) it had little effect on the bass. Matched subjectively with (6), it could sound richer, even 'boomier' on some systems.



8) A medium hard rubber (Ariston but similar to the *Avon*) gave a promising 10dB reduction with good effects in the upper mid and treble. The bass range was quite even although no better controlled, and with token losses at 25Hz and 160Hz.



9) A heavier rubber mat (*SE22*) gave a similar result to (8), namely a 10.6dB loss, although this time with better control at 630Hz; perhaps this is a platter mode in the *DQX1000*?

10) Applying a record clamp (J. A. Mitchell) to (9) produced no change in the 'A' weighted level, but provided improvements of –6dB at 25Hz, –12dB at 40Hz, and –2dB at 50 and 63Hz, as well as some changes from 80-300Hz. Under certain circumstances one might expect to benefit from a clamp, particularly with a disc warp in the right direction, but a 'reverse' warp could only be dealt with by the highly costly Trio rim clamp system.

Conclusions

The final subjective results will be a matter of trial and error, but the test results show that the harder, flatter and heavier the mat, then the better is the absorption of unwanted resonant energy in the disc. Plate glass is conveniently flat, dense and hard, thus filling the bill nicely, though a centre depression to accept the label and disc 'land' is almost mandatory.

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Glossary

Acoustic breakthrough: Sound that gets into the turntable and hence the cartridge from the air and thereby creates a risk of acoustic feedback (see separate entry).

Acoustic feedback: If any sound in the room can find its way through the body of the record deck to the cartridge stylus, then that sound will be reproduced from the loudspeakers, along with the wanted programme material. If too much of this sound from the loudspeakers is picked up by the cartridge in this way then a vicious circle of acoustic feedback will be created.

Arm mass: More accurately called *effective* arm mass, because it is *not* the weight of the arm on a pair of scales. It is the mass of the arm and cartridge combination that appears to be concentrated at, and thus felt by, the stylus tip which is tracking a record groove. There is nothing inherently good or bad about arms with light or heavy effective mass; what matters is the manner and choice of their combination with cartridges of different compliance and the low frequency resonance produced by such combination. See 'resonance'.

Belt drive: The motor has its rotational speed geared down to the required platter speed (33⅓ rpm for LP discs) by a rubber or similar resilient belt which runs round a small pulley on the motor shaft and a large pulley attached to or part of the platter.

Bias: Because the cartridge on a pivotal arm is being drawn across the record surface by the stylus tracking at an angle offset from the pivots, groove friction produces an imbalance of lateral force. Bias is the application of a compensatory lateral force acting in the opposite direction. This can be applied in a number of different ways, for instance by weights on the end of miniature thread-and-arm pulley systems, magnetic loading and springs. Bias compensators are usually adjustable, and produce forces of around 10-15% of the tracking downforce.

Coloration: If an item of audio equipment reproduces one frequency or band of frequencies more efficiently than others, then the reproduced sound will be coloured by the imbalance. Undamped resonances in record decks can produce coloration.

Compliance: The stylus of a cartridge is mounted on a tiny cantilever arm which itself must be resiliently mounted to enable the stylus tip to follow the groove wall undulations. Compliance denotes the degree of cantilever resiliance. Static compliance (ability of the cantilever to move against a fixed force) is in practice less significant than dynamic compliance (when the cantilever is tracking a groove in a resonant condition) and the two can differ noticeably.

Crosstalk: In a stereo system, sound from the left channel should not encroach on sound from the right channel, and *vice versa* (unless intended). Unwanted encroachment is called crosstalk, and in the context of the present report, we are concerned with crosstalk in the cartridge.

Damping: Resonances (see separate entry) can be reduced by careful use of additional material to absorb and damp down the resonant energy. But resonances can never be one hundred per cent damped, and damping may create fresh problems, for instance fresh resonances at other frequencies and excessive friction or weight.

Decibel (dB): A logarithmic unit of comparative measurement used in audio. Decibels are thus not positive units of measurement (like lbs, kilos, or litres) but function in the manner of ratios. A doubling of power (watts) is denoted by an increase in 3dB and a doubling of pressure (sound volume level or electrical voltage) is denoted by an increase of 6dB.

DIN B weighted: Measurements related to turntable rumble are measured in rms (a conventional means of averaging audio signals), and doctored according the the DIN B curve, to bring the results on paper into better correlation with what the human ear actually hears. This is necessary because the ear hears various frequencies differently according to their volume level.

DIN, peak weighted: Wow and flutter measurements are measured by their peaks, and these doctored according to another correlation curve.

Direct drive: This type of motor has one moving part, the platter/centre spindle. The other part of the motor is fixed to the chassis or plinth.

Downforce calibration: Equivalent to tracking weight calibration, and related to any controls provided to adjust the force with which the stylus acts down on the record groove.

Gimbal: A pair of concentric bearings used in pick-up arms to give freedom of movement in the vertical and horizontal planes.

Headshell: On some arms the cartridge is securely mounted in a light casing or headshell, which is itself mounted at the end of a pick-up arm, and is generally detachable.

Hertz (Hz): Also kiloHertz (kHz) — The modern manner of denoting cycles-per-second. 1 Hz = 1 cycle-per-second, and 1kHz = 1000 cycles-per-second.

Lateral friction: The resistance to movement of an arm and cartridge combination in the horizontal plane (ie across a record), caused by friction in its bearings.

Overhang: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm. Usually, such adjustment is provided for in a headshell (see separate entry). Overhang adjustment effectively controls the lateral angle at which the stylus tracks the groove.

Resonance: Any article 'rings' or 'sounds' at a natural resonant frequency when vibrated. So, all parts of a record

deck may exhibit resonance. The main resonance of an arm is the low frequency at which it resonates when the cartridge stylus is resting in a record groove supporting a compliant cantilever.

Rumble: The low or medium frequency sound produced mechanically by any moving parts in a turntable, mainly the motor and platter bearings.

Speed accuracy (absolute): The ability of a record deck to rotate the turntable at a speed which conforms with the required speed (e.g. $33\frac{1}{3}$ rpm for LP disc). Error is expressed in percentage. The ear is relatively insensitive to absolute speed errors, as long as they are constant.

Speed drift: Any temporary variation up and down from the required rotation speed of the platter will create wow and flutter in the reproduced programme (depending on the frequency of the up and down variation). The ear is very sensitive to such changes.

S-type arm: A pick-up arm which is bent into a loose S-shape to minimise tracking error. (Alternatively the arm is straight and the cartridge or headshell is attached to its end at an angle).

Template: A plan or pattern to assist in correctly locating the pivot of a pick-up arm with respect to the platter centre.

Tracking error: The discrepancy between the truly tangential angle at which a record is cut and the slightly off-tangential angle at which it is tracked by a stylus on a pivoted arm during some parts of the arm's travel.

Vibration/Shock sensitivity: A purely *ad hoc* assessment of the susceptibility of the system to disturbance at very low frequencies; ie. jolting, springy floorboards etc.

Deck recommend Dealers recom

BEDS. Tavistock Hi Fi, 35 Tavistock Street, Bedford. Target Electrical, 45 Catherine Drive, Dunstable. BERKS. Reading Cassette, 6 Harris Avenue, Friary Street, Reading. Sewards, Boutlon Road, Reading. Sonics Hi Fi, 35 Alexander Road, Windsor. BUCKS. Hi Vu Electronics, 38 Church Street, Wolverton. Unique, 16 Queenmere, Slough. Technosound, 55 Silbury Arcade, Secklow Gate, West, Central Milton Keynes. CAMBS. C. Speechley, 1 Hawthorn Way, Cambridge. CHESHIRE Cobalt Hi Fi, 106 Bridge Street, Warrington. The Hi Fi Centre, Greenlane, Wilmslow. Swifts Wilmslow, 5 Swan Street, Wilmslow. Hardman Radio, The Forum, Northgate Street, Chester. Regus Stores, 68–72 Lower Hillgate, Stockport. Peters Electrical, 2–6 Charles Street, Hoole, Chester. CLEVELAND Alcatronics, 110 High Street, Redcar. Boro Electronics, 118 Borough Road, Middlesbrough. CUMBRIA Chi Delta, Furness House, Barrow-in-Furness. DERBYSHIRE Baskills, Bridge Street, Clay Cross. Stuart Westmoreland, 67 St. Peter's Street, Derby. 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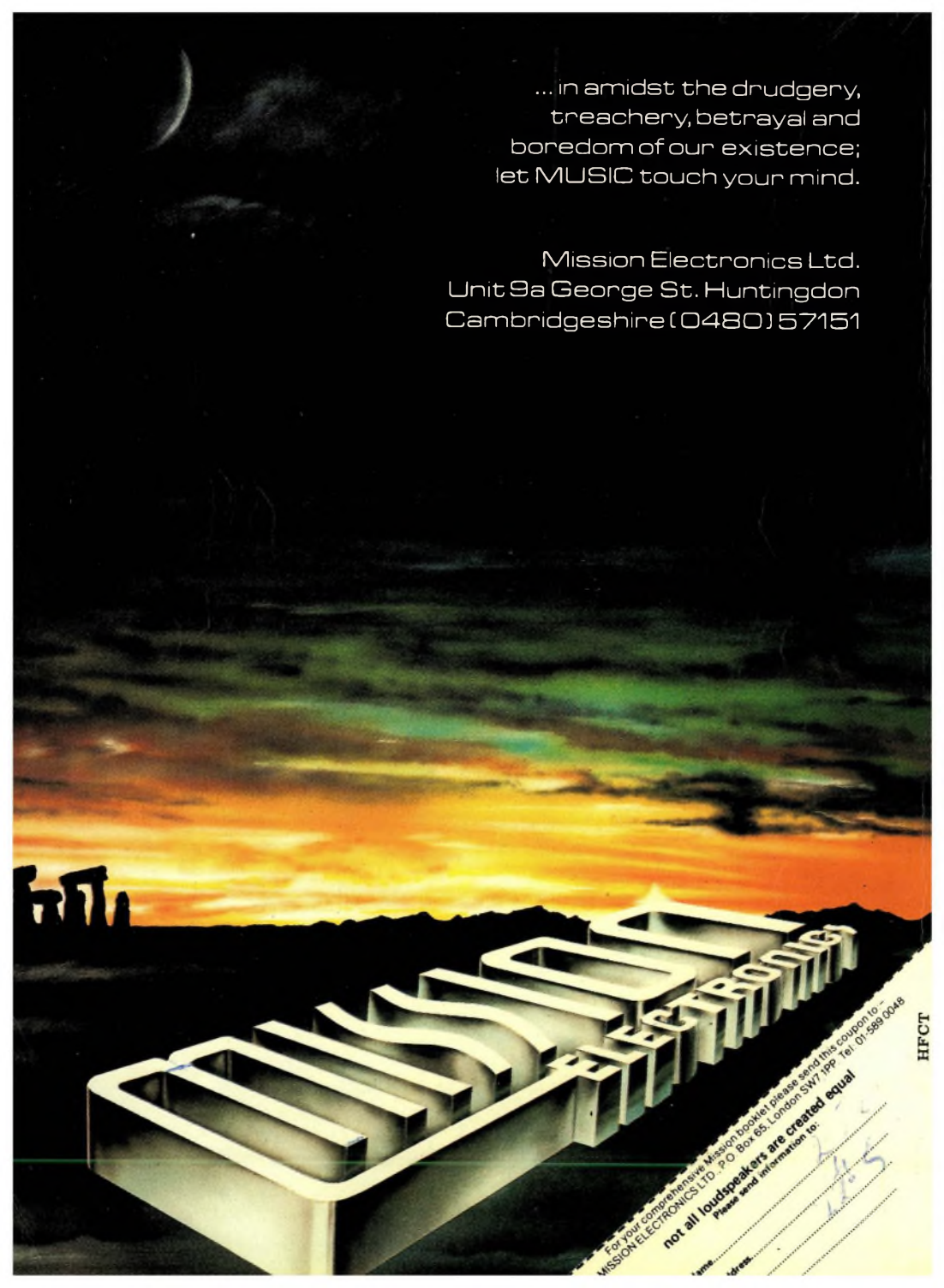
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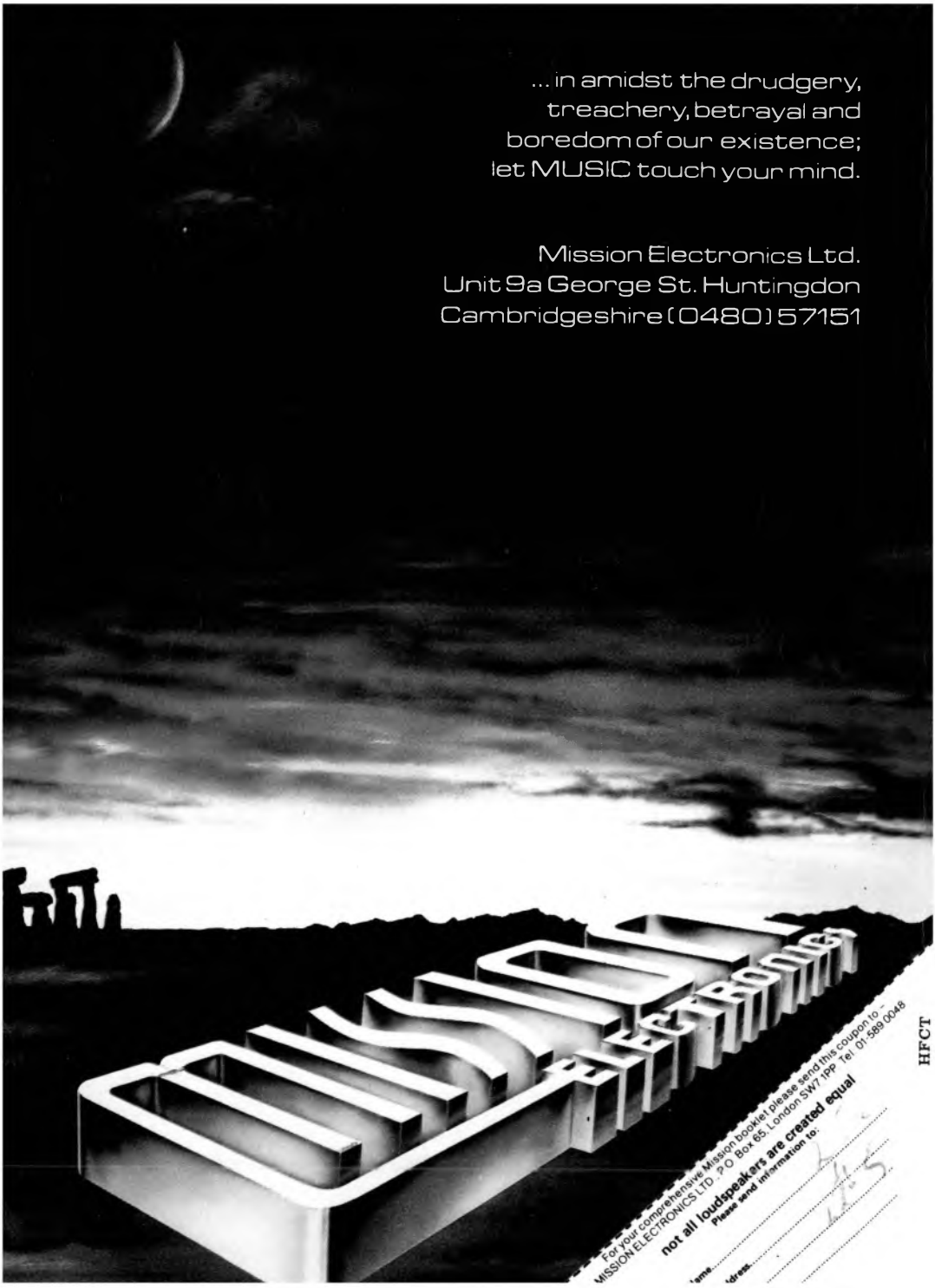
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