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**HI-FI CHOICE No 30**  
**Turntables and Tonearms**

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**CONTENTS**  
**by Martin Colloms**

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|                               |     |
|-------------------------------|-----|
| How to use this book          | 5   |
| Editorial Introduction        | 7   |
| Consumer Introduction         | 9   |
| Technical Introduction        | 23  |
| Turntable and Tonearm Reviews | 34  |
| Summary Reviews               | 203 |
| Conclusions                   | 207 |
| Best Buys and Recommendations | 213 |
| Overall Comparison Chart      | 218 |
| Platter mats                  | 221 |
| Compact Disc: Introduction    | 225 |
| Compact Disc: Test Report     | 227 |
| Product Index                 | 237 |
| Glossary                      | 239 |

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# HOW TO USE THIS BOOK

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Each edition of the Hi-Fi Choice series is designed to provide the most comprehensive examination of models in a given hi-fi product category. This page is a guide to the chapters which give background and conclusions.

Every *Choice* project involves extensive lab testing and generates a considerable amount of data. The introductory sections are arranged so as to make the tests and conclusions accessible to the general reader, and at the same time informative to the more technically-inclined.

The **Consumer Introduction** (written by Paul Messenger) is an attempt to deal with the essential considerations of disc replay and record deck design in strictly non-technical language, also providing guidance for those who would like to make the best possible use of the book 'starting from scratch'.

The **Technical Introduction** describes the tests which were undertaken and explains why particular measurement techniques have been used. Many of the traditional measurement techniques used to assess turntables do not give fine discrimination between models, and may not reflect the differences which can be heard under controlled 'typical use' listening-test conditions, and consequently we have striven to develop more sophisticated techniques to give more meaningful results. This in itself has pitfalls, as there are still no 'standard' test conditions for some aspects of performance – such as the turntable's sensitivity to the environment in which it is used, which can dramatically affect the performance of a system in ways which are often unpredictable. Successful interpretation of some of the data requires considerable experience of the different mechanisms that can combine to produce the results shown, so conclusions should be drawn with caution and in the light of the interpretation.

**Reviews** of course make up the biggest section of the book and in each case include description, test data and interpretation thereof in sufficient detail to allow necessary qualifications to be made. While we attempt to assist buyers by using a 'recommended' flash and summarising our results elsewhere in the book, it must be stressed that this does involve a degree of over-simplification.

Although we have covered as many products as possible in the reviews, we have also included a short section of **Summary Reviews**, allowing brief coverage of models tested in earlier editions which should still be available but which for space reasons could not be reprinted in full.

**Conclusions** is an important section which discusses the findings of the project in general terms, and amplifies on some of the crucial aspects of the test programme in view of the results obtained from the different designs.

**Best Buys and Recommendations** picks out designs in different price brackets which appear to us to offer a good overall performance for the price asked. In fact, as with the last 'Turntables' issue, we have refrained from setting out specific Best Buys, for reasons hinted at above. Naturally our recommendations are based on our interpretation of the relative importance of different aspects of performance and the reader should decide how these coincide or conflict with his own requirements and assess our 'value for money' conclusions in this light. Our findings are based on the prices available as we go to press, and of course any variation in price subsequently must be taken into account.

Separate tonearms and motor units are necessarily assessed in combination with the best ancillaries and will clearly attain the performance as assessed only when used under such conditions. We have tried to give as much information as possible on the technical and subjective matching of components to produce complete player systems, and have included a selection of suggested player combinations too.

The **Overall Comparison Chart** gives an 'instant' comparison of the main points made in the review. It should be useful when seeking to shortlist models with particular features or characteristics.

A short feature on **Platter Mats** investigates the often obscure effects which different mats can produce when used on many turntables – the audible results can be quite significant.

Finally, we come to **Compact Disc**. After a brief introduction, the test report on Compact Disc players looks at the performance of all the models available to us by the time of going to press (though we must point out that some of these were pre-production samples) in comparison with each other and with conventional LP analogue reproduction.

At the back of the book will be found a **Product Index** listing all the models reviewed, and a **Glossary** which we hope will save the reader from being baffled by the inevitable technical terms used in the book!



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# EDITORIAL INTRODUCTION

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**For this, the fifth Turntables and Tonearms issue in the Choice series, we aimed to represent the current hi-fi turntable market from the most esoteric separate components down to the most basic complete players.**

With this edition, we have continued the policy of including as many of the refined or innovative products of specialist manufacturers as possible, but at the same time have managed to cover rather more of the 'mass market' models than last time. In the last two years there have indeed been some innovations from those firms which aim at a more general market – particularly in the increasing number of linear-tracking compact or 'jacket size' turntables offering convenience in uses as well as saving space.

In the more rarefied strata of the specialist hi-fi scene there has been no shortage of new product or new ideas either. From the smaller British manufacturers have come several worthy new competitors to add to an already long list of quality designs. Also, many products which were first reviewed in the last edition have been revised and improved so that this time they had to be regarded as virtually new models and these have been completely reassessed. In some cases the process of research and refinement is almost continuous, and inevitably by the time we went to press we became aware of one or two changes 'in the pipeline', which may significantly change the performance attainable from certain models in the future. Where possible we have warned of impending alterations at the end of the reviews concerned. While the continuing improvement of products is of course a very healthy process which ultimately benefits the consumer, it can be a little frustrating for the reviewer – although at the same time it is heartening that many manufacturers do react to constructive criticism. As always, we can only comment on the samples we receive, and although we have done our best to be flexible in accommodating subsequent changes during the course of preparing the book, the purchaser is advised to try to confirm our findings rather than to assume that his sample will necessarily be identical to ours! We cannot stress too strongly the importance of going to a good dealer and listening for yourself.

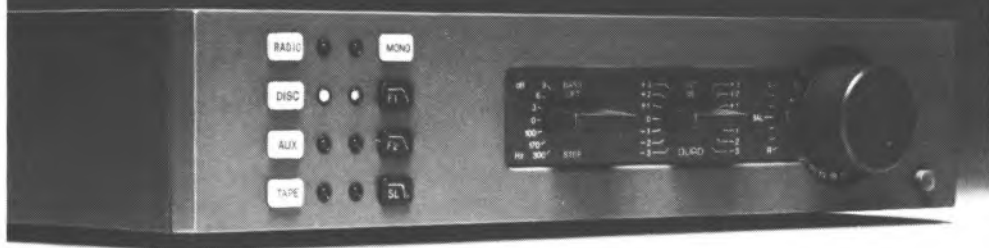
With separate motor units and arms, mechanical subtleties can make or mar a product's ultimate sonic performance, and hence its relative acceptance in the extremely competitive hi-fi market of today. By the same token, turntables probably still arouse more controversy and debate than any other part of

the hi-fi chain, and the irreconcilable differences of opinion among manufacturers, dealers and reviewers, arguing on both theoretical and subjective grounds, are enough to make consumers (let alone editors!) despair. In this situation the *Choice* approach to turntable reviewing can claim the advantage of consistency at least, for all models are tested in a controlled manner under the same conditions. While we would concede that there is still plenty of room for debate on the relevance and viability of certain aspects of turntable testing, the techniques used in *Choice* are the result of many years of experience and experiment – and that experience, gained in the examination of multitude of designs, hopefully has enabled us to avoid misinterpretation of turntable or arm behaviour and to give every product the fairest possible hearing.

Hi-fi by definition demands a striving after 'perfect' reproduction of recorded sound, and how far away the best (or the worst) products now are from that goal may well be regarded as a matter of individual perspective. In *Hi-Fi Choice* the references for performance standards have always been created by the products available rather than by some imaginary absolute – and in the specialist field at least the general standard is improving all the time. This means that we have had to effectively downgrade our recommendations on some models previously tested, as they have become less attractive in the light of recent competition. On the other hand, while the very low priced 'rack system' type turntables appeared for some years to be getting worse every season – cost-cutting by manufacturers tending to produce flimsy plinths and unsatisfactory arms – the rot seems to have stopped here in some quarters at least, as there are now some very cheap decks which offer surprisingly good sound considering their price. The rush to compete with the Technics range of jacket-size decks has however produced rather mixed results.

While nobody pretends that the analogue LP is going to become obsolete without a very long swansong, digital audio has at last come upon us in finalised and reviewable form. For this issue we looked at several Compact Disc players and have at least made a start on an assessment of this new sound carrier.

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# CONSUMER INTRODUCTION

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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 sep-

arate 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 undesirable; 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-



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# CONSUMER INTRODUCTION

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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.

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# CONSUMER INTRODUCTION

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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

unwanted 'microphone' that will promote feedback. Turning to the pickup arm, it is necessary 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 undesirable 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



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# CONSUMER INTRODUCTION

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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 technique 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 the 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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# CONSUMER INTRODUCTION

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grandmother or the baby-sitter attempting to operate it, so its suitability 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

# CONSUMER INTRODUCTION

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.

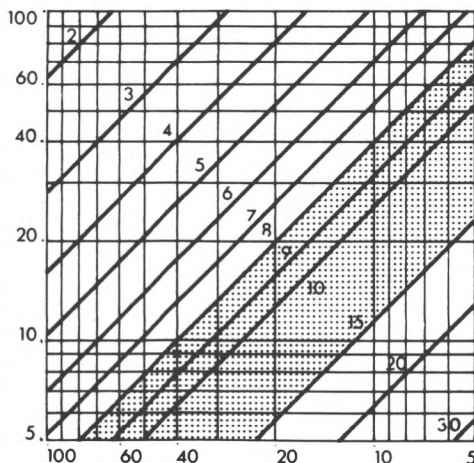
Getting back to the real position of the cartridge, stylus, and groove, we should get little relative movement and hence output below resonance, substantial output and possible tracking problems at resonance, and 'normal' output corresponding to the groove modulations above resonance. Now we are obviously 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.



# CHOICE HI-FI.



## The Esotec Series PM6.

Esotec is the crème de la crème.

Shown here is the Esotec stereo pre-main amplifier which offers class A or class AB operation.

In class AB mode it delivers 120 watts per channel RMS of high speed amplification. In class A mode it delivers 30 watts per channel RMS of silky smooth supreme fidelity.

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to complement the best cartridges available today.

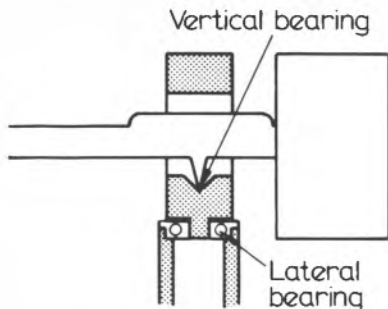
Naturally such equipment is not available in every hi-fi store. We make precious few of them but we make each one very, very well.

For further information on Esotec equipment contact us direct on the Freephone number below.

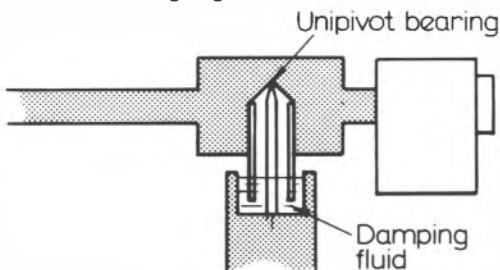
**ESOTEC** SERIES  
**marantz.**

# CONSUMER INTRODUCTION

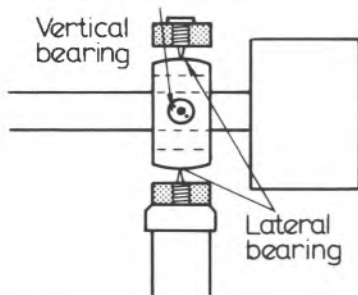
## THREE TYPICAL ARM BEARING TYPES



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 independent 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 undesirable 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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# CONSUMER INTRODUCTION

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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 intrinsic 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 undesirable 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'.

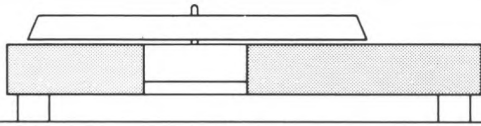
One cannot at this stage make definite assertions about the 'correct' approach to these situations, but evidence does suggest that systems resolving the most musical detail couple the cartridge closely to the arm tube, avoiding resonances as much as possible, and provide the finest bearings to transmit 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

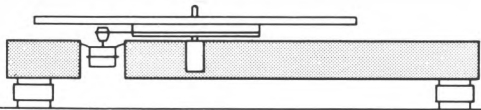
Pickup arms tend to use a limited number of engineering principles, and designers or their advertising agencies can be fiercely partisan about their chosen approach. It is true that some outstanding no-compromise systems can work extremely well for some people, but others may not find them to their taste 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.

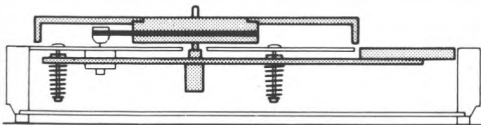
## THREE TYPICAL TURNTABLE DESIGNS



**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.**

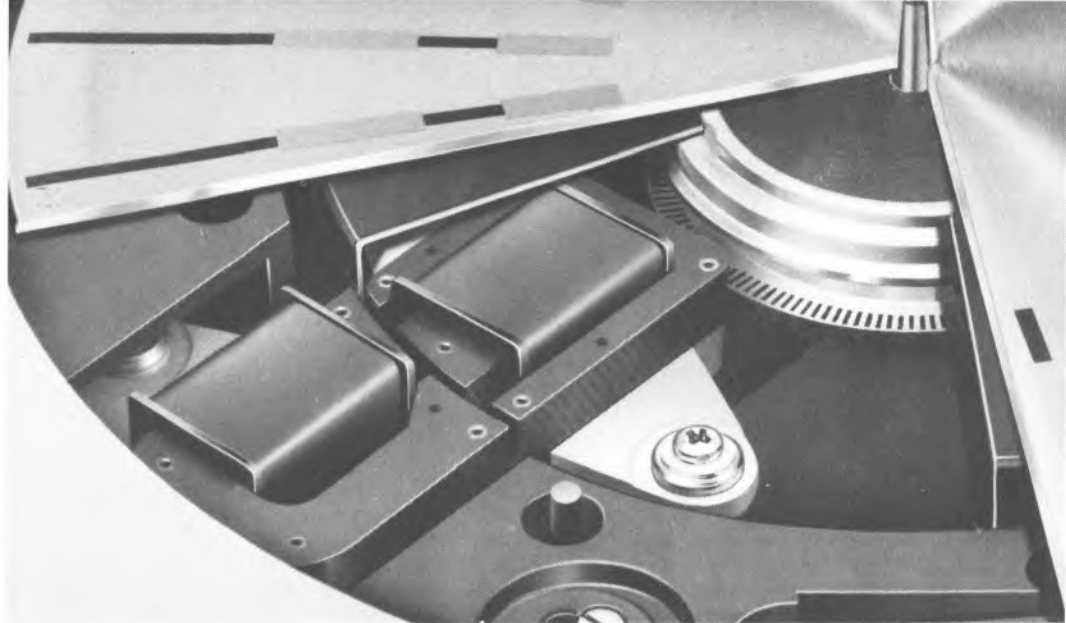


**3. A decoupled sub-chassis/belt drive system offers good environmental and motor isolation. The entire suspended section is shaded.**

## 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.



## Direct drive is good enough for some decks. But not for ours.

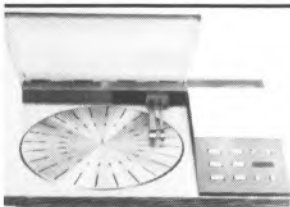
Just imagine, if you can, a record deck that has the best of everything – arm, pick-up, speed accuracy, suspension etc. – but no motor. Imagine that the turntable is moved by some mystical means that involves neither heavy bearings, moving parts, nor any physical contact with the platter. How would this affect performance? You would get no motor noise for a start. No motor vibration. No age-related deterioration. No problems with the hum fields every electric motor produces. Overall, an excellent net loss!

Now dismiss your dream and face reality. A close second to this ideal deck actually exists, with a contact-free drive system that is fact, not fantasy.

The system – called tangential drive – uses the elementary law of physics that says any current-carrying object placed in a magnetic field will experience a force

that will cause it to move. Like the wheel of an ordinary electricity meter (which works by the same law) the platter rotates, silently and accurately, for as long as the magnetic field is maintained by current passing through two adjacent coils.

Tangential drive is only one of several unique features built into the Beogram 8002. Microcomputer technology adds machine intelligence that makes operation quick, easy and foolproof. A patented suspension system eliminates interference from external knocks and vibration. Ultimate tracking precision is ensured by the servo-controlled tangential tone arm, made of hard-drawn brass, carrying the latest MMC 2 pick-up with its unframed contact-line diamond and miniaturised design (see detail pic. below) which allows a total cartridge weight of only 1.6 grams.



Computerised control system allows one-touch automatic operation with pause and multi-repeat functions. Actual speed registers on digital readout. Fast and slow arm scan for inner track play. Manual over-rides for non-standard disc speed/size and record cleaning.



Rumble > 75dB DIN weighted. Wow/flutter <math>\leq \pm 0.02^\circ \text{ WRMS}</math>. Speed deviation <math>\leq 0.03\%</math>. Pitch control gives  $\pm 3\%$  speed variability. Vertical tracking error <math>\leq 0.04^\circ</math>. Channel separation > 25dB/1kHz. Frequency response 20-20,000 Hz  $\pm 1.5\text{dB}$  ETM 0.3 mg.

See and hear the Beogram 8002 in action by visiting your local Bang & Olufsen dealer (he's listed in Yellow Pages under Television and Radio Shops) or write for free Design Story to us, Bang & Olufsen UK Limited, Dept HC4, Eastbrook Road, Gloucester GL4 7DE. Telephone (0452) 21591.

# Bang & Olufsen



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# TECHNICAL INTRODUCTION

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This is the fifth edition of *Turntables and Tonearms* to appear in the *Hi-Fi Choice* series. The review format and product content was adjusted in the last edition to take account of changes in the UK scene — for example, a higher proportion of upmarket product was included than previously and where appropriate, extended analysis and more detailed listening tests were carried out. By this means the depth and quality of the reviews was generally improved, although at the inevitable expense of a small reduction in the quantity of the new product assessed. This edition continues with a similar policy. Many products included last time have undergone revision or improvement over the past eighteen months, and these appear again in extensively revised or as completely new reviews.

We have tended to limit the number of integrated turntables of rack- or music-system orientation, and while a number of budget models are included down almost to the £50 price level, the main content is composed of the better-sounding separate components which include many fine UK designs.

## LABORATORY TESTS

Once again we can claim improvements in laboratory technique which continue to provide greater discrimination between products, and bring us a trifle closer to understanding and perhaps predicting the sonic performance from the technical data. It must be stressed however that the total performance and operating interaction that occurs in a turntable is very complex and not amenable to simple analysis, and listening tests will continue to play a vital part in product assessment. It is easy to hear turntable faults despite the poor quality of some discs, because the player faults are distinctly different. The failings of a weak turntable will pervade all the pressings it reproduces; a characteristic which will soon fatigue the listener.

## Turntable systems

Returning to analogue turntable systems, tests have been devised to bring out, as much as possible, aspects relevant to sound quality. Only in the most simple and obvious cases do conventional measurements such as those for wow and flutter and rumble etc have much relevance to subjective quality. For example, peruse the figures for any modern turntable with pretensions to quality: rumble and wow figures are quoted which surpass even our test

methods, and which are below audibility thresholds; yet in practice these tell nothing about sound quality of the deck in question if experienced and perceptive listeners are involved.

Assuming that a turntable's sound quality *does* matter, we can then consider a number of subtle parameters which are notably difficult to quantify. For example, stereo imaging can be flawed in terms of both clarity and the ability to reproduce depth, due to instability in subchassis systems or unwanted energy input to the cartridge; the low bass range may be weakened due to incipient feedback cancellation, and its upper registers appear boomy and emphasised for the same reason. Mid-range quality can be coloured due to the resonances in lids, plinths, and their supports, as well as arm mounting boards, disc support (mats etc), platters and subchassis structure. Low mass platters are easily excited in acoustic terms, and they tend to suffer the greatest vibration amplitudes in a heavy plinth system; rotational inertia is also small, and under recorded modulation variations, dynamic wow can occur as a result of stylus drag changes.

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

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

# TECHNICAL INTRODUCTION

excess lateral drag, impairing isolation and worsening vibration rejection; finally the belt-subchassis mass resonance may become involved — a factor usually kept at bay due to a minimal belt tension consistent with good drive.

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

However we have found it dangerous to use the *Sondek* as a reference turntable for comparative auditioning, due to its unique character and sonic balance. Other decks can sound equally as good, if not better in certain respects, but cannot be made to sound the same, and that difference can often be a source of confusion to the listener. For example, it can be shown technically that a felt mat is far from ideal and endows a turntable with a recognisable character. But remove it from a well set up *Sondek* equipped with the matching *Ittok* and *Asak*, replacing it with a 'better' mat, and the overall sound in subjective terms is generally the poorer for the substitution.



*Breakthrough calibration signals: above soundfield (acoustic); below, acceleration (platform vibration) (1in freq; log amp).*

## Acoustic and vibration isolation

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

## Tonearm resonances

Tonearms possess an ability to flex and resonate in the audio bandwidth, and are therefore a potential source of coloration, due to their close coupling with the cartridge. Less severe with high compliance models, these resonant effects are most marked using close-coupled, less compliant moving-coil cartridge, the Dynavector *10X*, used to illustrate resonant interactions with the tonearms we tested, being an example of the latter. Its compliance measured  $18 \times 10^{-6}$ cm/dyne (18cu), and the acceleration in the side of its die cast body resulting from a lateral sweep 20Hz-20kHz (*TRS1007*) was sensed by an ultra low mass wide-band accelerometer (*B&K 8307*) which records both bending and torsional modes in fair proportion.

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

Ideally the arm should be infinitely rigid, to perform the task of supporting the cartridge accurately with respect to the record groove throughout the frequency range. At the same time the bearings, while free of slackness, must be of sufficiently low friction not to impede the progress of the stylus across the record, or affect its ability to ride warps and

other related imperfections. Play and lack of rigidity in a tonearm not only colours the sound through audible resonance, but this very imprecision also upsets the cartridge groove relationship, adding spurious intermodulation interference over the whole frequency range, and detracting from clarity and the quality of the stereo image.

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

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

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

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

## **Arm effective mass and arm/cartridge subsonic resonance**

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

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

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

Theoretically, a system resonance in the 9-12Hz range with a rise of 5-10dB currently provides the best compromise.

## **Low frequency sound quality**

Really clean bass from a turntable is impossible due to the compromises involved in the complete recording/reproducing chain. For example, as mentioned in a previous issue, twelve low frequency filters are typically present between the original sound and the listener. Those we can pinpoint easily are those due to the loudspeaker itself, the amplifier and the cartridge/turntable combination, and to these we can add the disc cutter, the low frequency filter in the cutter amplifier and the magnetic head on the studio recorder. If a multitrack recording is involved, then several tape stages may also be present, while the microphone capsule plus its preamplifier are also 'in line'. So far we have ten or so filters in cascade (or additive condition); now we can include the small audio transformers used for balanced line coupling of the vast majority of studio equipment namely microphones, noise reduction systems, such as *Dolby A* and *dbx*, equalisers, echo, mixers etc. At best we can add five roll-offs due to the LF limiting frequencies of these transformers; at worst some

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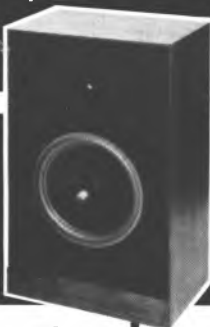
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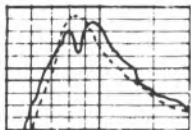


Fig. 2. Linn/Breuer resonance interaction: sub-chassis free (solid) and clamped (dotted).

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.

## 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.

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

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

On theoretical grounds it can be argued that a sufficiently low rumble level for direct inaudibility may still not guarantee complete freedom from other rumble induced effects. Whether directly audible or not, any unwanted or spurious displacement due to platter main

bearing inadequacy or out of balance motor torque effects will interfere with the accuracy of groove/stylus tracing. After all DIN B rumble is only an arbitrary weighted curve approximating to the directly audible sound of rumble noise. With the help of the 'coupler' we have discovered that while a  $-72\text{dB}$  DIN B figure was in some instances insufficient to guarantee inaudibility, with others measurements as poor as  $-66\text{dB}$  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  $-7\text{dB}$  DIN B region (power off, motor free-wheeled). Reconnection of the supply resulted in degraded figures, not due to hum, but generated by the torque pulses in the motor. This interference was also observed with at least one belt drive design, the source being readily traced to poor isolation of motor vibration from the arm base.

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

## Wow and Flutter

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

By comparison with previous results this method yielded 20-30% higher readings with commensurately greater accuracy and consistency. Linear peak readings were also taken for wow below 6Hz, as well as for flutter above this frequency (with a poorly damped arm/cartridge subsonic resonance these measurements can be in error and accordingly a Shure

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# TECHNICAL INTRODUCTION

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V15/V with damper was mainly employed for the flutter tests, in place of the Dynavector). The finest example recorded 0.04% DIN peak-weighted (sigma 2), and this level is probably close to the residual flutter on the test disc itself. Therefore models reading 0.05% or below are simply quoted as measuring less than 0.05%. Denon claim very low wow and flutter measurements using a magnetic shaft encoder a derivative of their magnetic pulse speed control method encoded on the platter rim.

While still on this subject it is particularly interesting to note that some 0.1% unweighted peak wow can be produced by an off-centre displacement of the record of as little as 1mm which can be the result of poor record manufacture, an oversized or inaccurately placed centre hole (the standard specifies 7.24-7.33mm diameter) or even an under-sized turntable spindle. For an off-centre record rotating at 33 $\frac{1}{3}$  rpm, the wow frequency is 0.5Hz approximately, a rather slow rate.

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

A few degrees of cartridge misalignment will degrade the channel separation of a high class

cartridge by a factor of some 15dB, but on the other hand it will produce relatively little impairment of the already moderate separation characteristic of a less expensive pick-up. At present the importance of accurate arm alignment is highly underrated. 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 pick-up arms, as these have an array of parallel lines against which the cartridge side face can be aligned when the stylus point is in a specified position. However the majority of protractor cards (SME and its counterparts) have a stylus point at a 6cm radius from the spindle, working on the basis that the optimum tracing distortion trade-off will thus be obtained, if using a traditional spherical stylus and a mix of 45 rpm singles and 33 $\frac{1}{3}$  LPs. In practice, this is not the best solution for the mean music radii of today's 33 $\frac{1}{3}$  LPs (45s discounted), particularly if used with the now almost universal elliptical and line/hyperbolic styli supplied with hi-fi cartridges.

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

Aside from matters of mass/compliance 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

# TECHNICAL INTRODUCTION

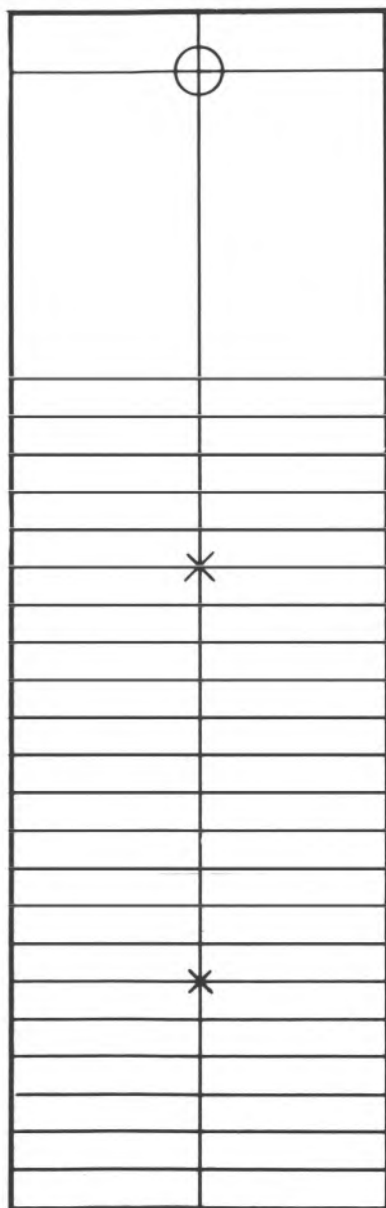
accurately aligned perpendicular to the record surface; hopefully this is ensured when the cartridge body itself is truly vertical when viewed from the front. Small degrees of tilt of the order of  $1^\circ$  may again degrade separation, and vertical alignment is particularly important with Shibata 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 measures  $20^\circ$  but in practice it is closer to  $23^\circ$ , and if this is not maintained, the stylus side contact line will rake across the cut groove axis at an angle, distorting the playback. Unfortunately it is not enough to simply ensure that the top surface of the cartridge is parallel to the record, as some cartridge manufacturers are not wholly consistent and many pickups when set visually parallel have cantilever/generator axis 'rake angles' as great as  $40^\circ$ .

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  $35^\circ$  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  $1-2^\circ$  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



Alignment protractor (see 'Lateral tracking angle alignment').



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for the arm dimensions. It must be admitted that these shortcomings are not wholly of the manufacturer's making, but reflect the inaccuracy of the disc playing system, which is so 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!

While the laboratory tests in this book essentially match those of the fourth edition some equipment changes have occurred which alter the presentation of certain graphical data. Previously the double spectrum photographs — for rumble electrical (a) and total (b), and for isolation and breakthrough acoustic (a) and vibration (b) — were presented on an 80dB total scale range, with 10dB per vertical amplitude division. By comparison the new graphs are compressed with the total vertical scaling now at 120dB. In consequence, the imperfections or bumps, as it were, look smaller and need to be scrutinised with greater care. Unavoidable substitution of the arm resonance drive cartridge, due to cantilever failure, has also altered the look of the arm resonance graphs and some loss of low-frequency analysis is apparent. Dynamic range problems with the low output micro-accelerometer continue, but nonetheless much useful information on arm resonances remains. For the cartridge responses, the JVC TRS1007 test disc was used, with the manufacturers' recommended loading. Of necessity the cartridge assessment was relatively brief — this area being the prime responsibility of the Hi-Fi Choice Cartridges and Headphones edition.

## SUBJECTIVE TESTS

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

Conceding that a firm and neutral extreme low frequency range performance was difficult to achieve in my calibrated listening room, and also that its tonal balance was somewhat

closer to a recording studio than many typical domestic listening rooms, we took the opportunity to use Studio 99's new 'Concert Room' listening facility at Swiss Cottage. Their (Naim) tri-amped Linn *Isobariks* were chosen as providing the cleanest low frequency delivery at good power levels, and were employed for the auditioning of a considerable proportion of the front rank models, in order to further aid their differentiation and classification.

The "Concert Room" is rather unforgiving, showing an airy, light and bright character, tending to excess treble, but at the same time offering a spacious and relaxed perspective with exceptional low frequency solidity and attack. Since the Linn player was included care was taken to assess and account for its special performance in an environment to which it was arguably more suited than any other player. Consequently the use of the *Sondek* as a reference was avoided as far as possible.

For the latest edition, those earlier tests were backed by a more extensive auditioning in my own listening room. KEF *R1054* loudspeakers, stand mounted in free space were extensively used, in conjunction with the Quad *ESL63*, Spendor *BC1* and Celestion *SL6*. Amplification included the Lentek, used as a pre-amplifier in conjunction with the Mission power amp, plus the Sony *Esprit* pre- and power-amp combination. Test cartridges comprised the *Linn Asak*, *Koetsu Black*, *Kiseki Blue*, *Dynavector Ruby* and a pair of *Osawa 60Ls*, with the moving-magnet examples including the *Shure V15 V*, *Technics EPC205111* and the new *B&OMMC2*.

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

My own conclusion is that there is no such thing as a universal high performance motor unit, since the consequences of leaving other matters of disc support, arm and cartridge in someone else's hands usually prejudices the end result. I believe that a very limited number

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of options exist for each model to provide a top class performance, and we have tried to identify these, albeit in a limited fashion, for as many models as possible.

## DIGITAL DISC 'CD' (Compact Disc or DAD)

A sprinkling of CD players were loaned to us for assessment, these being supplied with the well ahead of their launch date to allow inclusion in this issue. It was too early to obtain the software necessary for technical tests to be carried out and so we were forced to limit their appraisal to one of features and facilities backed by an assessment of sound quality. Certain of the units were unquestionably handmade prototypes and exhibited minor faults — but obviously they should not be prejudiced on these grounds.

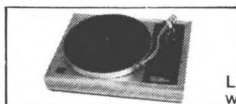
Fortunately the music test records supplied had a number of popular works which were already in available in analogue (conventional LP) form. The test framework was obvious — compare the digital record players with the conventional ones, using the same pro-

gramme! To this end the finest turntable/tonearm/cartridge combinations were pressed into service and battle commenced. In addition, wide-band programme spectral analyses were made for the digital and analogue reproductions. The results are in the reviews and the final conclusions.

## ACKNOWLEDGEMENTS

Many thanks are due to Paul Crook, my assistant on this issue; to Marianne Colloms for her help in checking and typing copy, and to the listeners involved in auditioning the product in this and the last issue; Paul Messenger, Alar, McGechan, Steve Harris, David Praker, John Atkinson and Paul Crook. Thanks are also due to the following manufacturers for the special loan of product to aid evaluation: Acoustical Manufacturing Co Ltd (Quad ESL63); KEF (105:4), Celestion (SL6); Sony (*Esprit* amplifiers) Mission Electronics (amplifiers) and Absolute Sounds (Koetsu). Thanks to Audio T, our local dealer, who also loaned equipment.

## South East Audio



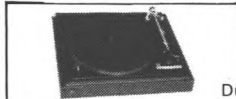
Possibly the best front-end on the market, the LP12 is also available with the LVX and LVV arm.  
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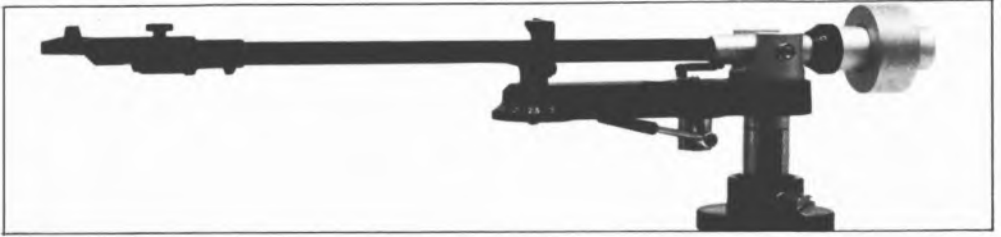
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# ADC ALT 1

BSR Ltd, 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 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

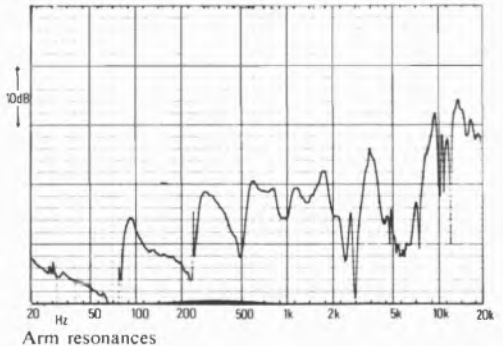
The value is quite good, and the fact that there are few low mass arms around at this price level works to the ALT-1's advantage, since the more compliant cartridges should work well in this model.

Re-examined for this latest edition, we found that the bearing slackness still remained, and overall we were a little less enthusiastic about this product in the context of more recent introductions on the tonearm scene. One of its least pleasant sound characteristics concerns a touch of 'brashness' and 'brittleness' in the upper range, which does little to help inexpensive cartridges, so models with a 'richer' balance are to be preferred.

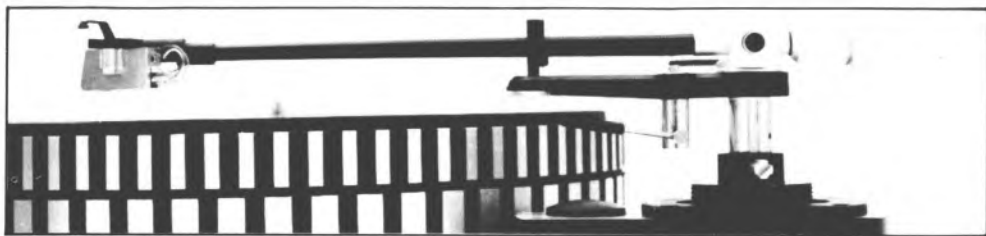
This remains one of the least expensive models currently available, but will face stiffer competition than hitherto from other designs such as the new Linn *Basik*, both arms having components in common. Its specific advantage lies in its moderate effective mass, the figure for which has been amended to a more representative 8.5g in this issue.

## GENERAL DATA

|   | Tonearm                             |
|---|-------------------------------------|
| Approximate effective mass inc screws, excl cartridge | 8.5g                                |
| 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                      | £44                                 |



BSR Ltd, Powke Lane, Cradley Heath, Warley, West Midlands B64 5QH  
Tel (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 *ASBI* 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.

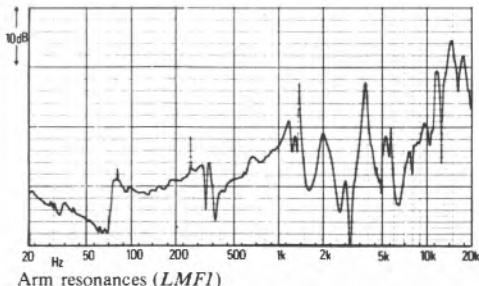
Friction was excellent in both planes with the bias in excess by approximately 30%, this allowing a correction of up to 2g downforce. Relative to the dialled settings, a commensurate 30% reduction is thus recommended when setting up.

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 good quality tonearm at the price and is recommended. A conventional counterweight 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) |  | 6g (7.5g)                        |
| 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/280hg/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                          |  | £70                              |



# Aiwa APD60

Aiwa Sales and Service (UK) Ltd, 163 Dukes Road, Western Avenue, London W3 0SY  
Tel 01-993 1672



This low-profile, lightweight-construction turntable weighs some 5.0kg, of which 1.0kg is taken up by the platter. There is no separate sub-chassis and the light and acoustically-resonant plastic lid joined directly to the plinth via the spring hinges.

A variable speed direct drive motor is used, and the arm is equipped with automatic facilities. An illuminated stroboscope aids speed setting. The motor/platter assembly is rather weak, its resonance unfortunately coinciding with a lid resonance at 25Hz, which significantly worsened the feedback margin.

All the controls are conveniently sited on the front of the plinth and cover speed selection as well as fine speed adjustment, play/repeat and cueing.

The arm is a simple, light, moulded affair with a fixed headshell and a built-in cartridge. On the assumption that the user is unlikely to upgrade to a more expensive cartridge, the fitted model was also assessed and found to be a moving magnet type fitted with a shank mounted spherical stylus, and a cantilever system of modest trackability and separation.

## Lab report

Platter record damping was below average, as the impulse response demonstrates. The direct drive motor provided a rapid start-up and good torque, plus good levels of wow and flutter. Rumble was satisfactory at  $-70\text{dB}$  DIN B, equal on both channels and containing a fair proportion of unwanted pole-pulse harmonics. Arm bearings had some play, but

nonetheless gave low friction values, although with weak bias compensation at the rim position. Measured with the fitted cartridge, the arm resonances were poor, with a dominant mode at 600Hz.

On frequency response the cartridge met  $\pm 1.5\text{dB}$  limits from 30Hz to 14kHz, rising to  $+2.5\text{dB}$  at 18kHz, which was not too serious in context. Separation was reasonably good at typically 29dB and still measured 25dB at 10kHz. However, the deck proved to be quite poor on acoustic breakthrough, vibration and feedback, with below average shock resistance.

## Sound quality

Sound quality was found to be poor, judging the complete system in a good state of alignment. The stereo stage was flattened in perspective with little depth or ambience present, while dynamics were also compressed with reduced differentiation between soft and loud sections. The mid-range was hardened and the treble lispy and edgy, the bass being seriously depressed with a poor definition.

## Conclusion

While its low-profile styling, good finish and versatile facilities might well appeal at the price, by *Hi-Fi Choice* standards this turntable's sound quality was inadequate to justify a recommendation. The cartridge cannot easily be replaced, and in any case, was not primarily responsible for the poor sound.

**GENERAL DATA**

Integrated turntable(inc. cartridge)

**Motor Section**

Type..... fully automatic, direct drive  
 Platter mass/damping..... 1.0kg/average  
 Finish and engineering..... good/average  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... 0.09%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.06% 0.08%  
 Absolute speed error..... - 0.05%  
 Speed drift, 1 hour/load variation..... approx. 0.1%/- 0.1%  
 Start-up time to audible stabilisation..... 1.3 secs  
 Rumble, DIN B wtd L/R average (see spectrum)..... - 70 dB

**Arm Section**

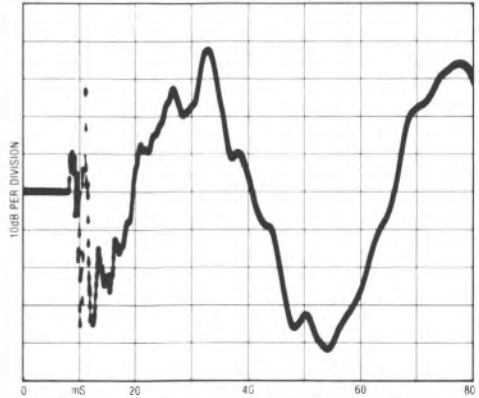
Approximate effective mass, inc screws, excl cartridge... N/A  
 Type/mass of headshell..... non-detachable  
 Geometric accuracy..... good  
 Adjustments provided..... none  
 Finish and engineering..... excellent/excellent  
 Ease of assembly/setting-up/use..... excellent/excellent/excellent

Friction, typical lateral/vertical..... 35mg/10mg  
 Bias compensation method..... fixed internal spring  
 Bias force, rim/centre (set to 1.5g elliptical)..... 80mg/175mg  
 Downforce calibration error, 1g/2g..... N/A  
 Cue drift, 8mm ascent/descent..... none, 0.7 secs/1.7 secs  
 Arm resonances..... \*below average  
 Subjective sound quality..... poor  
 Lead capacitance/damping method..... -/none

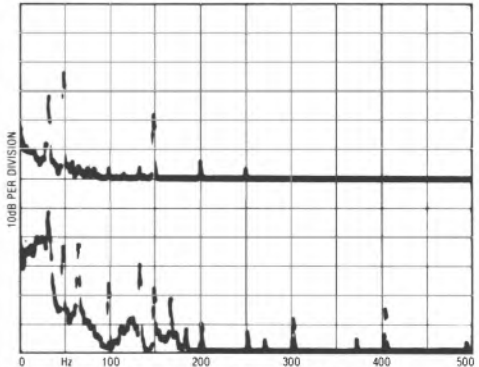
**System as a whole**

Size/clearance for lid rear..... 42(w) x 38(d) x 7.5(h)/3cm  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... poor  
 Subjective sound quality of complete system..... poor  
 Hum level/acoustic feedback..... average/poor  
 Vibration sensitivity/shock resistance..... below average/below average

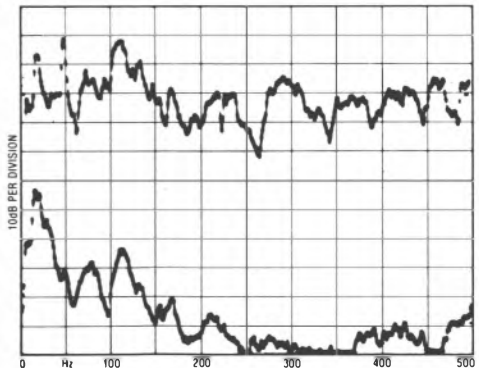
Estimated typical purchase price..... £100  
 \*with cartridge supplied



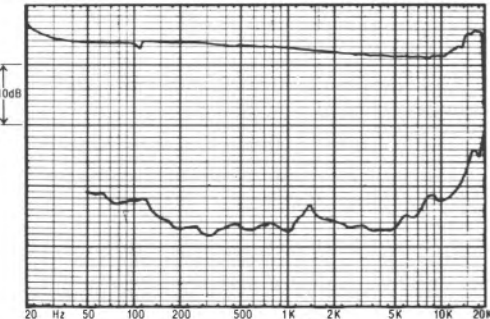
*Disc impulse transmission showing damping*



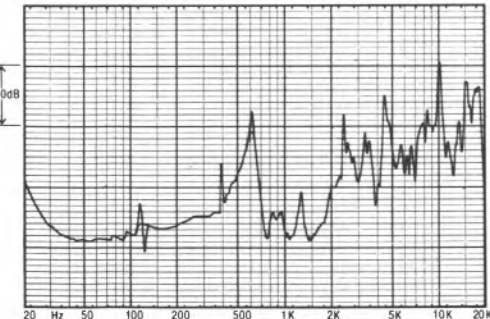
*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*



*Frequency response and separation, cartridge*



*Structural arm resonances, audio band*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

# Aiwa LX100

Aiwa Sales and Service (UK) Ltd, 163 Dukes Road, Western Avenue, London W3 0SY  
Tel 01-993 1672



A smart-looking 'jacket-size' turntable, the LX100 has a square front with touch-button controls. While the lid is detachable and may be hinged up, the upper section of the front panel drops down to reveal its proper mode of operation, namely front loading. An ingenious powered mechanism lifts up the platter, then projecting it forward on a slide drawer to accept the record. At the touch of another button the disc is safely drawn inside. Fitted with an Ortofon LM5 cartridge, the lightweight parallel- or linear-tracking arm is microprocessor-controlled for automatic operation. Photoelectric detection of record size is combined with selection of the appropriate speed. In fact the detachable stylus is easily replaced and may be upgraded to certain more advanced Ortofon types. But as the LM5 worked well enough it is probably not worth replacing this until worn out.

A direct-drive motor is employed, with variable speed facilities and the usual stroboscope. The arm has power cueing and traverse and need never be touched except for stylus cleaning. This compact unit measures 33cm deep, and needs no additional rear clearance, so it is a strong candidate for bookshelf installation.

## Lab report

The special sub platter (no mat) provided quite reasonable (better than expected!) disc damping, while the direct drive motor provided gave satisfactory levels of wow and flutter as well as good speed stability and accuracy. Torque

was sufficient to give a rapid 1.3 second start-up time. Rumble was quite good at  $-73\text{dB}$ , the noise being mainly hum related components rather than motor pole interference.

## LX100-2

With a low estimated moving mass, the arm/cartridge combination was stable and tracked well. Certain parameters could not be tested due to the deck's construction and fully automatic operation, but the resonance behaviour was assessed using the supplied cartridge, and was classed as unpromising. Severe resonances at 250Hz and 1kHz are plain to see on the graph, and there are also minor related aberrations on the cartridge frequency response. The latter otherwise measured a fine  $\pm 1.5\text{dB}$  from 100Hz to 20kHz, with a bass lift at low frequencies rising to  $+8\text{dB}$  by 20Hz as the subsonic arm/cartridge resonance was approached. A low-cut or rumble filter on the accompanying amplifier could be a help here. Cartridge separation was to a surprisingly good standard, at over 30dB mid band.

Acoustic breakthrough performance was below average but shock and vibration resistance were quite good, as was the feedback margin.

## Sound quality

Sound quality of this Aiwa was quite promising. Some mid-hardness was apparent, this attributable to the arm resonances, but the stereo presentation was above average and the sound tonally balanced, lacking the usual treble harshness. The bass was also above average with reasonable definition.

## Conclusion

Supplied with a pleasant cartridge and demonstrating fairly good stereo as well as an above average feedback performance, the LX100 wins some approval and a potential recommendation, though the price is on the high side. Final choice on the part of a purchaser will depend on the importance of its size and presentation.



**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

Type . . . . . front-load linear-tracking, fully auto, direct drive  
 Platter mass/damping . . . . . 1.05kg/average  
 Finish and engineering . . . . . excellent/good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . 0.1%  
 Wow and flutter (LIN peak wtd 0.26Hz/6-300Hz) . . . . . 0.1%/0.07%  
 Absolute speed error . . . . . -0.15%  
 Speed drift, 1 hour/load variation . . . . . -0.3%  
 Start-up time to audible stabilisation . . . . . 1.3 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . 73 dB

**Arm Section**

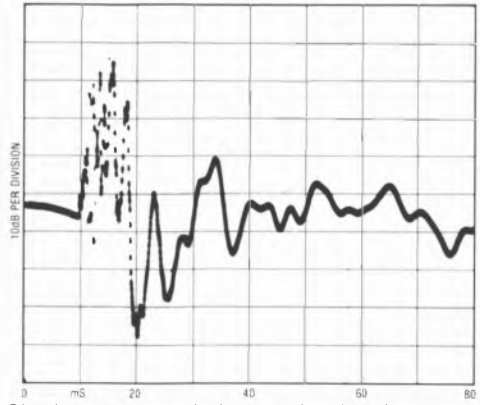
Approximate effective mass, inc screws, excl cartridge, est. 6g  
 Type/mass of headshell . . . . . non-detachable (Ortofon cartridges)  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . none  
 Finish and engineering . . . . . excellent/very good  
 Ease of assembly/setting-up/use . . . . . very good/excellent/excellent

Friction, typical lateral/vertical . . . . . N/A  
 Bias compensation method . . . . . not required  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . N/A  
 Downforce calibration error, 1g/2g . . . . . N/A  
 Cue drift, 8mm ascent/descent . . . . . none, 1.6 secs/1.6 secs  
 Arm resonances . . . . . poor  
 Subjective sound quality . . . . . average  
 Lead capacitance/damping method . . . . . —/none

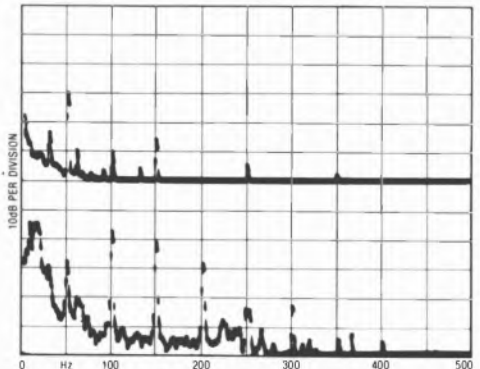
**System as a whole**

Size/clearance for lid rear . . . . . 33(w) x 33(d) x 11(h)/4cm  
 Ease of use . . . . . excellent  
 Typical acoustic breakthrough and resonances . . . . . below average

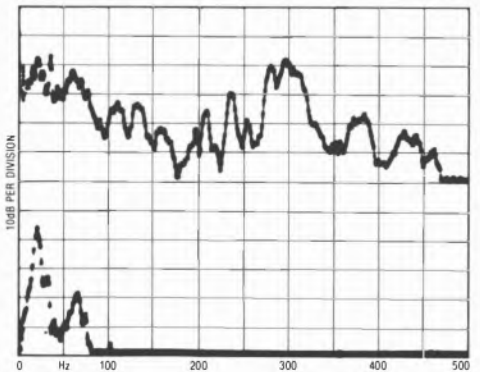
Subjective sound quality of complete system . . . . . average +  
 Hum level/acoustic feedback . . . . . average + /good  
 Vibration sensitivity/shock resistance . . . . . above average/good  
 Estimated typical purchase price . . . . . £150  
 \*with cartridge supplied



Disc impulse transmission showing damping

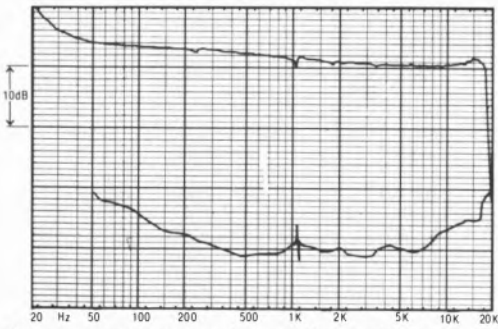


Rumble, electrical (above) and total (below)

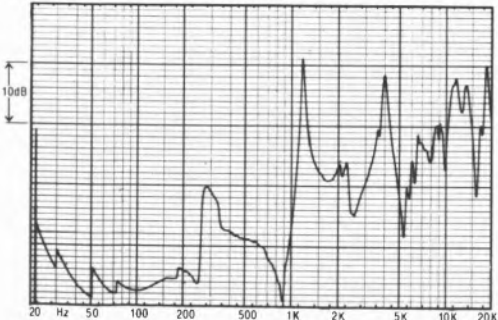


Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques



Frequency response and separation, cartridge



Structural arm resonances, audio band

# Akai APB110

Akai (UK) Ltd, 12 Silver Jubilee Way, Haslemere Heathrow Estate, Hounslow, Middlesex TW4 6NF  
Tel 01-897 6388



An inexpensive model, this Akai is supplied with a 'V' magnet cartridge tracking at 2 grams. The cartridge design is intriguing by virtue of its plastic composite cantilever, this being a feature of some of the less expensive Audio-Technica models. The stylus tip was a shank mounted spherical, and separation was quoted at 20dB minimum.

Rather a lightweight turntable, the *APB110* has a thin 0.5kg platter driven via a belt from a four pole synchronous motor. The unit has little external isolation and the lid is also rather resonant in character. A moderate-mass arm is fitted with a detachable plastic headshell and, as supplied, the cartridge was not well aligned. Two speeds are provided (33 $\frac{1}{3}$  and 45rpm) and an auto-return facility is included.

## Lab report

The disc damping provided by the platter and mat was below average, as confirmed by the extended low frequency oscillations in the disc impulse photo. Wow and flutter was good, with fine speed accuracy and satisfactory torque allowing rapid start-up of the light platter — better than one second. Rumble was also sat-

isfactory at -70dB and mainly composed of motor breakthrough.

At 10g effective mass, the arm falls into the medium-mass category, and offered surprisingly low friction at the expense of some bearing play. Bias compensation was poor at the 1.5g setting, with no compensation present at the rim until dial settings of above 1.75g were used. Downforce calibration was however accurate and in other respects the arm worked quite well.

The resonance graph demonstrated impaired resolution but nonetheless suggested reasonable behaviour, while arm lead capacitance was high at 320pF. Acoustic feedback isolation was poor, with vibration resistance little better, and shock immunity was only fair.

## Sound quality

Rated 'poor' on auditioning, this Akai model was notably deficient as regards the bass end. The sound was thin, tinny and metallic with the upper treble on the verge of acceptability. A false 'echo' resonance was audible — induced by the lid — and the effect was considered fatiguing, lacking in stereo depth or ambience. As far as could be judged, the arm's contribu-

tion was satisfactory. This deck was more prone to feedback problems than usual, and needed to be kept well away from the loudspeakers.

### Conclusion

Despite its very modest price, I cannot seriously suggest this turntable for high-fidelity applications. No recommendation is possible.

### GENERAL DATA

Integrated turntable (inc. cartridge)

#### Motor Section

Type . . . . . semi-automatic, belt drive synchronous motor  
 Platter mass/damping . . . . . 0.5kg/below average  
 Finish and engineering . . . . . very good/average  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd. sigma 2) . . . . . 0.05%  
 Absolute speed error . . . . . 0.05%/0.04%  
 Speed drift, 1 hour/load variation . . . . . + 0.05%  
 Start-up time to audible stabilisation . . . . . 0.9 sec  
 Rumble, DIN B wtd L/R average (see Spectrum) . . . . . - 70 dB

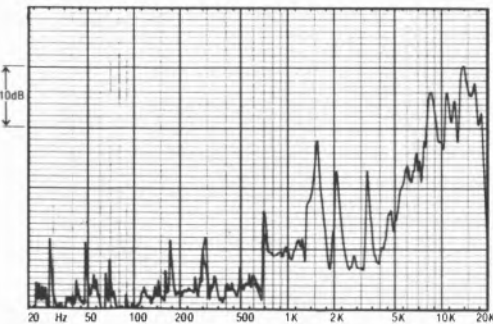
#### Arm Section

Approximate effective mass, inc screws, excl cartridge . . . . . 10g  
 Type/mass of headshell . . . . . special detachable/4g  
 Geometric accuracy . . . . . average  
 Adjustments provided . . . . . overhang/offset  
 Finish and engineering . . . . . very good/average  
 Ease of assembly/setting-up/use . . . . . good/very good/very good  
 Friction, typical lateral/vertical . . . . . less than 10mg/less than 10mg

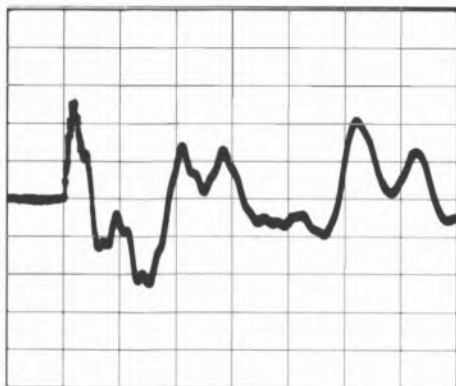
Bias compensation method . . . . . internal spring  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . -/150mg  
 Downforce calibration error, 1g/2g . . . . . - 0.025g / - 0.05g  
 Cue drift, 8mm ascent/descent . . . . . negligible, 0.6 secs/1.2 secs  
 Arm resonances . . . . . average  
 Subjective sound quality . . . . . below average  
 Lead capacitance/damping method . . . . . 320pF/none

#### System as a whole

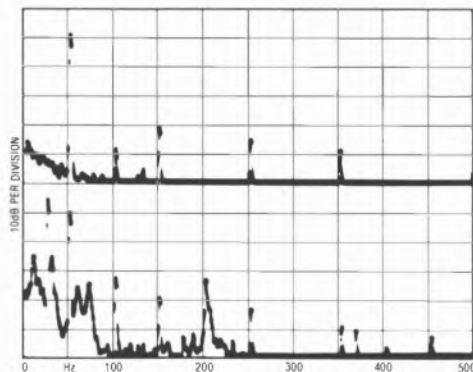
Size/clearance for lid rear . . . . . 44(w) x 38(d) x 13(h)/5cm  
 Ease of use . . . . . very good  
 Typical acoustic breakthrough and resonances . . . . . poor  
 Subjective sound quality of complete system . . . . . poor  
 Hum level/acoustic feedback . . . . . fair/fairly poor  
 Vibration sensitivity/shock resistance . . . . . fair/fair  
 Estimated typical purchase price . . . . . £50



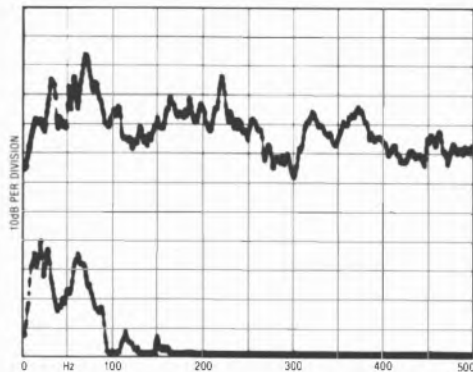
Structural arm resonances, audio band



Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)



Rumble, electrical (above) and total (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Akai APQ310

Akai (UK) Ltd, 12 Silver Jubilee Way, Haslemere Heathrow Estate, Hounslow, Middlesex TW4 6NF  
Tel 01-897 6388



Akai's 310 is a direct-drive quartz-lock turntable with fully automatic arm operation, though lacking an automatic record size detection facility — instead there is a record size selector button. A moderate mass arm is fitted, using a light fixed plastic headshell. This comes fitted with an inexpensive plastic-cantilevered 'V' magnet cartridge, having quite good geometrical adjustment. Few isolation features are built in, and the deck sports a thin plastic lid, which is likely to cause resonance problems. The two speed motor has very low claimed wow and flutter plus a good rumble specification of  $-73\text{dB}$  DIN, which we were not quite able to match in actual measurement.

## Lab performance

A sensible flat mat was fitted to the platter and gave quite good disc damping (see impulse photo), the platter mass proving average at 1.1kg inclusive of mat. On this sample wow and flutter was not as good as claimed, but nonetheless was satisfactory at 0.08% DIN peak. As it should be, speed was entirely accurate with good dynamic characteristics, low overshoot and good torque. Start-up took 1.5 seconds while rumble measured a satisfactory  $-70\text{dB}$  DIN and was mainly composed of

mains harmonic breakthrough — the supply transformer perhaps?

Arm bearing showed some play and there was evidence of notching. Friction towards the end-of-side position increased to 100mg or so — double the typical measured values. Bias compensation was rather low; at the 1.5g setting, it measured about one third of that required. Arm descent was also a trifle slow, and the arm resonance characteristics were judged poor, with breakup evident at 200Hz and more seriously at 2kHz and 1.5kHz.

Environmental isolation was disappointing. Both acoustic and vibrational energy were inadequately rejected, the rating being only 'fair' on acoustic feedback, with 'poor' for shock resistance.

## Sound quality

A 'poor' rating was denoted by the sound quality tests, these conducted using a much improved moving magnet cartridge, and somewhat surprisingly, it was judged as audibly inferior to its cheaper brother the APB 110. The 310 was considered to be relatively unmusical, and gave a 'flattened' and 'compressed' sound which was felt to be fatiguing. The arm sound was brash with a tizzy treble and a thin mid-range, while bass was severely attenuated

with minimal definition. It was also unduly disturbed by mild shock.

### Conclusion

In earlier years we have felt that some Akai models, notably the APQ70C were quite promising, and as such, the new APQ310 was something of a disappointment. No recommendation is possible here.

### GENERAL DATA

Integrated turntable (inc. cartridge)

#### Motor Section

Type..... fully automatic, quartz-locked direct drive  
 Platter mass/damping..... 1.1kg/good  
 Finish and engineering..... excellent/above average  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... 0.08%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.06%/0.04%  
 Absolute speed error..... negligible  
 Speed drift, 1 hour/load variation..... quartz-locked/negligible  
 Start-up time to audible stabilisation..... 1.5 secs  
 Rumble, DIN B wtd L/R average (see Spectrum)..... -70 dB

#### Arm Section

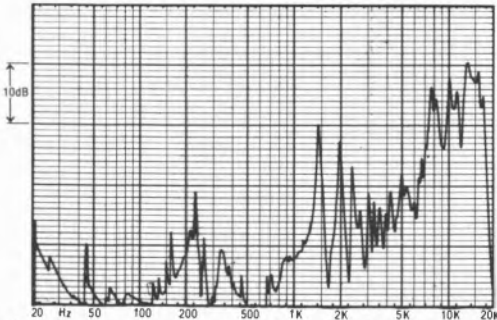
Approximate effective mass, inc screws, excl cartridge... 8.5g  
 Type/mass of headshell..... non-detachable  
 Geometric accuracy..... good  
 Adjustments provided..... overhang/offset  
 Finish and engineering..... very good/above average  
 Ease of assembly/setting-up/use..... very good/very good/very good

Friction, typical lateral/vertical..... 50mg/50mg  
 Bias compensation method..... internal spring  
 Bias force, rim/centre (set to 1.5g elliptical)..... .75mg/.75mg  
 Downforce calibration error, 1g/2g..... -0.075g/-0.05g  
 Cue drift, 8mm ascent/descent..... none, 0.6 secs/2.6 secs  
 Arm resonances..... poor  
 Subjective sound quality..... poor  
 Lead capacitance/damping method..... 75pF/none

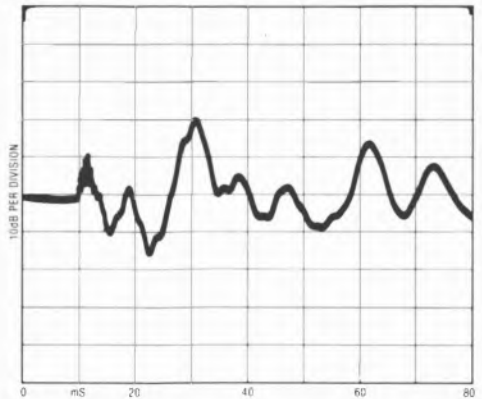
#### System as a whole

Size/clearance for lid rear..... 43.5(w) x 35.5(d) x 9.5(h)/4cm  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... below average

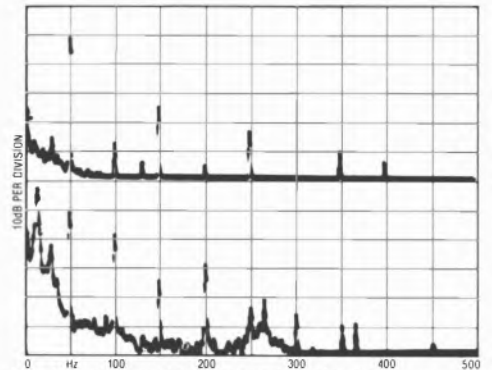
Subjective sound quality of complete system..... poor  
 Hum level/acoustic feedback..... average/fair  
 Vibration sensitivity/shock resistance..... fair/poor  
 Estimated typical purchase price..... £80



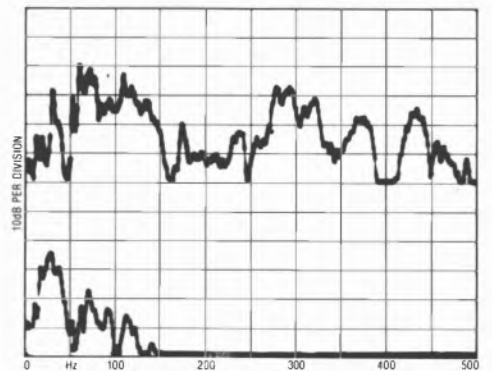
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

RECOMMENDED

# Alphason HR100S

Alphason, 31 Shawbrook Close, Euxton, near Chorley, Lancs  
Tel (02572) 76626



Since I was first asked to report privately on an early prototype of this UK-designed arm over a year ago, production models have undergone significant further development.

A medium mass arm possessing high rigidity, the Alphason's main feature is the use of a substantial titanium beam tube with classic 'S' shape geometry. This has allowed a straight join to the headshell, itself ingeniously formed from the front end of the tube; a transition accomplished with minimal impairment to good interfacing of cartridge and arm. A considerable proportion of the beam upper surface continues down to the 'shell' or cartridge mounting platform.

The concentric gimbal bearings are built of hardened tool steel for maximum strength and the pivots are pre-loaded high precision ball races. During the course of the review the bearing surfaces were updated using ultra-hard carbide inserts — pre-loading could then be dispensed with, offering much higher rigidity with reduced friction levels.

Considerable care has been taken to maximise rigidity as well as to minimise resonances in the design by suitable choice of materials and structure, the resulting performance reflecting the mechanical engineering expertise of the designer. Appearance and finish are undoubtedly to a good standard, but nonetheless this arm exhibits a 'craftsman' approach rather than the superlative feel and finish of the Japanese manufactured designs, for example.

At present the arm is supplied with a pillar base specified as Linn *Ittok/Basik* compatible, but we did not find this to actually be the case. 6mm rather than the required 4mm bolts are used, and the tracking geometry is optimised for a 58mm radius zero tracking-error point,

rather than the accepted 64-65mm. The arm is also slightly longer than the *Ittok* by about 2mm. However we understand that these discrepancies will soon be overcome in production to make the arm fully compatible. The long slotted headplate of the Alphason of course allows any desired overhang/offset angle to be obtained, and in this sense the geometry is already compatible.

The Alphason's fixed arm leads are reasonably compliant, aiding subchassis cable dressing, and are fitted with gold-plated plugs of good quality. Cable capacitance was low at 95pF. It is likely that two counterweights will be provided, these sliding on a hard nylon insert with a locking socket-head screw, while the weight carrier is stiffly engaged on a threaded section allowing fine adjustment of downforce — 0.4g per revolution for the heavier weight, which is suited to the Koetsu.

## Lab report

Effective mass was in the low to medium range at 10g inclusive of steel fixing bolts, and the structure was highly 'dead' as well as most rigid, with zero bearing play. The geometry (optimised) was excellent with very good finish and fine engineering. With the larger bias weight on the centre notch the compensation was fine for a 2g downforce as well as being in the right ratio, while friction was very low particularly on the 'carbide' version now standard. The cue worked well though the arm lock was rather stiff — I would prefer a separate pillar rest. Resonance graphs were plotted for the first sample which has steel bearings and a small counterweight, and also for the second sample with 'carbide' bearings and larger stiffened counterweight assembly. The latter showed improved rigidity, noticeable

in the 'sharper' nature of the resonances but in both cases behaviour was very good, indicative of a very low-coloration design. Below the 'carbide' graph, the excitation on the Linn arm board is shown as a dotted line, demonstrating the substantial pillar coupling and clear interactive relationship between arm and mounting.

**Sound quality**

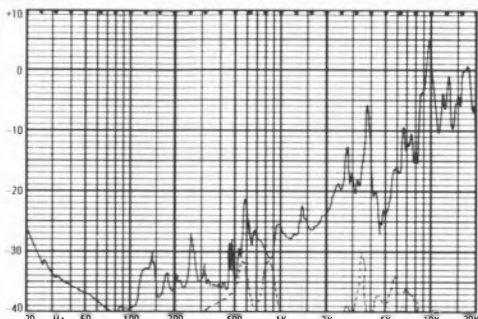
The HR100 impressed us strongly by its neutral and tonally balanced performance. Treble was detailed and precisely located and yet free of 'edge' or 'grain'. The mid-range gave excellent rendition of vocal lines while bass was firm, extended and detailed. Stereo was exceptional with precise positioning and fine depth and ambience, and despite an apparent 'smoothness', transients were nevertheless reproduced with fine 'attack'.

**Conclusion**

While the price is high and the overall finish not quite commensurate with the cost, the technical and more importantly the audible performances are both undoubtedly worth the money. The HR100S confidently joins the ranks of the 'super' arms, its moderate mass giving an extra margin of tracking stability for most cartridges.

**GENERAL DATA**

|  |                             |         |
|--|-----------------------------|---------|
| Approximate effective mass, inc screws, excl cartridge | 10g                         | Tonearm |
| Type/mass of headshell                                 | non-detachable              |         |
| Geometric accuracy                                     | N/A                         |         |
| Adjustments provided                                   | overhang/offset/height      |         |
| Finish and engineering                                 | good/excellent              |         |
| Ease of assembly/setting-up/use                        | very good/good/good         |         |
| Friction, typical lateral/vertical                     | 10mg/20mg                   |         |
| Bias compensation method                               | thread, pulley and weight   |         |
| Bias force, rim/centre (set to 1.5g elliptical)        | 180mg/150mg                 |         |
| Downforce calibration error, 1g/2g                     | - 0.1g/ - 0.1g              |         |
| Cue drift, 8mm ascent/descent                          | negligible, 0.5 sec/1.0 sec |         |
| Arm resonances   | very good                   |         |
| Subjective sound quality                               | very good                   |         |
| Lead capacitance/damping method                        | .95pF/none                  |         |
| Estimated typical purchase price                       | £300                        |         |



Structural arm resonances, audio band



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**RECOMMENDED**

# Ariston RD80SL

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD  
Tel (0292) 76933



Favourably reviewed in the last issue, the Ariston *RD80* has undergone some changes over the intervening 18 months — hence the current designation *RD80SL*. As outlined by the manufacturer, changes comprise improvements to the electrical insulation to meet Semco-Demco standards, while the platter is now machined to a slightly concave upper surface. Using the screw-down record clamp, standard with the unit, this allows reduction of most record warps as well as improved record-to-mat contact. Fine adjustment of the motor/pulley/belt angle is now possible by a tilt frame and a nut-runner is supplied for this purpose and for subchassis suspension levelling. Access is now provided underneath the tonearm without removing the base plate and in addition a new absorptive composition mat is included.

Of slightly plain finish and appearance, the *'80SL* employs a weighty 2.5kg platter. The subchassis has a well-balanced three-point spring suspension, and plinth and cover being substantial non-resonant items.

## Lab report

Though apparently undamaged externally our review sample suffered motor disintegration in transit, but fortunately survived a rebuild. The supplied *LVX* arm fared less well as the counterweight had been left in position; the result was 'notchy' bearings.

Lab performance of the version was much the same as for the earlier model, both being to a respectable standard. Speed, wow and

flutter and rumble figures were all good, if marginally poorer than before on our sample, and some mains-related rumble was evident on the drive, though the bearing showed signs of improvement with continued use — Ariston do state that there is a 'running-in' period.

Platter damping was fine, with a clean initial transient but some subchassis/platter flutter in the 'after-shock' (see impulse plots). Vibration isolation proved very good, as did resistance to acoustic breakthrough, with tolerable shock resistance and very good feedback immunity. Some rotational whippiness around 9Hz was observed with the subchassis, the main resonance being at 6Hz — while belt loading with the ridged two-speed pulley could be troublesome if adequate talc dressing had not been previously applied.

## Sound quality

Maintaining the standard set previously on sound quality grounds, the *80SL* provided a substantial proportion of the required performance parameters on a number of basic counts. The stereo soundfield seemed well focused, stable and precise, while the overall balance was generally neutral and the sound fairly transparent. The bass showed good depth and evenness, and pitch stability was also pretty good.

## Conclusion

While not a truly great turntable, the *RD80SL* is nonetheless a substantially good one at a realistic price. Its performance and sound quality, plus new additional features, have maintained its competitive quality, and accordingly the design continues to merit a *Choice* recommendation.

## GENERAL DATA

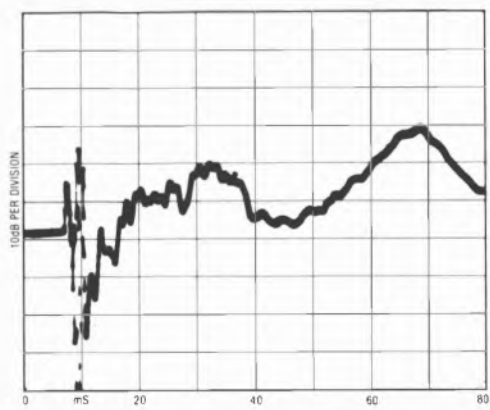
|   |  |            |
|---|--|------------|
| Type  | ..... manual belt drive, synchronous motor, subchassis | Motor Unit |
| Platter mass/damping                            | ..... 2.6kg/very good                                  |            |
| Finish and engineering                          | ..... good/very good                                   |            |
| Type of mains                                   | ..... 2-core   |            |
| Speed options                                   | ..... 33/45 rpm  |            |
| Wow and flutter (DIN peak wtd, sigma $\sigma$ ) | ..... 0.08%  |            |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)  | ..... 0.1%/0.07%                                       |            |
| Absolute speed error                            | ..... + 0.08%  |            |
| Speed drift, 1 hour/load variation              | ..... synchronous/ - 0.25%                             |            |
| Start-up time to audible stabilisation          | ..... 4.0 sec  |            |
| Rumble, DIN B wtd L/R average (see Spectrum)    | ..... - 75 dB  |            |
| Size/clearance for lid rear                     | ..... 44.5(w) x 36(d) x 17(h)/4.5cm                    |            |
| Ease of use                                     | ..... good   |            |
| Typical acoustic breakthrough and resonances    | ..... very good  |            |
| Subjective sound quality of complete system     | ..... good +   |            |
| Hum level/acoustic feedback                     | ..... very good/very good                              |            |
| Vibration sensitivity/shock resistance          | ..... very good/fairly good                            |            |
| Estimated typical purchase price                | ..... £180   |            |



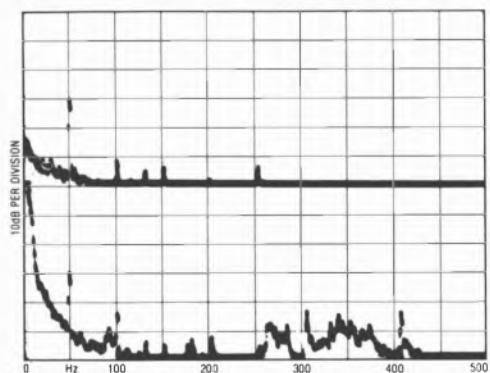


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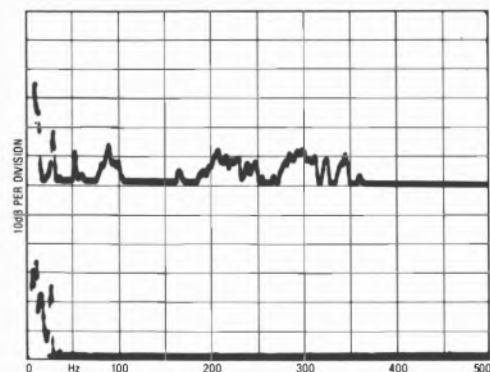
**ARISTON  
DUNLOP, PIONEER, ADC,  
MARANTZ, HITACHI, AIWA,  
SME, DYNAVECTOR, SHURE,  
DBX, TEAC, IMF, QUAD,  
MAYWARE, MISSION,  
ORTOFON, AR, DUAL INPUT  
DESIGN, WHARFEDALE,  
AUDIO TECHNICA, THORENS,  
MORDAUNT SHORT,  
CRIMSON, CELESTION.**



*Disc impulse transmission showing damping*



*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

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# Ariston RD11 Superieur

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD  
Tel (0292) 76933



This is an entirely new model from Ariston, owing very little to their previous designs despite the retention of the old *RD11* title. Ariston have been experimenting with 'electronic drives for many years now, and were to have launched a power-supply suited for mains-powered synchronous motors some time ago. In fact this new *Superieur* is an electronic turntable, but instead of the synchronous route pioneered by Thorens and now adopted by Linn, it uses a small DC servomotor run from a stabilised power supply.

To our eyes the turntable looked a little strange at first, standing on three highish feet, sufficient to give clearance for the control cluster on the angled-down front lefthand portion of the plinth. Here a rather awkward three position rocker switch — 33, off and 45rpm — is flanked by the two uncalibrated speed adjuster knobs. True speed must be set via a card stroboscope placed on the platter and illuminated by a mains-energised lamp — difficult to see in good daylight!

Ariston have dispensed with the two-section platter used on most turntables of this class, opting instead for a 3.2kg single unit with apertures to facilitate both belt loading and adjustment of suspension springs. This operation is in fact easier than for most since the platter remains in position. Long multi-turn coil springs are used in conjunction with a flat

steel plate subchassis, Ariston here choosing thickness rather than the usual bracing and rim flange. A cast metal plate provides the arm mounting.

The suspension was rather free, with a resonance estimated at 3.5Hz, which is lower than ideal since the recovery time is proportionately longer than when in the preferred 5-6Hz range. As with the *RD80*, the platter is concave by 1mm from rim to centre and this, in conjunction with the new mat and screw-down clamp, provided improved disc support and damping by comparison with earlier models.

## Lab report

Integrated wow and flutter readings were very good, with low flutter although linear wow was slightly high at 0.15%, possibly due to the soft suspension. Speed accuracy was indeterminate (no 'cal' setting) and while drift was low, the speed dropped a considerable 0.6% under our standard Dust Bug loading, potentially a cause of mild programme wow. Start-up was rapid at 1.8 seconds, and weighted rumble was also very good at -78dB. The DC motor drive was pretty clean and free of significant mains or other cyclic mechanical components. This new *RD11* was 'Superieur' in the field of disc damping where the platter/mat system delivered a very good result. Vibration isolation was also excellent, but acoustic breakthrough,

although very good, was nonetheless poorer than expected. Hum levels were low and very good immunity to acoustic feedback was demonstrated. Shock resistance was fairly good, though the suspension took some time to settle down after shock.

### Sound quality

Fitted with a recent *Ittok* tonearm, the turntable was auditioned using matched Osawa 60L cartridges — a good quality moving coil type of Supex pedigree — and sound quality was found to differ from other decks (including the *AD80*) to a surprising degree.

Judged by the highest standards, the mid-range showed a degree of thinness and congestion tonally, plus a weakened, 'distant' quality. In stereo terms, depth was not too well preserved, while the bass was somewhat uneven sounding although quite powerful. The treble was less pleasant with a slight glassy emphasis. As the auditioning proceeded there was more than just a hint that pitch was not entirely stable on some transient programme, notably rock.

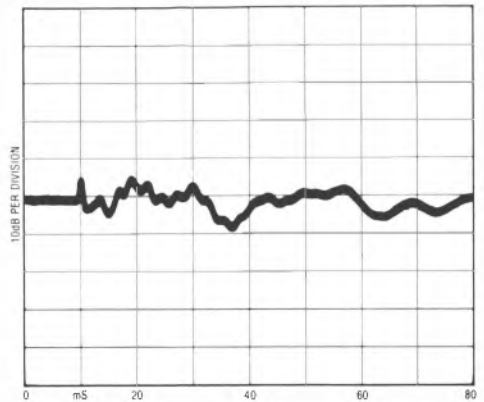
### Conclusion

It is possible that this deck would benefit from a 'softer' sounding tonearm than the *Ittok*, and perhaps an experienced dealer could help here. The pitch anomaly would seem to correlate with the significant lack of torque noted in the lab tests, while the speed change and controls were not particularly convenient to use, and in our view detracted from the appearance.

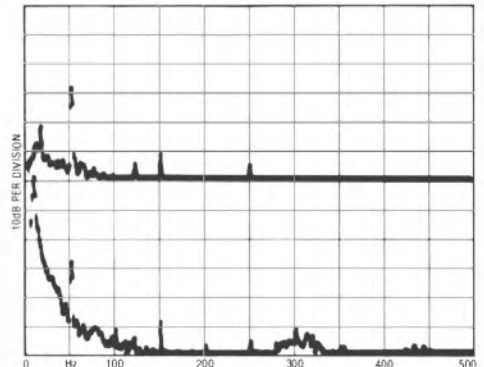
On the plus side and despite the criticisms above, the sound quality did in fact gain a 'good' rating, and many performance parameters were more than satisfactory. It remains an easy-to-set-up turntable, which we feel is not worthy of outright recommendation but could be worth considering.

### GENERAL DATA

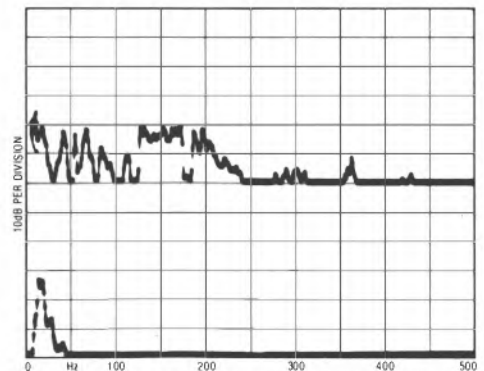
|  |                                      |
|--|--------------------------------------|
| Type   | Motor unit                           |
| Platter mass/damping                           | manual, belt drive motor, subchassis |
| Finish and engineering                         | 3.2kg/very good                      |
| Type of mains/connecting leads                 | good/very good                       |
| Speed options                                  | 2-core, line transformer             |
| Wow and flutter (DIN peak wtd, sigma 2)        | variable, 33/45 rpm                  |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.06%                                |
| Absolute speed error                           | 0.15%/less than 0.05%                |
| Speed drift, 1 hour/load variation             | less than 0.1%/- 0.6%                |
| Start-up time to audible stabilisation         | 1.8 secs                             |
| Rumble, DIN B wtd L/R average (see spectrum)   | - 78 dB                              |
| Size/clearance for lid rear                    | 44.5(w) x 36(d) x 17.5(h)6cm         |
| Ease of use                                    | good                                 |
| Typical acoustic breakthrough and resonances   | very good                            |
| Subjective sound quality of complete system    | good +                               |
| Hum level/acoustic feedback                    | very good/very good                  |
| Vibration sensitivity/shock resistance         | excellent/fairly good                |
| Estimated typical purchase price               | £350                                 |



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



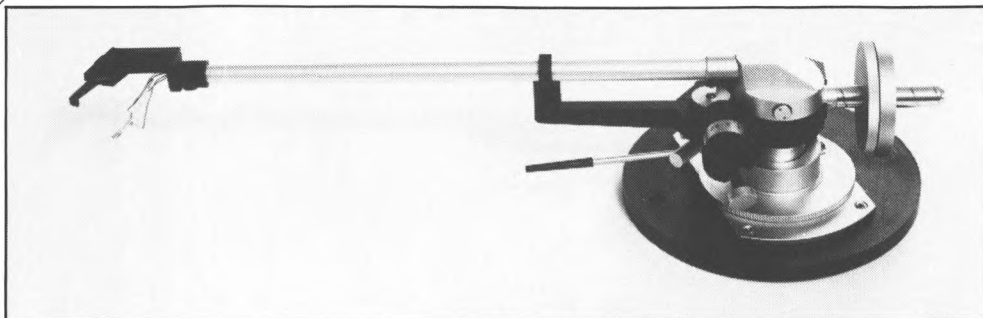
Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction for explanation of test techniques*

# RECOMMENDED

## Audio-Technica AT1120

Audio-Technica (UK) Ltd, Hunslet Trading Estate, Low Road, Leeds  
Tel (0532) 771441



In the last issue a group of related Audio-Technica arms were assessed, including the 1070, the 1100 low-mass and high-mass versions. This year they are joined by a new low mass version of the 1100 called the 1120.

The 1100 was characterised by its detachable arm carrier fitted with a rigid low mass fixed headshell, the counterweight an elaborate affair with a lead-screw drive. With the 1120 Audio Technica have in essence simplified the design and taken some steps to improve certain areas, notably the bearings. These changes are in fact sufficient to result in a new arm model and justify a full review here.

The 1120 is a genuine low mass model in the 5g effective mass range. This makes it compatible with high-compliance cartridges that are unsuited to the more massy arms which are increasingly becoming available. As it is supplied with a fluid damping unit which may be used if required, this versatility is further extended. Low mass does of course mean that some sacrifice in rigidity is necessary, and this can mean a reduction in compatibility with lower compliance moving coil cartridges – not so much on grounds of subsonic resonance but more in the context of mutual resonances in the audible range.

The arm tube and shell of the arm are fixed in the 1120, and the alloy shell of the 1100 has been replaced by a lighter but frailer carbon-fibre-loaded plastic moulding. The new arm is clearly designed for use with low mass cartridges and will correctly counterbalance units as light as 2g. The upper cartridge weight limit is 9g, even with the use of an extra counterweight, so high-mass cartridges are ruled out. The counterweight is one of the ubiquitous rotating types with a sliding scale and it has a rubber decoupling insert in its mounting. Audio-Technica's 'DTS' system is incorpor-

ated, whereby the vertical pivot plane is located below the stylus tip, thereby reducing the tendency for a stylus to lift out of the groove under heavy modulation. In fact stylus drag tends to increase the short-term downforce with this system, giving an increase in trackability.

### Lab report

With previous arms in this series the bearings have never seemed quite tight but in the case of the 1120, judged by our sample at least, the pivots are free of detectable play. Bearing play and any other indeterminate looseness or incipient rattle in an arm can seriously detract from the sound, generally resulting in a muddling of detail and a failure to reproduce transients with good clarity.

Despite this absence of play the bearings provided low levels of friction, giving an excellent 5mg lateral measurement, and a fine 20mg vertical reading. Finish and engineering were both to an enviable standard, and the geometry was sound. The effective mass figure of 5g includes mounting bolts. The usual AT weighted lever bias compensation is used, and on this example gave lower values than usual as well as being in the inverse ratio to that needed for accurate compensation from beginning to end of a record side. Pillar angle adjustment can ameliorate this somewhat and the dialled settings need to be increased by 20-30% to attain the correct values.

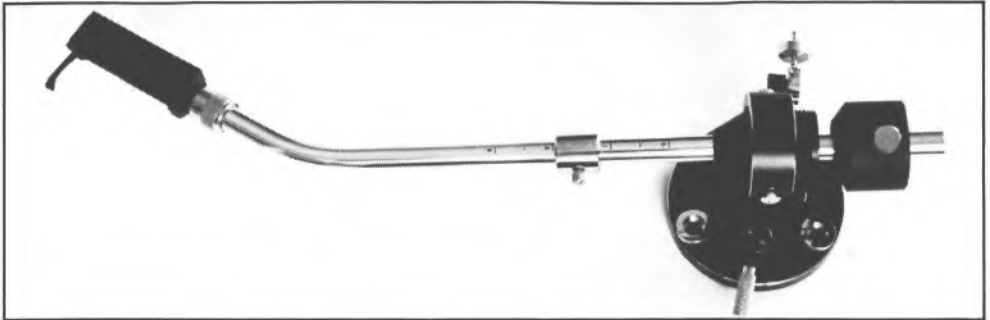
Downforce calibration was accurate, while the cueing and fluid damping systems worked well. Leadout cable capacitance was low at 85pF. However the arm resonance behaviour was none to promising, with the 100Hz mode (redrawn) probably deriving from the counterweight while that at 400Hz was a shell/tube

*continued on page 52*

RECOMMENDED

# Audio-Technica AT1503 III

Audio-Technica (UK) Ltd, Hunslet Trading Estate, Low Road, Leeds  
Tel (0532) 771441



Rarely seen in this country, the Audio-Technica 1500 series is designed for professional applications with a minimum of frills and inbuilt high durability. However Audio-Technica agreed to supply the latest *Mark III* version for review, and it was auditioned using the Lux *PD300* vacuum platter turntable – one of the very few decks large enough to take this substantial arm. Possessing a 10in nominal length, the overall dimensions are 330mm and the effective length (stylus tip to pivot) 257mm. Another similar version, the *AT 1501 III* is longer still at 285mm.

Effective mass is high at 20g, this including mounting hardware; the substantial cast metal headshell alone weighs 13.5g inclusive of screws. An array of blind threaded holes is provided on the headshell underside for cartridge fixing. Small overhang increments are thus possible but a change of offset angle is not. The shell has the universal SME-type collet fixing, this heavily reinforced with a clamping chuck to improve the arm/shell coupling.

Claimed to help in absorbing resonances in the main beam, the downforce adjuster is a sliding weight on the tube, and is equipped with a locking screw to prevent vibration. For what it's worth, the arm is wired with pure silver, teflon insulated as is usual for silver conductors. Bias compensation is of the thread-and-weight lever type, possessing low friction, and the arm height is easily adjusted via a lever-operated locking base arranged to provide high securing forces on the three point pillar locking system. The large rear counterweight is partially decoupled by a tensioned multilayer rubber damper, and large ball bearings are employed to provide firm control and adequately low friction.

Cartridges in the 1 to 20g mass range may

be accommodated and in the case of integral-headshell types up to 33g can be accepted. The *1503* may thus be seen as the antithesis of the *AT1120!* The geometry is slightly imperfect in that while a 1 deg 55 sec maximum tracking error is specified, the instructions suggest that an additional  $\pm 1$ mm overhang error is admissible, this due to the headshell fixing intervals – so in fact 1 deg of additional error can then result.

## Lab report

With a 20g effective mass, low compliance cartridges are definitely the rule, particularly in view of the absence of a damper. Actually, in extreme cases the use of an accessory damper such as the Zerostat *Z-Track* would be a definite advantage in stabilising the cartridge to the record surface. Given the reservation noted above, geometry was otherwise very good, and the 'feel', finish and engineering were quite excellent. The arm proved easy to use despite the absence of a cue mechanism. Lateral friction was just satisfactory at 50mg while in the vertical plane it was fine at 10mg. Bias levels were appropriate for the setting and effective length; with the reduced offset angles on longer tonearms less bias is required. Downforce calibration was pretty accurate.

Arm resonance results were surprisingly good for a detachable head arm. Resonances were undoubtedly present, but the general energy trend was comparatively uniform and when the breaks did occur – notably at 300Hz, 600Hz and 3kHz – they were not too serious.

## Sound quality

Judged a superior product on auditioning, some mild loss of definition was attributable

*continued on page 52*

mode. The slope is rather broken up and is severely dissected above 2kHz.

**Sound quality**

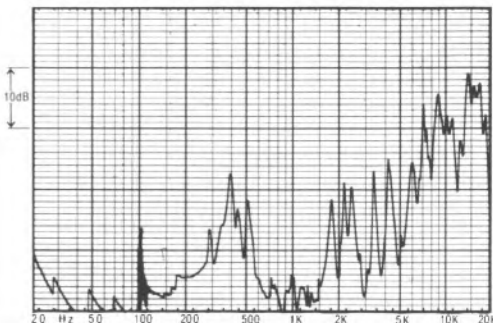
Auditioned on a good quality sub-chassis turntable, the sound quality was better than the resonance graph might suggest. Tonal balance was quite pleasant with the central image reasonably well defined, with some worthwhile depth rendition. The treble was not so well defined, yet remained inoffensive, and while the bass definition was below that of the 'super' arms, demonstrating some 'lumpiness', again this was not too serious. With a moving magnet cartridge (Shure V15 V) all these problems seemed reduced by an order of magnitude.

**Conclusion**

While less suited to the more intolerant moving coil models, the 1120 performed pretty well with others, such as the Dynavector 23R or the Denon 303 and 305. Moving magnet examples generally gave good results, and although in context the arm is rather expensive it is probably worthy of recommendation on the basis of its overall performance.

**GENERAL DATA**

|  |                          |
|--|--------------------------|
|  | Tonearm                  |
| Approximate effective mass, inc screws, excl cartridge | . 20g                    |
| Type/mass of headshell                                 | special detachable/13.5g |
| Geometric accuracy                                     | very good                |
| Adjustments provided                                   | overhang, height         |
| Finish and engineering                                 | excellent/excellent      |
| Ease of assembly/setting-up/use                        | very good/good/very good |
| Friction, typical lateral/vertical                     | . 50mg/10mg              |
| Bias compensation method                               | weighted lever           |
| Bias force, rim/centre (set to 1.5g elliptical)        | . 150mg/150mg            |
| Downforce calibration error, 1g/2g                     | - 0.05g/ - 0.1g          |
| Cue drift, 8mm ascent/descent                          | . N/A                    |
| Arm resonances   | . good                   |
| Subjective sound quality                               | . good +                 |
| Lead capacitance/damping method                        | . 95pF/none              |
| Estimated typical purchase price                       | . £155                   |



*Structural arm resonances, audio band*

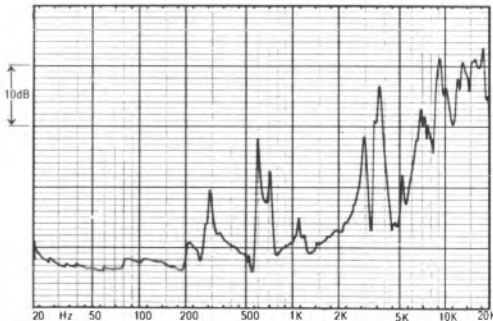
to the lowered subsonic resonance resulting from the 1503's high effective mass. Nonetheless the stereo performance was good with promising depth and detail. The sound was tight and punchy with good bass power and extension plus good tonal integration and balance over much of the frequency range. It gave a feeling of solidity and security. The upper treble showed a slight 'sheen' with a mild loss of detail.

**Conclusion**

This is one of the best high-mass detachable headshell arms so far reviewed, and while the price is high, it is by no means extortionate in view of the excellent constructional quality and finish. The arm is a product with professional durability and should give a long life, free of fuss or drama. As such, and bearing in mind the minor reservations expressed, the 1503 carries our recommendation although you will need a large turntable to accommodate it!

**GENERAL DATA**

|  |  |
|--|--|
|  | Tonearm  |
| Approximate effective mass, inc screws, excl cartridge | . 5g   |
| Type/mass of headshell                                 | non-detachable                                 |
| Geometric accuracy                                     | . excellent                                    |
| Adjustments provided                                   | overhang/offset/height                         |
| Finish and engineering                                 | . excellent/very good                          |
| Ease of assembly/setting-up/use                        | very good/very good/very good                  |
| Friction, typical lateral/vertical                     | . 5mg/20mg                                     |
| Bias compensation method                               | weighted lever                                 |
| Bias force, rim/centre (set to 1.5g elliptical)        | . 175mg/145mg                                  |
| Downforce calibration error, 1g/2g                     | - 0.05g/none                                   |
| Cue drift, 8mm ascent/descent                          | . none, 0.5 secs/2.6 secs                      |
| Arm resonances   | . average +                                    |
| Subjective sound quality                               | . good +                                       |
| Lead capacitance/damping method                        | . 85pF/decoupled counterweight and damping pot |
| Estimated typical purchase price                       | . £110   |



*Structural arm resonances, audio band*

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*Clement Brown*



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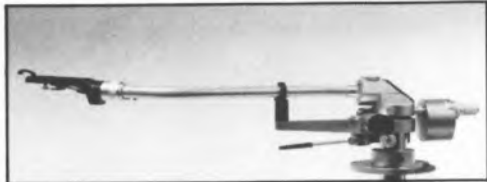
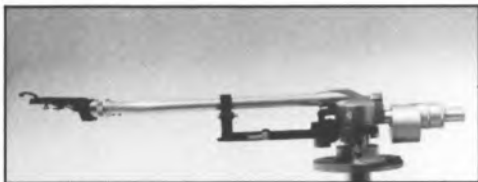
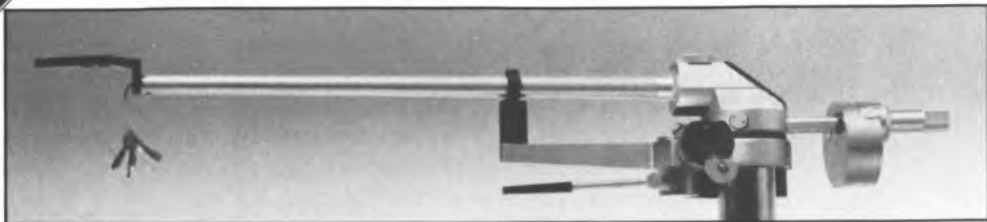
Unit 12, Ashford Industrial Estate, Shield Road, Ashford, Middx. Tel: Ashford 46421

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# Audio Technica AT 1100/1010

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

RECOMMENDED



## Features and design

This family of Audio Technica tonearms makes an interesting group, with the various members exhibiting distinct differences.

The AT1010 is an established seller reviewed before by *Choice* and here reassessed. Comprising a medium/high mass design, it effectively has an S-type main tube, with a universal detachable headshell. Audio Technica make a range of headshells as accessories with various mass and resonance damping properties, and in our case a magnesium die-cast version was supplied. The arm incorporates a variable counter-weight damping facility, adjustable via a clamping thumb-wheel at the arm pivot (see graphs).

Both the 1010 and the 1100 exhibit a refined geometry, whereby the vertical motion pivot axis is in line with the stylus tip, thereby minimising the effect of varying stylus drag upon instantaneous downforce. Both have an approximately 8cm back extension behind the pillar, and while the 1010 offers a dynamic balance weight called a 'gyrobalance', the 1100 has a fluid well damper pot rather like that fitted to SME models. The arms are interchangeable in their pillar mounts, which use three-point pillar contact locking, although the mounts themselves differ in detail between the two models.

The basic 1100 comes with a low mass straight arm tube, plus a complete interchangeable carrier, the latter locking by a thumbscrew into the upper bearing housing making the signal connections automatically.

In contrast to the 16g effective mass of the 1010, the 1100 offers a genuinely low 6g. An accessory S-tube carrier is also available which

accepts a universal headshell, together with a high mass counterweight – double interchangeability if you like – but this is probably best suited to integrated cartridges such as the Ortofon *Concordes*. Fitted with an 8g headshell the S-tube effective mass came out at a medium 12.5g, and might effectively be lower of course if an integrated headshell/cartridge is used.

These arms were superbly finished in a matt chrome, and all moving parts worked smoothly and precisely, although a trace of looseness remained in the horizontal bearings of both. The counterweights could not be tightly fixed, but in fact this is intentional to allow for the convenient and accurate rotary downforce dials. The fit of the headshells etc, was exemplary, with well executed socket connections which could be tightly secured. A splined collet is a feature of the new AT shells, giving adjustment of vertical tilt and overhang, though the tilt facility is omitted from the low mass straight carrier tube.

## Lab results

Taking the 1010 first, the effective mass was in the medium range suggesting the suitability of cartridges in the 18–8cu bracket, which are generally moving-coil models. Like the sample we tested previously the biasing was still rather high, and values of about half those suggested in the manual are about right. Other characteristics including low lead capacitance and accurate downforce calibration were satisfactory.

The variable damping control was initially investigated in terms of the subsonic arm/cartridge resonance. A cartridge which offered a +9dB resonance at 9Hz showed an amplitude change of only 0.5dB over the whole range of the



damping settings. Conversely, when the audio range resonance graph was plotted the damper variation was significant, indicating that it should be experimented with on audition; in particular the behaviour in the 30Hz to 500Hz range was materially affected. In fact this arm was not especially clean in terms of its overall resonance behaviour, but its energy trend was quite uniform on average, indicating a neutral tonal balance (see graph).

The 1100 is characterised by its low effective mass with effective fluid damping (the latter adjustable *via* depth and viscosity). It is suitable for a wide range of cartridges from 12 to 40cu, showing excellent friction levels and bias compensation near the ideal, if a little on the high side. Downforce calibration was excellent and the audio resonance curve was promisingly uniform showing a well-controlled character, only marred by the counterweight mode at 90Hz; the first tube mode at a quite high 550Hz indicates good rigidity.

The strong 'coupling' of this model is seen in a plot of the acceleration recorded in the rigid subchassis (Logic) on which the 1100 was mounted, taken at the same time as the arm resonance graph. This shows that the cartridge can 'read' the mounting chassis *via* the arm on this model.

The second 'S' tube resonance graph used the detachable headshell and heavier counterweight, the latter's resonance mode now appears at 75Hz, with a headshell socket resonance at 190Hz; the remainder was quite tidy and well-controlled.

### Sound quality

Using a medium compliance cartridge (Technics EPC205 III), the low mass 1100 was the best of the three versions, offering a good standard of general clarity, frequency balance, stereo precision and ambient depth, plus good bass definition. The 'S' 1100 was quite well suited to moving-coil models of lower compliance, but had a hint of a less even tonal character in comparison, proving more forward in the lower mid-range and restrained in the treble. The sound of the 1010 was a touch firmer in the bass than the 'S' 1100, but it sounded somewhat hard and even slightly ringing in the midrange, where a loss of depth and stereo focus occurred with even the best cartridges. The tonal balance was a trifle 'dulled' overall.

### Conclusion

The 1100 is the best of the three, and provides a well balanced standard of performance at the price. The low mass, straight version gave fine results with the more delicate moving-coils, including Dynavector *Karats* and Denon models, while the 'S' tube is an accessory possessing

*continued overleaf*



# LINN



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considerable merit, allowing the use of headshell cartridges as well as models of lower compliance.

Compared to the 1100 'S', the 1010 would seem to be inferior in several respects. Nevertheless, the standard of performance is reasonable for the price.

**GENERAL DATA** **AT1100 (straight tube)**

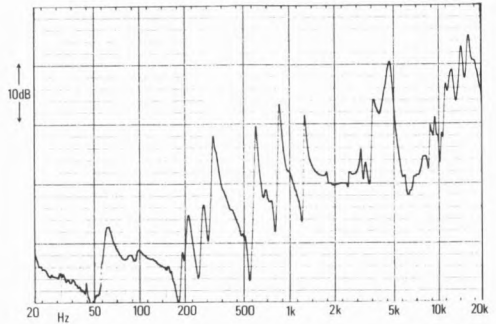
Approximate effective mass inc screws, excl cartridge . . . . . 6.0g  
 Type/mass of headshell . . . . . plug in straight arm/N/A  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . overhang, lateral angle, height  
 Finish and engineering . . . . . excellent/very good  
 Ease of assembly/setting up/use . . . . . excellent/very good/very good  
 Friction: typical lateral/vertical . . . . . 25mg/less than 10mg  
 Bias compensation method . . . . . weighted lever  
 Bias force: rim/centre (set to 1.5g elliptical) . . . . . 260mg/220mg  
 Downforce calibration error 1g/2g . . . . . +0.05g/-0.05g  
 Cue drift/8mm ascent/descent . . . . . negligible/0.5sec/2.2secs  
 Arm resonances . . . . . good  
 Subjective sound quality . . . . . good++  
 Lead capacitance/damping method . . . . . 95pF/fluid damping optional  
 Estimated typical purchase price . . . . . £120

**GENERAL DATA** **Tonearm**

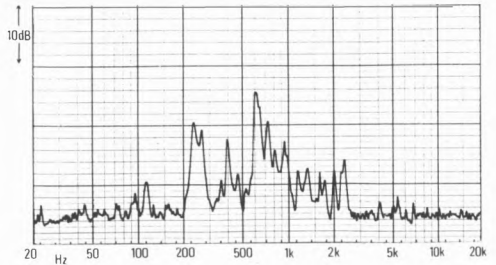
Approximate effective mass inc screws, excl cartridge . . . . . 12.5g  
 Type/mass of headshell . . . . . universal detachable on accessory 'S' tube/9g  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . tilt, overhang, height  
 Finish and engineering . . . . . excellent/very good  
 Ease of assembly/setting up/use . . . . . excellent/very good/very good  
 Friction: typical lateral/vertical . . . . . 50mg/less than 10mg  
 Bias compensation method . . . . . weighted lever  
 Bias force: rim/centre (set to 1.5g elliptical) . . . . . 300mg/280mg  
 Downforce calibration error 1g/2g . . . . . +0.02g/-0.05g  
 Cue drift/8mm ascent/descent . . . . . negligible/0.5sec/2.0secs  
 Arm resonances . . . . . fairly good  
 Subjective sound quality . . . . . good  
 Lead capacitance/damping method . . . . . 95pF/fluid damping optional  
 Estimated typical purchase price . . . . . £120

**GENERAL DATA** **AT 1010**

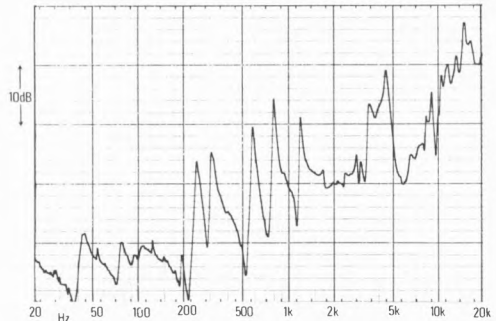
Approximate effective mass inc screws, excl cartridge . . . . . 16g  
 Type/mass of headshell . . . . . universal detachable/11g  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . overhang, tilt, height  
 Finish and engineering . . . . . excellent/very good  
 Ease of assembly/setting up/use . . . . . excellent/very good/very good  
 Friction: typical lateral/vertical . . . . . 30mg/less than 10mg  
 Bias compensation . . . . . weighted lever  
 Bias force: rim/centre (set to 1.5g elliptical) . . . . . 380mg/320mg  
 Downforce calibration error 1g/2g . . . . . -0.1g/-0.05g  
 Cue drift/8mm ascent/descent . . . . . slight/0.5sec/2.3secs  
 Arm resonances . . . . . fairly good  
 Subjective sound quality . . . . . good+  
 Lead capacitance/damping method . . . . . 95pF/some variable counterweight decoupling  
 Estimated typical purchase price . . . . . £160



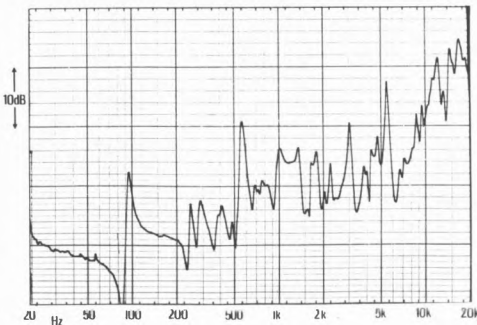
Arm resonances, tight damping, AT1010.



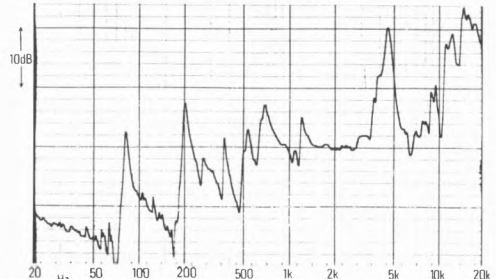
Vibration transmitted via AT1100 measured on Logic arm board.



Arm resonances, loose damping, AT1010.

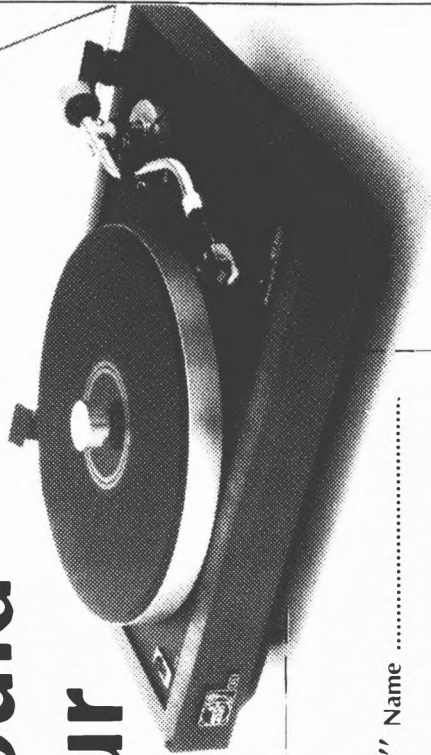


Arm resonances, fixed light counterweight, AT 1100.



Arm resonances, 'S' version with heavy counterweight.

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CH1

# Aurex SR-M70

Toshiba House, Frimley Road, Frimley, Camberley, Surrey.  
Tel (0276) 62222



## Features and design

Alightly built but inexpensive belt drive integrated turntable, the *SR-M70* is one of those products where, in our opinion, fidelity has been sacrificed in favour of a clever operational feature. In this case a sensor system is fitted which allows the starting point on a record to be pre-selected by a process of band counting. For example, it can start on band three having missed the first two, and while playing three it can then be programmed to skip further tracks before playing the next selected one. It does not however have the ability to store a sequence of tracks in any special order; furthermore, while an ability to count to 10 is provided, the start buttons only go to five, and higher numbers must be obtained by addition! Auto return and stop are also featured, together with a fine speed control and a mains referenced stroboscope. The usual light and resonant plastic lid is fitted, and the plinth feet offer minimal isolation.

The tonearm uses many plastic components including the non-detachable headshell. Total moving mass was some 20g, suitable for the specified cartridge compliance of 8cu, and in fact the cartridge fitted is a special one, although Aurex do not mention this in any of the literature. The record sensor is inbuilt, and hence the cartridge cannot be changed. It comprises a basic moving magnet model, equipped with a shank mounted spherical stylus and a quoted compliance of 8cu, with a 2g tracking force. It was factory fitted and supplied slightly out of alignment, but this was probably an insufficient error to produce any major change in sound quality.

A rather light 0.8kg platter was fitted with a mat which offered some disc support, but platter resonance itself prevented the use of expanded scaling for the disc impulse response. Neither could the arm resonance curve be taken; instead the frequency response and separation of the fitted cartridge was measured, with results not unlike those for the Linn *Basik* model. (Note that the small regular blips on the trace are from the test record and not the responsibility of the cartridge.)

## Lab results

The cartridge was a satisfactory tracker at a 2g downforce, giving a 20Hz to 20kHz response  $\pm 2.5$ dB, a channel separation of around 27dB midband, and a good 16dB plus from 10kHz to 20kHz. The loss in separation at 200Hz was probably due to an arm/headshell flexure.

While wow and flutter results were good, the rumble performance was not of true hi-fi calibre, measuring an average  $-65$ dB DIN B. Spectral analysis revealed a whole chain of motor vibration harmonics, which were audible on audition. Vibration isolation was also poorer than average, while below 250Hz the acoustic isolation was distinctly poor. The disc impulse test was dominated by a severe low frequency platter rock at 20Hz. Although considerable play was evident in the bearings, the arm exhibited satisfactory friction and biasing, and the automatics (cue rate, etc) were all fine.

## Sound quality

Putting considerations of price aside for the moment, the sound did not find favour with the

panelists. The treble appeared 'splashily' emphasised, and was not very clean, while little front to back depth was apparent. The unit showed a tendency to feedback at high levels. Coloration was evident in the midrange, and the bass was 'softened' with weak transient attack plus a notable loss of extreme low frequency power. On very quiet program some motor noise was also audible.

### Conclusion

The partial automation of programme detection and space skipping have clearly taken a heavy toll in this model, and it would not be unfair to describe it as a 'music centre' product. It was not unpleasant to listen to, but the sound had little to do with quality reproduction in the *Choice* context, so this deck cannot be recommended.

### GENERAL DATA

Integrated Turntable

#### Motor Section

Type ..... auto belt drive, track selection  
 Platter mass/damping ..... 0.8kg/fairly good  
 Finish and engineering ..... very good/fair  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... 33/45rpm (variable)  
 Wow and flutter (DIN peak wtd sigma 2) ..... 0.07%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... 0.15%/0.08%  
 Absolute speed error ..... variable  
 Speed drift 1 hour/load variation ..... -0.4%/ -0.4%  
 Start up time to audible stabilisation ..... approx 1.5secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -62/-67dB

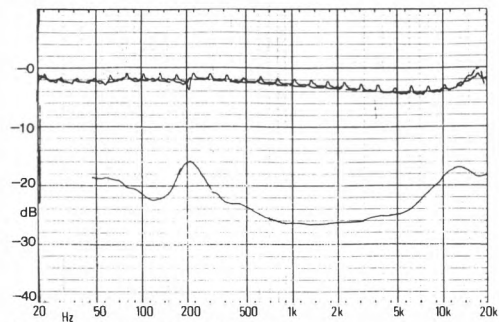
#### Arm Section

Approximate effective mass inc screws, incl sensor cartridge ..... 20g  
 Type/mass of headshell ..... non detachable/N/A  
 Geometric accuracy ..... fairly good  
 Adjustments provided ..... overhang, lateral angle  
 Finish and engineering ..... good/good  
 Ease of assembly/setting up/use ..... very good/very good/very good +

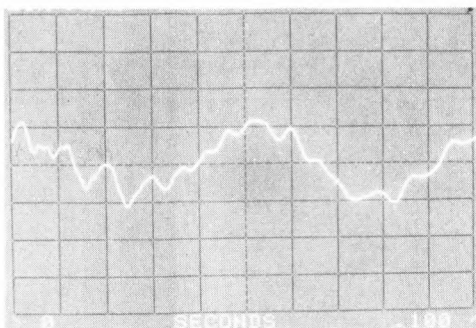
Friction: typical lateral/vertical ..... 60mg/60mg  
 Bias compensation method ..... internal spring  
 Bias force: rim/centre (set to 1.5g elliptical) ..... 220mg/200mg  
 Downforce calibration error: 1g/2g ..... -0.2g/-0.15g  
 Cue drift/8mm ascent/descent ..... negligible/1.3secs/1.5secs  
 Arm resonances ..... not applicable  
 Subjective sound quality ..... see cartridge response  
 Damping method ..... Decoupled counterweight

#### System as a whole

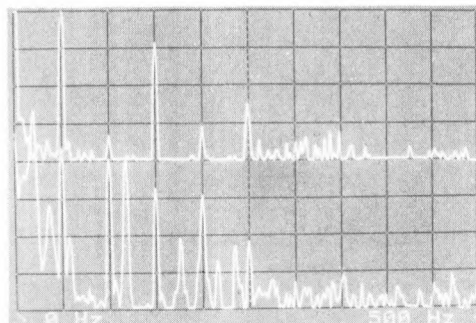
Size/clearance for lid rear ..... 42.0(w) x 38.0(d) x 13.0(h)/5.5cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... poor  
 Subjective sound quality of complete system ..... fair only  
 Hum level/acoustic feedback ..... fairly good/below average  
 Vibration sensitivity/shock resistance ..... below average/good  
 Estimated typical purchase price ..... £121



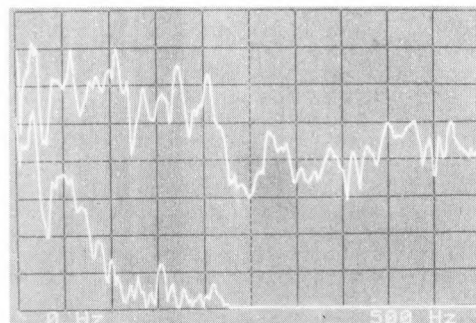
Cartridge response/crosstalk.



Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

# Aurex SR-Q770

Toshiba House, Frimley Road, Frimley, Camberley, Surrey.  
Tel (0276) 62222



## Features and design

As the Q in this model's title implies, this Aurex uses a quartz-locked direct drive motor. But lest this convey an image of overall quality engineering, note should be taken of the very light 0.7 kg platter, a considerable proportion of which is supplied by the weight of the rubber mat!

Possessing fewer automatic features than the SRM-70, the 770 nevertheless incorporates record size detection cueing, accomplished once the correct speed has been set; auto-return at end of side is also fitted. For some unknown reason a digital readout of the record speed is given, despite it being already indicated on the speed selector; fine pitch control is not included.

At 5.5 kg the whole player weighs less than some audiophile platters alone. The light plastic lid was highly resonant in acoustic terms, and the situation is aggravated because the resulting vibrations are coupled straight into the plastic plinth. Little attention has been paid to vibration isolation, with rubber feet providing a plinth support resonance in the 10–15Hz range; this is above the likely arm/cartridge resonance, but is in the cartridge operating area nevertheless.

The arm was not particularly rigid, with some play evident in the bearings, and it uses a fairly popular detachable Japanese low mass headshell, made of lightweight plastic and fixed by a clampscrew. The overall effective mass of 8.5g suggests cartridges in the 15–30cu range.

## Lab results

In practice the motor was fairly respectable, providing sufficient torque as well as a servo system free of dynamic wow effects. Wow and flutter was well controlled, and as with all quartz lock models speed accuracy and stability were beyond reproach.

Rumble was satisfactory at  $-71/72$ dB DIN B weighted, but spectrum analysis showed that the motor produced quite a strong electrical pole switching field, reflected by the pole harmonics in the electrical graph. Comparison with the total rumble (below) reveals further pole harmonics of a mechanical nature, and this is evidently not a very 'clean' motor. X1 scaling was essential for the disc and impulse transmission graph, which showed moderate mid damping dominated by a severe platter mode at 30Hz. Vibration isolation was acceptable, but the acoustic breakthrough result only merited a 'poor' rating.

The arm was satisfactory with respect to biasing, friction and geometry, but unpromising in terms of audio band resonance analysis. The counterweight resonated at 55Hz, followed by the headshell at 150Hz (with a rattle). This then led to a complex multiple breakup sequence, with the energy levels falling rather than rising (as should have been the case). We found the arm cue lever was a little stiff, and rather limited space was provided in the headshell to accommodate longer cartridges.

## Sound quality

Immediately this turntable was used at high sound levels, feedback problems became apparent, requiring careful siting for their amelioration. The bass register was 'boomy' and lacked depth while the stereo was 'flat' with noticeable midrange coloration. Tonally the sound was unbalanced, with a mid/treble 'sharpness' and 'hardness', while detail was significantly blurred.

## Conclusion

On sound quality grounds alone no recommendation is possible for this model. Furthermore, the rumble performance was below par, and the player was also feedback prone. However modestly priced, it cannot be said to offer 'sound' value for money.

## GENERAL DATA

Integrated Turntable

### Motor Section

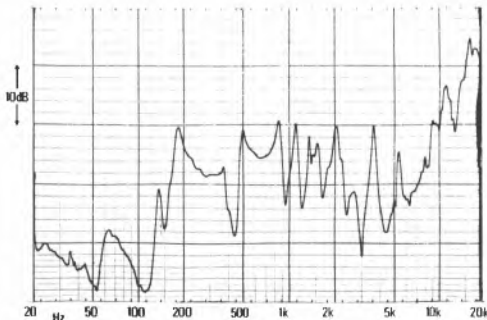
Type..... direct drive, quartz lock, fully automatic  
 Platter mass/damping ..... 0.7 kg/fairly good  
 Finish and engineering ..... very good/good  
 Type of mains lead/connecting leads ... 2 core/phonos + earth  
 Speed options ..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... 0.06%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... <0.1%/<0.01%  
 Absolute speed error ..... <0.01%  
 Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
 Start up time to audible stabilisation ..... approx 1.2secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -71/72dB

### Arm Section

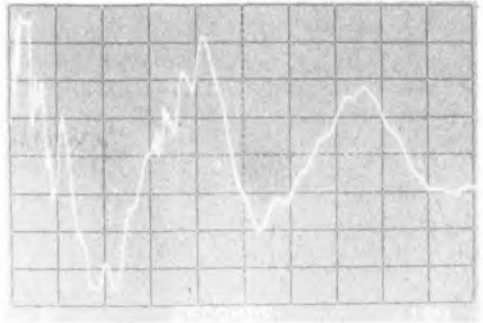
Approximate effective mass inc screws, excl cartridge .... 8.5g  
 Type/mass of headshell .... special detachable (ADC type)/4.5g  
 Geometric accuracy ..... very good  
 Adjustments provided ..... overhang, lateral angle  
 Finish and engineering ..... very good/good  
 Ease of assembly/setting up/use ... very good/very good/very good  
 Friction: typical lateral/vertical ..... less than 30mg/less than 30mg  
 Bias compensation method ..... spring  
 Bias force: rim/centre (set to 1.5g elliptical) ..... 220mg/180mg  
 Downforce calibration error: 1g/2g ..... 0.00g/0.05g  
 Cue drift/8mm ascent/descent ..... negligible/0.5sec/1.0sec  
 Arm resonances ..... fair  
 Lead capacitance/damping method ..... 175pF/decoupled counterweight

### System as a whole

Size/clearance for lid rear ..... 42.0(w) x 38.2(d) x 12.5(h)/6cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... below average  
 Subjective sound quality of complete system ..... below average  
 Hum level/acoustic feedback ..... fairly good/below average  
 Vibration sensitivity/shock resistance ... below average/fairly good  
 Estimated typical purchase price ..... £140



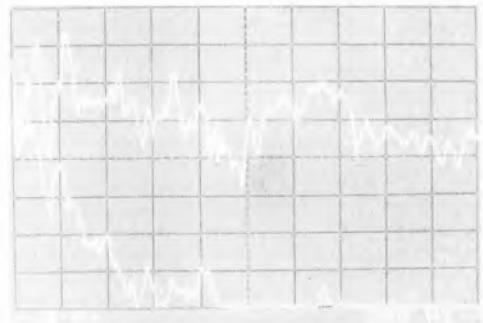
Structural arm resonances, audio band.



Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

# Beogram 1700

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



## Features and design

Briefly mentioned in the last issue, the 1700 has now been in full production for some time, sporting an impossibly thin looking tonearm plus B&O plug-in cartridge. In many respects it represents a development from the established 2200/1500 models which were strongly recommended in previous editions, using the same ultra-light alloy platter (0.45kg) with support patches of sprayed *nextel* suede paint, but no mat proper.

This automatic deck offers two speeds *via* push button controls. Manual track selection is also possible by pushing the cued-up tonearm, but as the sequences are otherwise 'hands free' no finger lift is provided. The cartridge from the 20 series is fitted with a non-detachable spherical tipped diamond stylus, and comes complete with a calibration certificate.

The 1700 is belt-driven from a small DC motor, and an effective gravity/leaf spring suspension based on a light steel sheet subchassis is used. Physical examination showed that the arm was a very light structure, with vertical knife edge bearings, the whole almost loosely fitted by gravity in its mounting pillar assembly. In representing the antithesis of the usual strength and rigidity expected of a tonearm, it was particularly interesting to investigate its sonic performance.

## Lab results

While the light platter offered little potential for either support or damping, requiring the 'X1' scale to illustrate its 'transient response', it was rather better behaved than that of the much more costly 8000, presumably because the *nextel* patches did contact at least some of the disc surface area.

The turntable started up rapidly, and the automatic cycle was very quick to engage the leading grooves. Wow and flutter was low in DIN peak-weighted form, but was not so clean un-weighted, suggesting that it might have been optimised for the specification. Speed slowing under load was a trifle high at 0.5%, but the torque was more than sufficient for the cartridge supplied. Rumble was fine, and better than for previous designs.

The arm proved to be well adjusted with respect to friction and bias, and suited to tracking in the 1.5 to 2.0g range. Effective mass was very low at an estimated 6.5g *including* the cartridge, endowing the combination with a stable subsonic resonance in the preferred range (12.5Hz) well clear of the subchassis modes at approximately 5Hz.

Plotted using its own 20S cartridge strictly speaking the arm resonance curve is not comparable with the others; but it does nevertheless give some idea of the arm's behaviour. The potential problem area between 200 and 600Hz defined by the low arm rigidity has been skilfully suppressed, and in terms of termination and damping as well as resonance the graph looks good, offering an improvement over the 8000 in fact.

The graphs also show that this model is much better than average on grounds of acoustic and vibration isolation, confirming the quality of the simple subchassis design.

## Sound quality

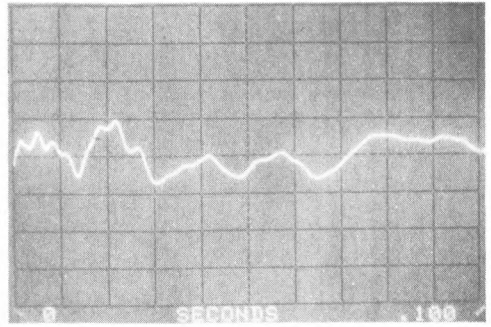
Exhibiting excellent shock resistance and acoustic feedback behaviour, the 1700 was a little above average for its price class overall. The subjective character was softer and less well-



focused than the 8000, and although free of unpleasant coloration or emphasis, it seemed somewhat muddled, complex material not being well separated in the stereo stage. Impact and ambience were also lacking.

**Conclusion**

This trim automatic player has taken the goal of component lightness too far, and despite control of resonance and fine isolation the sound did not cohere to the extent which is possible with more substantial and rigidly constructed systems. It is however worth recommendation at its modest price, especially for a B&O matching system. It will survive adverse environments and the included cartridge is also to its advantage.



Disc impulse transmission, standard X1.

**GENERAL DATA**

**Motor Section**

Type ..... belt drive, fully automatic  
 Platter mass/damping (outer platter) ..... 0.45kg/fair  
 Finish and engineering ..... very good/good  
 Type of mains lead/connecting leads ..... 2 core/DIN  
 Speed options ..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... 0.08%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... 0.14%/0.16%  
 Absolute speed error ..... -0.1%  
 Speed drift 1 hour/load variation ..... <0.15%/-0.5%  
 Start up time to audible stabilisation ..... <1.5secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -75dB

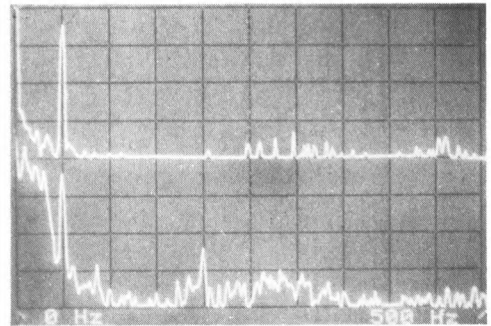
**Integrated Turntable**

**Arm Section**

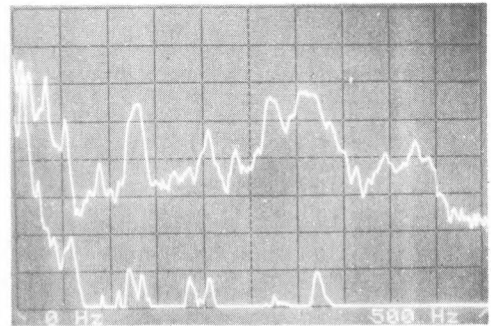
Approximate effective mass inc screws ..... 6g incl cartridge  
 Type/mass of headshell ..... N/A / N/A  
 Geometric accuracy ..... very good  
 Adjustments provided ..... downforce  
 Finish and engineering ..... good/fairly good  
 Ease of assembly/setting up/use ..... excellent/excellent/excellent  
 Friction: typical lateral/vertical ..... est <50mg/est <30mg  
 Bias compensation method ..... internal spring  
 Bias force: rim/centre (set to 1.5g elliptical) ..... 150mg/250mg  
 Downforce calibration error: 1g/2g ..... +0.1g/-0.15g  
 Cue drift/8mm ascent/descent ..... negligible/1 sec/1 sec  
 Arm resonances ..... graphed with B&O cartridge  
 Damping method ..... N/A

**System as a whole**

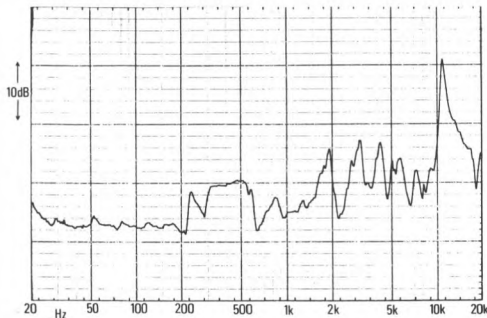
Size/clearance for lid rear ... 44.0(w) x 33.0(d) x 9.5 (h)/not required  
 Ease of use ..... excellent  
 Typical acoustic breakthrough and resonances ..... very good  
 Subjective sound quality of complete system ..... above average  
 Hum level/acoustic feedback ..... very good/excellent  
 Vibration sensitivity/shock resistance ..... very good/very good  
 Estimated typical purchase price ..... £99



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

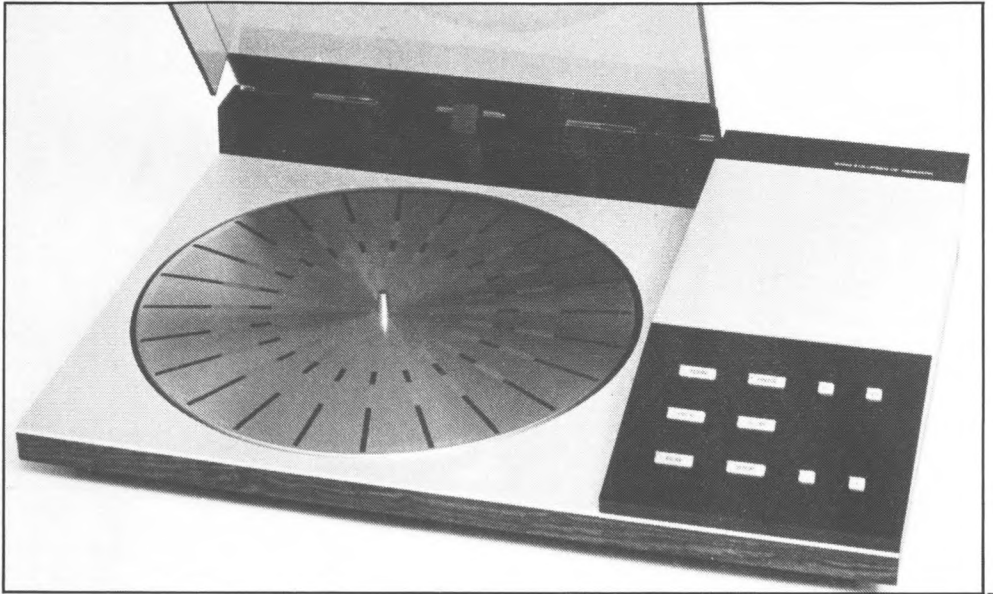


Arm resonances, B&O 20S cartridge.

RECOMMENDED

# Beogram 8002

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



Replacing the previously-reviewed 8000, the 8002 incorporates a number of significant improvements. There is a 'remote control' terminal at the rear which, via a single cable, links both audio signals and control facilities to a matching B&O receiver, and a neat infra red remote control supplied with the receiver allows complete command of the turntable. The deck of course complements the elegant and unified Scandinavian styling of the other B&O components.

The 8002 is an automatic player with photo-electric sensing of record presence and size – hence, on the remote, functions of start, stop and pause/cue lift, are all that is required. The central control interface in the receiver will also accept data from the turntable when operated manually. With the remote disconnected, the turntable may be operated in a conventional manner with a DIN to phono audio adaptor lead.

Other salient features include micro-processor control via B&O's versatile and ergonomically angled touch-button panel. Two speeds are available, with incremental pitch variation monitored by a large three digit LED display. Repeat playing may also be selected up to a maximum of nine times, while the arm is servo controlled with touch-button cueing

and proportional arm traverse. Most important perhaps is the superbly executed sub-chassis system, based on a near-perfect pendulum suspension with adjustable leaf springs. A heavy steel sub-chassis plate provides the foundation for the drive and also the complex arm assemblies.

The direct-drive motor system applies power via magnetic eddy currents induced in an aluminium drum located beneath the platter, speed being under full servo control. The platter has been considerably revised by comparison with earlier models and the oft-criticised hard plastic ribs have been supplanted by a platter with thin film Nextel pads for support and photo electric detection. These are just 0.15mm high and provide a good non-scratch interface with the disc, resulting in much improved record contact and damping. B&O claim the platter is deliberately light (0.6kg) so that the record damps the platter, and *vice-versa*.

The tonearm is an ultra low mass design of integrated concept and matches B&O's new range of quality lightweight cartridges. The model fitted in fact weighs just 1.6g – it is a detachable cartridge, to be replaced entirely when the stylus is worn or damaged. Total effective mass with cartridge is a little under

7g. This integration results in foolproof installation, correct geometry and proper stylus compliance-tonearm compatibility, with the subsonic resonance placed in the ideal 12-14Hz range providing excellent warp immunity. The tonearm is a linear or parallel tracking design, traverse provided by a near-silent servo controlled leadscrew. Photo-electric detection of tracking angle holds errors to a miniscule  $\pm 0.04$  deg or less, and bias compensation is not required. The box-beam arm tube is constructed of hard drawn brass which gives satisfactory rigidity despite its pencil-like thinness.

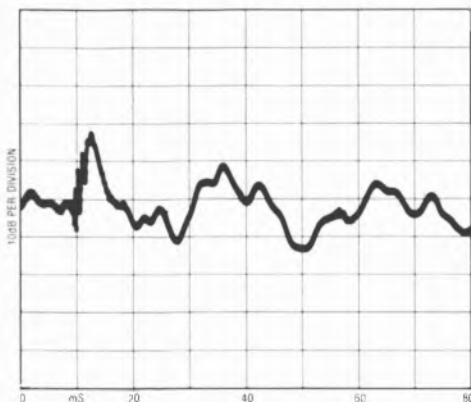
The cartridge must be assessed in the context of its inclusion in the integrated turntable package. The 8002 is fitted with the topline MMC2 (the MMC1 is only a selected version of this), a brand new B&O design with a hollow sapphire cantilever. It uses a semi-line-contact, grain-orientated naked stylus tip of very low tip mass, tracking confidently at just 1g downforce. 20Hz to 20kHz is specified within  $\pm 1.5$ dB, with a reduced sensitivity to load and temperature, by comparison with earlier versions. Separation is quoted as 25dB minimum at 1kHz and better than 20dB from 50Hz to 15kHz.

### Lab report

The 8002 proved to have an excellent motor section with textbook levels of wow and flutter, and unweighted wow. Speed was accurate and freedom from speed variation under load was fine. Start-up time was, inconsequentially, average at 2.5 seconds. DIN B rumble was low at  $-77$ dB, with no motor harmonics visible and just a trace of 200Hz mains supply breakthrough. As testified by the impulse photo, disc damping was effective, a result vastly better than previously attained. The arm collected a list of 'excellents' for geometric accuracy, finish, engineering, ease of assembly, setting up and use. Cue rate was safe and rapid, minimising record damage.

However, most arm parameters could not be measured due to the servo control although they could be inferred from the excellent tracking performance of the cartridge at a 1g downforce. An insensitive arm would not allow this high standard. Arm resonances were plotted with the supplied cartridges, the behaviour indicated being above average in view of the main energy continuity through the spectrum. It was not free of breakup, this beginning as low as 200Hz with further modes at 350Hz, 800Hz, 1kHz and 2.5kHz, and these were just sufficient to impose small blips on the steady state frequency response of the cartridge.

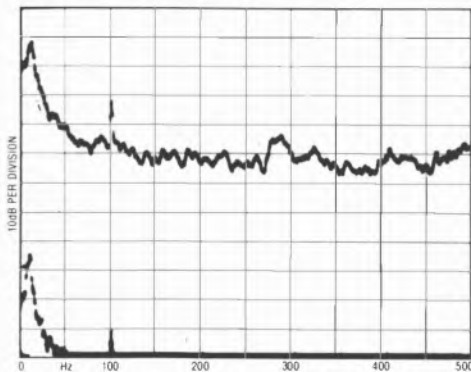
*continued on page 66*



*Disc impulse transmission showing damping*



*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

Proving very good on acoustic breakthrough, and excellent as regards vibration resistance and feedback margin, the deck also demonstrated outstanding shock immunity. The cartridge delivered a good performance on this abbreviated evaluation (it will be reviewed fully in a future Hi-Fi Choice) with the response meeting  $\pm 1.5\text{dB}$  limits as specified from 35Hz to 20kHz, having an impressively uniform treble range. Mid-band separation reached 34dB but, on this test at least, was curtailed somewhat at high frequencies.

**Sound quality**

Addedition complete with cartridge, the 8002 attained a substantially good standard even by comparison with audiophile exotica using costly moving-coil cartridges. First impressions were of a confident and firm presentation with good timing and pitch, plus a tuneful articulate bass line. Surfaces were quieter than usual, while the midrange was well projected with good detail and stable stereo focusing. Slight mid 'horniness' or hardness was noted, but the treble did not draw attention to itself, and was slightly depressed or 'laid back' – not a bad thing with some records! Stereo stages were well rendered with promising depth and ambience.

**Conclusion**

After years of personal campaigning for B&O to refine their tangential player particularly with respect to the platter, I am pleased to say the 8002 has finally done the trick. A high quality, foolproof automatic player, it deserves serious attention. Viewed as a package the price is realistic, the sound quality good overall and particularly acceptable as regards pitch, timing and bass quality. B&O aficionados and indeed others can confidently consider this elegant creation, as the 8002 wins a recommendation this year.

*Note: Our sample 8002 was supplied well ahead of first production in order to meet deadlines for this issue. We have since learned that the main resonance modes in the tonearm have responded to the application of damping. A very similar belt-drive version is soon to be released – the 6002 at £295 and the non-remote control TX which gives the user the choice of any B&O cartridge, being supplied without cartridge at £ . On the basis of our previous experience with B&O belt drives, these models should also be worthy of recommendation.*

**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

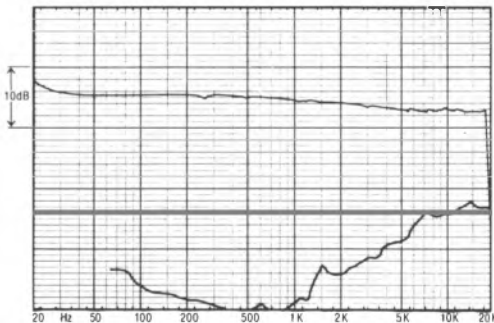
Type . . . . . fully automatic, linear-tracking, direct drive  
 Platter mass/damping . . . . . 0.6kg/good  
 Finish and engineering . . . . . excellent/excellent  
 Type of mains/connecting leads . . . . . 2-core/5-pin DIN  
 Speed options . . . . . variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . less than 0.06%/0.05%  
 Absolute speed error . . . . . – 0.05%  
 Speed drift, 1 hour/load variation . . . . . less than 0.05%/– 0.1%  
 Start-up time to audible stabilisation . . . . . 2.5 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . – 77 dB

**Arm Section**

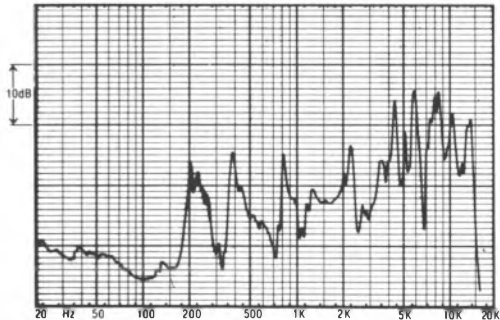
Approximate effective mass, inc screws, excl cartridge . . . 52g  
 Type/mass of headshell . . . . . special, non-detachable  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . none  
 Finish and engineering . . . . . excellent/excellent  
 Ease of assembly/setting-up/use . . . . . excellent/excellent/excellent  
 Friction, typical lateral/vertical . . . . . N/A  
 Bias compensation method . . . . . N/A  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . N/A  
 Downforce calibration error, 1g/2g . . . . . N/A  
 Cue drift, 4mm ascent/descent . . . . . none, 0.3 secs/0.8 secs  
 Arm resonances . . . . . above average  
 Subjective sound quality . . . . . good  
 Lead capacitance/damping method . . . . . –/none

**System as a whole**

Size/clearance for lid rear . . . . . 49(w) x 38(d) x 8.5(h)/none  
 Ease of use . . . . . excellent  
 Typical acoustic breakthrough and resonances . . . . . very good  
 Subjective sound quality of complete system . . . . . good +  
 Hum level/acoustic feedback . . . . . very good/excellent  
 Vibration sensitivity/shock resistance . . . . . excellent/very good  
 Estimated typical purchase price . . . . . £450



Frequency response and separation, cartridge



Structural arm resonances, audio band

---

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Happily life's ups and downs hold no terrors for our Series III precision pick-up arms. These agile performers allow the cartridge to follow surface irregularities closely, minimising the effects of warp and eccentricity.

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SME Limited, Steyning, Sussex,  
BN4 3GY England  
☎ Steyning (0903) 814321  
Telex: 877808 SME G



**SME**

## Dais 'Heavy'

Ambience Audio Ltd, Holly Bank, 145B Buxton Road, Heverley, Stockport, Cheshire  
Tel 061-483 9656



An early version of this design was assessed in the previous edition when it carried the Image name. Still made in the UK by Newline Engineering, the Dias, in addition to its new name, also has a new distributor. Two versions of this substantial subchassis turntable are available — the standard model which carries the original 4.4kg platter and the 'Heavy,' where the platter mass rises to 7.0kg. The heavier platter may in fact be retrofitted to the standard version on an exchange basis on payment of the price difference of around £80. The 'Heavy' version is the main subject of this review but we are reliably informed that though the context of a £1000-plus player system the larger platter is worthwhile, the nonetheless substantial 4.4kg 'standard' version represents only a small compromise in performance.

With a distinctive cylindrical shape, and now finished in superb black gloss, the Dias has an arm mounting consisting of and outrigger extension of the exposed subchassis. A conventional three-point spring suspension is used with one spring arranged as a rotational mode canceller by virtue of its asymetry and its contra-spiral winding.

As before, a slow speed synchronous mains motor provides power via a white silicone-rubber cord, end-joined and of round section, the grooved pulley having two diameters for 33 $\frac{1}{3}$  and 45 rpm. The base 'plinth' is of gravity-cast aluminium, the interior including an 11-ply wood reinforcement for damping. Top surface

access to the alignment bolts (massive socket-head screws) is convenient although there is no provision for base levelling (this is also true of the Linn). The turntable is also very awkward to move once set up, and is best assembled on site, then left alone thereafter. The main subchassis resonance is rather low at 3-3.5Hz and after-shock recovery is consequently rather slow. The original Image sample showed a distinct tendency to rotate about the platter's centre of mass at around 8Hz, inducing scrub flutter and exciting the cartridge subsonic resonance — but this problem is certainly cured with the Dias.

The platter comes with a felt mat which may be discarded allowing direct record contact with the well finished platter surface. No recess is however provided for label or rim, so this suggestion is not as sound as it might be. An acrylic disc is provided to prevent dust from accumulating on the mat, but the arm is left to the elements, unless an additional £100 is spent on a custom acrylic box cover for the entire unit.

### Lab report

Large rubber inserts on the massive platter result in a rather dead assembly, which despite the felt mat produced a well damped impulse response. Wow and flutter was good at 0.08% DIN weighted. Flutter readings were low, but the pure wow residual was poorer than expected from this class of turntable — 0.14% was

recorded, and observation of the absolute speed indicator revealed cyclic wow probably associated with belt join, a point noted with the previous version. Absolute speed was fine, with only a 0.1% error, and load variation satisfactory at -0.25%. Start-up was slow at 5 seconds.

Rumble remains a problem with this model, the right channel proving fine at 78dB but with the left only resolving -70dB. Subjectively, this is good enough, but not in the superfi class. Motor harmonic breakthrough is the cause and would justify further attention. Rated excellent on acoustic breakthrough and vibration coupling, the Dias was very good on feedback and satisfactory as regards shock immunity.

### Sound quality

Augmented with the Zeta arm, which made a handsome combination, the Dias met top-class standards. Bass was notably clean, even and deep with excellent tonal differentiation; while stereo images were well focused and spacious, with an impression of a strong foundation. Feedback was not detectable in our set up. Two very slight reservations were expressed, one concerning a feeling of slight midband congestion and the other a marginal loss of absolute security of pitch on transient programme — the mild cyclic wow perhaps? The measured motor breakthrough apparently passed unnoticed.

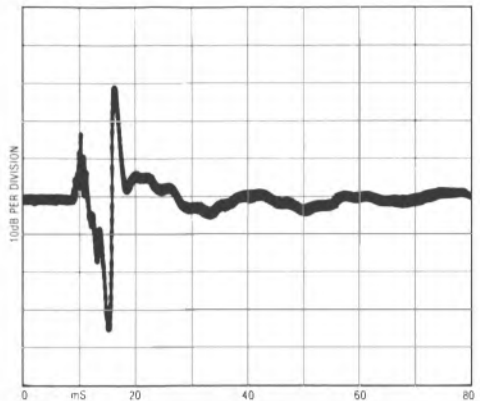
### Conclusion

I am still left with the feeling that the Dias has further potential waiting to be realised. When the dust cover is taken into account, both versions are very costly and hence would need to be virtually perfect to ensure a *Choice* recommendation. This might come with a little further development. The Dias can undeniably produce a very good sound with first-rate bass, but as it stands it suffers slightly by virtue of some minor flaws.

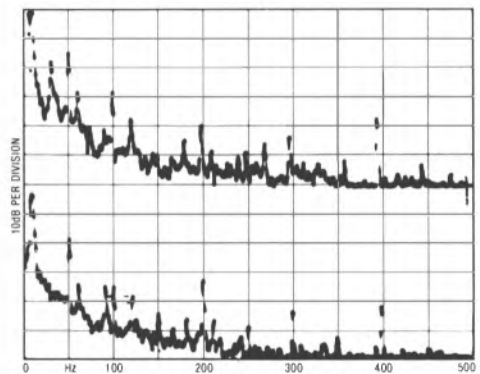
### GENERAL DATA

|  |                                   |
|--|-----------------------------------|
| Type   | Motor unit belt-drive, subchassis |
| Platter mass/damping                           | 7.0kg (*4.4kg)/very good          |
| Finish and engineering                         | excellent/excellent               |
| Type of mains/connecting leads                 | 3-core                            |
| Speed options                                  | manual change, 33/45 rpm          |
| Wow and flutter (DIN peak wtd, sigma 2)        | 0.08%                             |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.14%/0.06%                       |
| Absolute speed error                           | -0.1%                             |
| Speed drift, 1 hour/load variation             | synchronous - 0.25%               |
| Start-up time to audible stabilisation         | 5.5 secs                          |
| Rumble, DIN B wtd L/R average (see spectrum)   | -70/-78 dB                        |
| Size/clearance for lid rear                    | 46(w) x 33(d) x 13(h)/none        |
| Ease of use                                    | fairly good                       |
| Typical acoustic breakthrough and resonances   | excellent                         |
| Subjective sound quality of complete system    | very good                         |
| Hum level/acoustic feedback                    | good/very good                    |
| Vibration sensitivity/shock resistance         | excellent/fairly good             |
| Estimated typical purchase price               | £480 (*£399)                      |

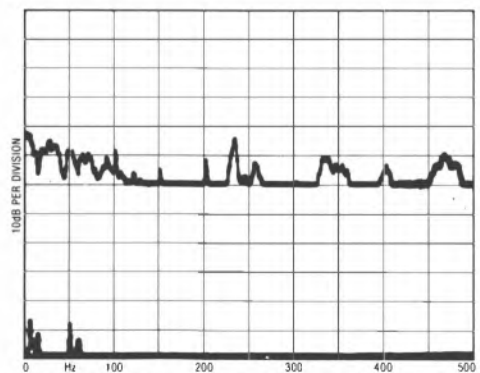
*\*\*Standard' version - all tests on 'Heavy' version*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

# Dual CS505-1AM

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Gerrards Cross, Bucks  
Tel (02813) 88447



First impressions of this revised stalwart were none too promising and little hope was held out for its success in our competitive context. But as testing proceeded it gained ground, and after the listening sessions virtues were no longer in doubt.

A classic spring-suspended turntable using a flanged steel deckplate/chassis, the 505 is an inexpensive design which now comes fitted with a promising Ortofon *LM10* cartridge. For the latest version the arm counterweight has been simplified to reduce spurious resonances, while the suspension spring compliance had also been lowered, and a superior flat type of mat fitted.

Belt-driven from a 16 pole synchronous motor the 505 is fitted with vari-pitch speed control. The motor pulley is multilobed and may be expanded or contracted by mild degrees to provide fine pitch variation.

Since it came fitted with a worthwhile cartridge, reaping the benefits of the low-mass integration of the cartridge and special arm fixing, the player was assessed as a complete unit. Used in this way, the arm effective mass is a low 5g, complementing the *Concorde*-style cartridge. Dual have always produced arms with higher than average sensitivity and they have not skimped on this one. Although of rather light construction, the design is rigid, with low friction and excellent bearing adjustment free of play, while both downforce and biasing are well executed.

## Lab report

Platter mass has been slightly reduced for this latest 505 but the improved mat has resulted in

better record damping and termination; all transients decay more quickly. Wow and flutter was fine on this sample, with balanced results for the separate components. Speed error was negligible and slowing under load small at 0.2%, with start-up average at 2.3 seconds.

Rumble was however just satisfactory and I feel it could and should have been improved — the 505 has been borderline on rumble for some years now. The platter bearing alone measured — 78dB, the poorer result entirely the fault of the motor vibration breakthrough.

The arm's basic parameters measured very well, with low friction, sensible biasing and reasonably accurate downforce calibration. As noted previously the resonance graph illustrates a fairly wild behaviour, the plot taken this year with the cartridge supplied. The 300Hz mode easily imposes itself on both the frequency response and the crosstalk curve of the attached cartridge, which is shown with two loading combinations, 200pF and the preferable 450pF. The Dual arm supplied 180pF of lead capacitance, to which the amplifier's contribution is added in practice.

Ease of use was highly rated on grounds of its semi-automatic operation. Vibration isolation was certainly improved and attained a good standard, while acoustic breakthrough was fairly good, feedback low, and shock immunity good.

## Sound quality

Within moments of starting the listening tests it was clear that the 505 sound had improved despite the marginal rumble measurements, and the end result was well above average. The stereo image was stable and quite well focused with surprising depth for a deck at this price. The overall tonal balance was quite neutral and detail was present at both extremes of the musical spectrum without serious exaggeration. Some mild coloration was noted, associated with the arm, and by comparison with far more costly systems it would appear that the 505 is a trifle 'loud' and 'brash'.

## Conclusion

Selling at under £80 inclusive of cartridge, in its improved form the 505 is an impressive, easy to use and fuss-free turntable system with a number of useful facilities. With a slight reservation concerning motor breakthrough, the unit nonetheless scores a full recommendation.



**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

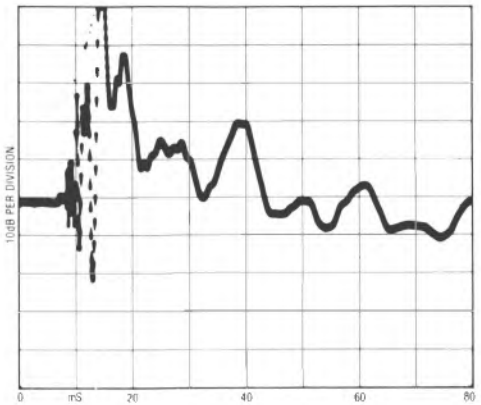
Type... semi-auto, belt drive synchronous motor, subchassis  
 Platter mass/damping... 0.8kg/above average  
 Finish and engineering... very good/good  
 Type of mains/connecting leads... 2-core/phonos and earth  
 Speed options... variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd. sigma 2)... 0.08%  
 Wow and flutter (LIN peak wtd 0.26Hz/6-300Hz)... 0.09%/0.07%  
 Absolute speed error... -0.05%  
 Speed drift, 1 hour/load variation... 0.05%/ -0.2%  
 Start-up time to audible stabilisation... 2.3 sec  
 Rumble, DIN B wtd L/R average (see spectrum)... -67 dB

**Arm Section**

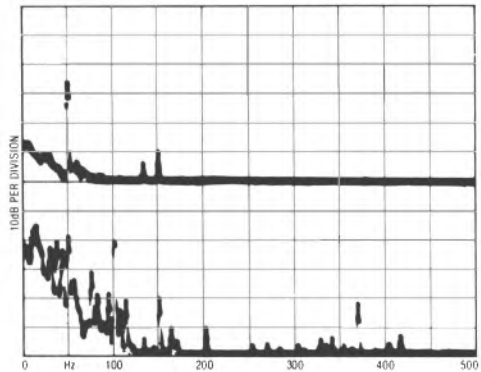
Approximate effective mass, inc screws, excl cartridge... \*5g  
 Type/mass of headshell... detachable special bracket/N/A  
 Geometric accuracy... very good  
 Adjustments provided... overhang/offset  
 Finish and engineering... very good/very good  
 Ease of assembly/setting-up/use... very good/very good/good  
 Friction, typical lateral/vertical... 30mg/10mg  
 Bias compensation method... internal spring  
 Bias force, rim/centre (set to 1.5g elliptical)... 250mg/260mg  
 Downforce calibration error, 1g/2g... +0.1g/+0.1g  
 Cue drift, 8mm ascent/descent... none, 1.5 secs/1.7 secs  
 Arm resonances... below average  
 Subjective sound quality... average +  
 Lead capacitance/damping method  
 180pF/decoupled counterweight

**System as a whole**

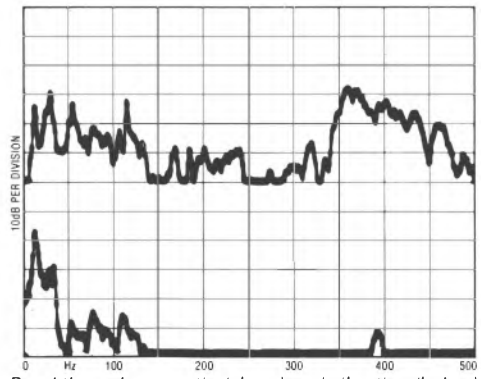
Size/clearance for lid rear... 43.5(w) x 36.5(d) x 13.5(h)/7.5cm  
 Ease of use... very good  
 Typical acoustic breakthrough and resonances... fairly good  
 Subjective sound quality of complete system... average +  
 Hum level/acoustic feedback... good/good  
 Vibration sensitivity/shock resistance... good/good  
 Estimated typical purchase price... £80  
 \*without accessory mounting bracket



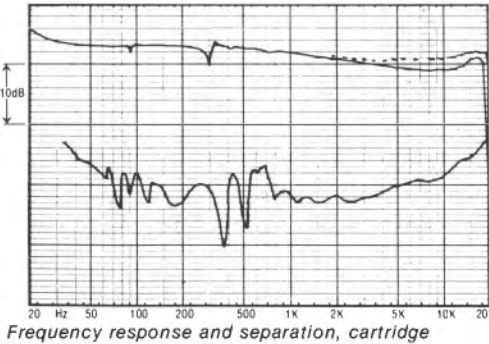
*Disc impulse transmission showing damping*



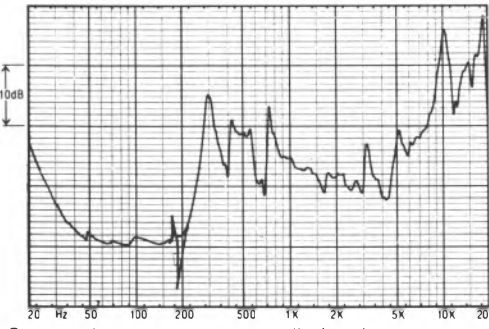
*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*



*Frequency response and separation, cartridge*



*Structural arm resonances, audio band*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

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Clem Brown HIFI FOR PLEASURE Nov. 1982



## TD 166

Value ★★★★★ Merit ★★★★★  
Plenty of technical merit definitely a top claimant on value criteria.  
Clem Brown HIFI FOR PLEASURE Oct. 1982

**CAMBRASOUND LIMITED**

(Sole UK Distributor) Britannia Road Waltham Cross Herts EN8 7EF

# Dual CS617Q

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Gerrards Cross, Bucks  
Tel (02813) 88447



This semi-automatic newcomer strikes one as a cross between a Dual 508 and a 741, possessing as it does the former's simple (non-subchassis) plinth construction and the elements of the latter's quartz-locked direct-drive system. Supplied complete with cartridge (future production will be fitted with an Ortofon LM20 equivalent), this player has a typical selling price of around £120, a reasonable sum these days.

The cast alloy platter weighs a modest 1.2kg and initially appears quite well damped — but as the disc-impulse response shows, severe low frequency modes are present. It seems little thought has been given to acoustic feedback or vibration isolation, the only concession being the inclusion of adjustable-compliance feet.

Constructed largely of plastic, the plinth is sprayed a Japanese-style silver metallic paint. A good quality low-mass arm is fitted, and as the cartridge supplied was of reasonable quality, it was briefly assessed in conjunction with the player.

## Lab report

Marginal disc damping has already been mentioned, while the continuing decay is probably a platter rocking mode in the 20Hz region. Steady state wow and flutter was impressively low with 'quartz' speed accuracy, and no long term slowing under load. Speed overshoot on load recovery was quite small. With quartz lock off, fine pitch control is also available. Rumble,

DIN B weighted, was satisfactory at -70dB although poorer than spec (-78dB); the spectrograms indicated that the main bearing was not to blame, but rather the ubiquitous mains-frequency-related components or motor or transformer vibration.

Providing a very good technical performance, the arm gave low friction levels and was generally well calibrated. The resonance characteristic was taken with the supplied cartridge (Ortofon ULM15), and despite the poor resolution on this particular graph, the arm can be seen to be quite resonant, and probably poorer than average in this respect.

Both acoustic and vibration breakthrough were also below average, while the feedback was unimpressive, although shock was reasonably handled.

## Sound quality

Rated a little below average, the 617 did offer a reasonably good midrange-to-treble sound with well-focused frontal stereo images. A trifle compressed and 'loud' sounding, stereo depth was rather poorer than for the 505, while the bass was noticeably less articulate.

## Conclusion

The sound quality rating for the 617 was only fair — not so terrible for the price but nonetheless insufficient for recommendation. This deck was let down by its poor isolation properties, and to a lesser extent by its failure to meet spec on rumble.

## GENERAL DATA

Integrated turntable (inc. cartridge)

### Motor Section

Type..... semi-automatic, quartz-lock, direct drive  
Platter mass/damping..... 1.2kg/good  
Finish and engineering..... very good/good  
Type of mains/connecting leads..... 2-core/phonos and earth  
Speed options..... variable, 33/45 rpm  
Wow and flutter (DIN peak wtd, sigma 2)..... 0.06%  
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.09%/0.05%  
Absolute speed error..... - 0.05%  
Speed drift, 1 hour/load variation..... none  
Start-up time to audible stabilisation..... 2.0 secs  
Rumble, DIN B wtd L/R average (see spectrum)..... - 70 dB

### Arm Section

Approximate effective mass, inc screws, excl cartridge..... 5g  
Type/mass of headshell..... detachable special bracket/N/A  
Geometric accuracy..... very good  
Adjustments provided..... overhang/offset  
Finish and engineering..... very good/good  
Ease of assembly/setting-up/use..... very good/very good/very good

Friction, typical lateral/vertical

less than 20mg/less than 20mg

Bias compensation method..... internal spring

Bias force, rim/centre (set to 1.5g elliptical)..... 210mg/250mg

Downforce calibration error, 1g/2g..... + 0. 1g/none

Cue drift, 8mm ascent/descent..... negligible, 1.3 secs/1.5 secs

Arm resonances..... average

Subjective sound quality..... average

Lead capacitance/damping method..... 150pF/dynamic damper

### System as a whole

Size/clearance for lid rear..... 44(w) x 38(d) x 14(h)/1. 5cm

Ease of use..... very good

Typical acoustic breakthrough and resonances

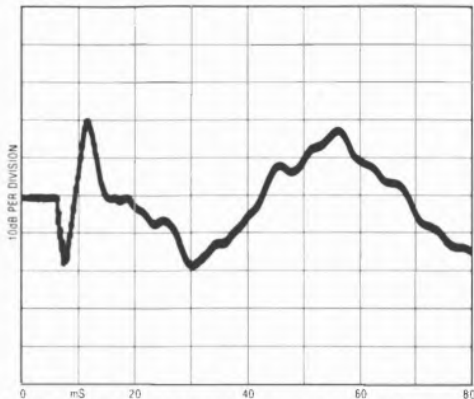
below average

Subjective sound quality of complete system..... below average

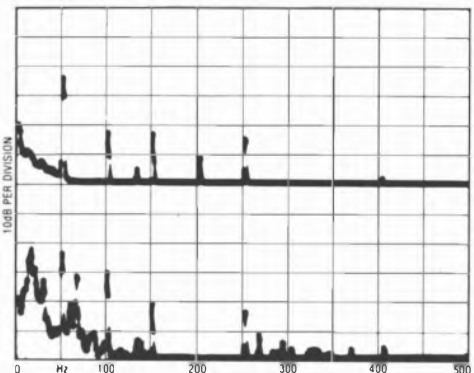
Hum level/acoustic feedback..... good/average

Vibration sensitivity/shock resistance..... fairly good/average

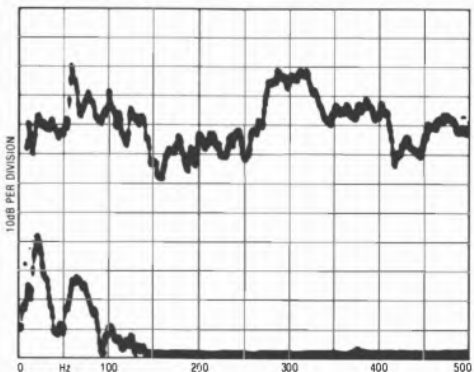
Estimated typical purchase price..... £120



Disc impulse transmission showing damping

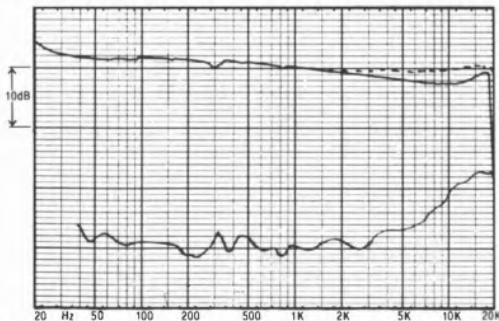


Rumble, electrical (above) and total (below)

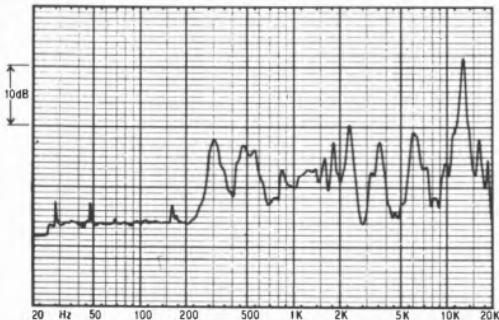


Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques



Frequency response and separation, cartridge



Structural arm resonances, audio band

# Dual CS741Q

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Gerrards Cross, Bucks  
Tel (02813) 88447



## Features and design

Described as 'Dual's latest flagship' the 741Q appears to have abandoned the traditional softly sprung floating subchassis in favour of a more fashionable silver finished moulded plinth in common with the 508. A form of internal subchassis has been retained however, although this is very heavily damped (mistakenly so in our opinion) in order to provide the maximum impact shock resistance, at the expense of broadband isolation requirements.

An important feature of the design is the integration of arm and cartridge, resulting in a claimed effective mass of 8g. The cartridge is the outcome of co-operative development on the part of Dual and Shure Electronics; designated the *TKS390E*, it tracks at a low 1g downforce and outwardly does not relate to any existing Shure model, although the internal components have some design similarities with the *M97* and *V15 IV*. A Shure Bi-Radial or 'pseudo elliptical' stylus tip is fitted to this moving magnet design, which claims a low 0.3mg tip mass for good high frequency trackability.

Damping is the keynote to the 741, a philosophy applied to all of the following areas: two way adjustable plinth feet, the internal subchassis springing, the tonearm tube (special *XM300* alloy), and the counterweight which incorporates a viscous fluid well to damp a seismic internal component – a technique we first encountered on the Technics *EPA100*. But despite all this emphasis on damping, Dual have not seen fit to look after the record support, as the X1 scaled impulse graph testifies.

Fully automatic in operation, the controls are presented on the front of the plinth, clear of a lid which requires no extra rear clearance for elevation. The quartz-locked direct drive motor carries a die cast 1.5kg platter with bold strobe markings; synthesiser-controlled variable pitch is also in-

cluded, together with a speed display indicator in coloured LEDs. The arm is adjustable for height, and uses a massive precision gimbal bearing assembly.

## Lab results

Dual have been capable of producing truly excellent direct drive motors for some time now, and the one fitted to the 741 belongs to that category. In all respects its performance was state of the art in terms of paper measurements, although our rumble spectrogram did reveal one component, -70dB at 123Hz, unrelated to mains frequency.

The disc impulse response showed poor damping, but the low frequency platter rocking noted with the less expensive models was better controlled here. A decent mat would however undoubtedly prove worthwhile. Above 100Hz the acoustic and vibration isolation was quite good, but it deteriorated at low frequencies; as a point of comparison, the vibration rejection at 70Hz was 45dB, whereas the Thorens 160CIII (by no means the best of the tested models) was nearly 20dB better.

The tonearm was very well adjusted and calibrated, with an effective mass of 6g (10g complete with cartridge). A lateral low frequency resonance of 9.5Hz was observed, whereas Dual recommend an anti-resonator setting of 11.5 (Hz), thereby implying a compliance discrepancy of some 50% unless they intend the damper for use in the vertical plane only. Audio range resonances were similar to the other Dual models with the marked breakup at 200Hz well defined, but the upper range behaviour was marginally better than the cheaper models.

## Sound quality

Showing some tendencies to low frequency feedback, with a 'light' and 'softened' bass sound,

the 741 gave slightly better stereo than its cheaper cousins, although it still exhibited some upper treble 'roughness'. Stereo depth and general definition were about average for the type, and the cartridge sound, though not extensively auditioned, seemed on a par with the recommended M97 type models from Shure.

**Conclusion**

While possessing additional facilities as well as an admittedly good 'footfall' shock immunity, the 741Q offers very little extra sound improvement over Dual's less expensive models, and does not justify recommendation. The 505 should not have been so good!

**GENERAL DATA**  
**Motor Section**

Type..... quartz direct drive, fully automatic  
Platter mass/damping ..... 1.45kg/good  
Finish and engineering ..... good/very good  
Type of mains lead/connecting leads ..... 2 core/phonos + earth  
Speed options ..... variable 33/45rpm  
Wow and flutter (DIN peak wtd sigma 2) ..... <0.05%  
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... <0.1%/<0.05%  
Absolute speed error ..... <0.01%  
Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
Start up time to audible stabilisation ..... <1.5secs  
Rumble: DIN B wtd L/R av (see spectrum) ..... -77dB

**Arm Section**

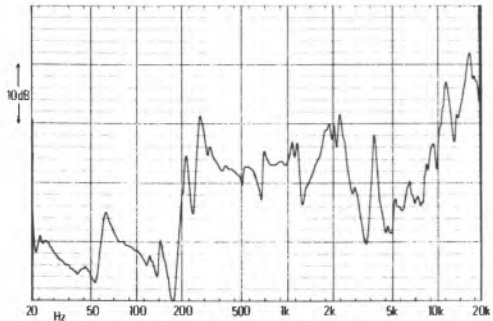
Approximate effective mass inc screws, excl cartridge ..... 6g  
Type/mass of headshell ..... special bracket detachable/N/A  
Geometric accuracy ..... very good  
Adjustments provided ..... arm height, overhang, lateral angle  
Finish and engineering ..... very good/good  
Ease of assembly/setting up/use ..... very good/very good/very good  
Friction: typical lateral/vertical ..... less than 20mg/less than 20mg  
Bias compensation method ..... internal spring  
Bias force: rim/centre (set to 1.5g elliptical) ..... less than 200mg/150mg

Downforce calibration error, 1g/2g ..... +0.05g/correct  
Cue drift/8mm ascent/descent ..... negligible/1.5-4 (var) secs/approx 1.5secs

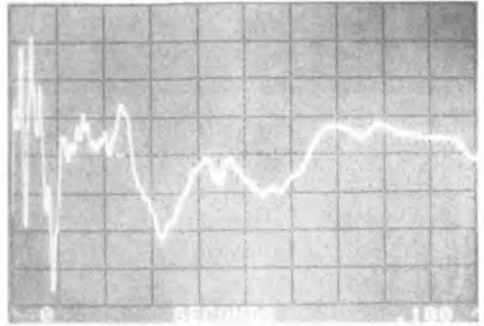
Arm resonances ..... fairly good  
Subjective sound quality ..... fairly good  
Lead capacitance/damping method ..... 150pF/tuneable dynamic damper (vertical plane)

**System as a whole**

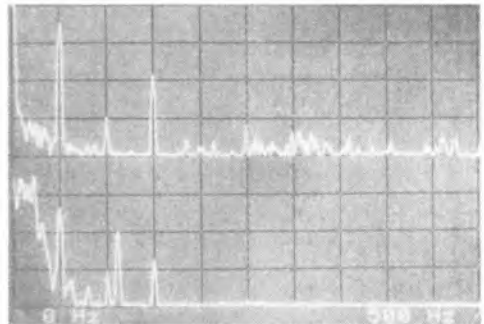
Size/clearance for lid rear ..... 44.0(w) x 38.0(d) x 11.0(h)/0cm  
Ease of use ..... good  
Typical acoustic breakthrough and resonances ..... good  
Subjective sound quality of complete system ..... average +  
Hum level/acoustic feedback ..... very good/fairly good  
Vibration sensitivity/shock resistance ..... below average/good  
Estimated typical purchase price ..... £240



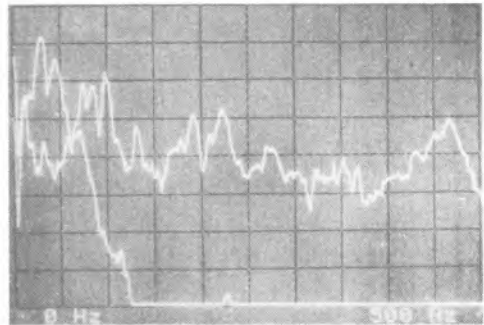
Structural arm resonances, audio range.



Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

# Dunlop Systemdek II

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



Dunlop have devoted considerable effort to the design of a low-cost true subchassis turntable, benefitting from the experience with their original *Systemdek* model. Built in an unusual cylindrical form and lacking a dustcover, it superficially resembles a small version of the Dais. The deck is belt driven by the usual synchronous motor, the two-part platter consisting of a reinforced plastic centre drum on which a plate glass platter is located. A felt mat is used, the disc clamped if so desired by the ingenious and secure spindle clamp provided. Two speeds are available, changeover on the double crown pulley being effected by hand with the platter removed.

A lightweight reinforced subchassis is employed, with the arm mounting arranged as an outrigger, providing easy access for cable dressing and mounting. The subchassis is suspended on three compliant springs and levelling may be done from above — more convenient than with those models requiring the removal of the base plate. Furthermore, three external plastic feet allow easy levelling of the whole unit, which is important in view of the soft suspension with its low resonant frequency — estimated at 2-3Hz in the dominant vertical mode. Rotational freedom is well controlled if the arm leads are well dressed, though the unit does take rather a long time to settle down after a shock impulse.

## Lab report

Despite the large size of the initial disc impulse transient with its secondary reflec-

tion, the pulse died down quickly after 30 milliseconds with little low frequency ringing thereafter. The platter has a reasonable mass of 2.1kg, and the general finish and engineering were considered very good. Wow and flutter, DIN peak weighted, was fine, though with the linear wow figure a touch on the high side. It also ran a little slow, — 0.43% (beware slower tempo on A/B comparisons!), although in use this will not matter a great deal. Torque was fine under load, and rumble was also good at — 74dB, this mainly attributable to motor-frame vibration breakthrough at 100Hz and 200Hz as shown on the spectrogram. Vibration resistance was excellent and acoustic breakthrough very good.

## Sound quality

We were most impressed by the sound quality of this model. It was felt to offer a neutral and open sound with good transparency and stereo depth plus fine bass, good 'drive', attack and depth. In this respect it approached the performance of far more costly models, and the feedback immunity was also impressive. Only the slightest reservation was expressed concerning subjective pitch stability, possibly due to the very soft suspension.

## Conclusion

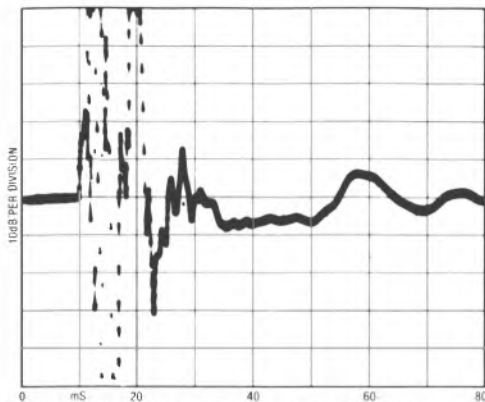
While devoid of a cover this turntable offers a remarkably high sound quality for the price and would do justice to a number of quality tonearms. We obtained good results using the Linn Basik LVX and Audio Technica AT11200 for example. If you like the look of the *Systemdek II*, we can back your preference with a strong recommendation.

*(Note: Dunlop have indicated that they intend to revise the suspension stiffness to give a higher resonant frequency.)*

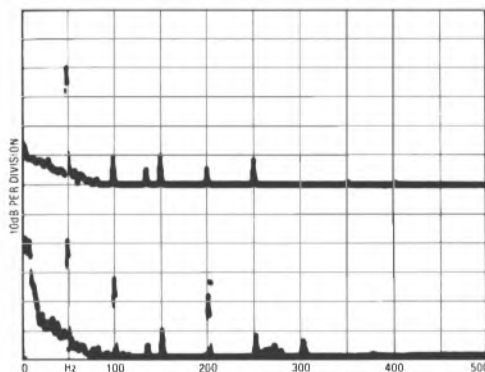
## GENERAL DATA

|  | Motor unit  |
|--|---|
| Type   | ... manual, belt-drive, synchronous motor, subchassis |
| Platter mass/damping                           | ... 2.15kg/good                                       |
| Finish and engineering                         | ... very good/very good                               |
| Type of mains/connecting leads                 | ... 3-core  |
| Speed options                                  | ... 33/45 rpm   |
| Wow and flutter (DIN peak wtd, sigma 2)        | ... 0.08%   |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | ... 0.15%/0.06%                                       |
| Absolute speed error                           | ... - 0.43%   |
| Speed drift, 1 hour/load variation             | ... synchronous — 0.18%                               |
| Start-up time to audible stabilisation         | ... 3.5 secs  |
| Rumble, DIN B wtd L/R average (see spectrum)   | ... - 74 dB   |
| Size/clearance for lid rear                    | ... 43(w) x 31(d) x 13.5(h)/none                      |
| 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               | ... £115  |

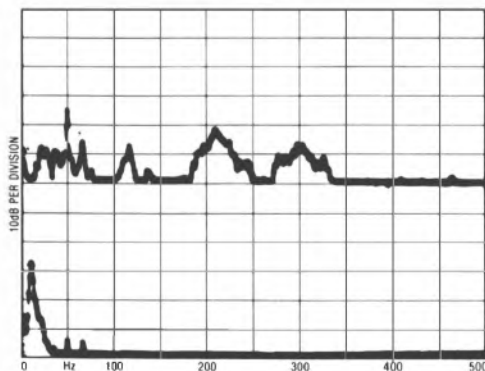




Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques



# Dunlop SYSTEMDEK II £115.00

Borrowing many of the design features of the SYSTEMDEK III, this new budget turntable demonstrates the immense benefits that a properly engineered signal source will provide. Illustrated with the Linn Basik LW – an excellent match at £161.00 (including cartridge).

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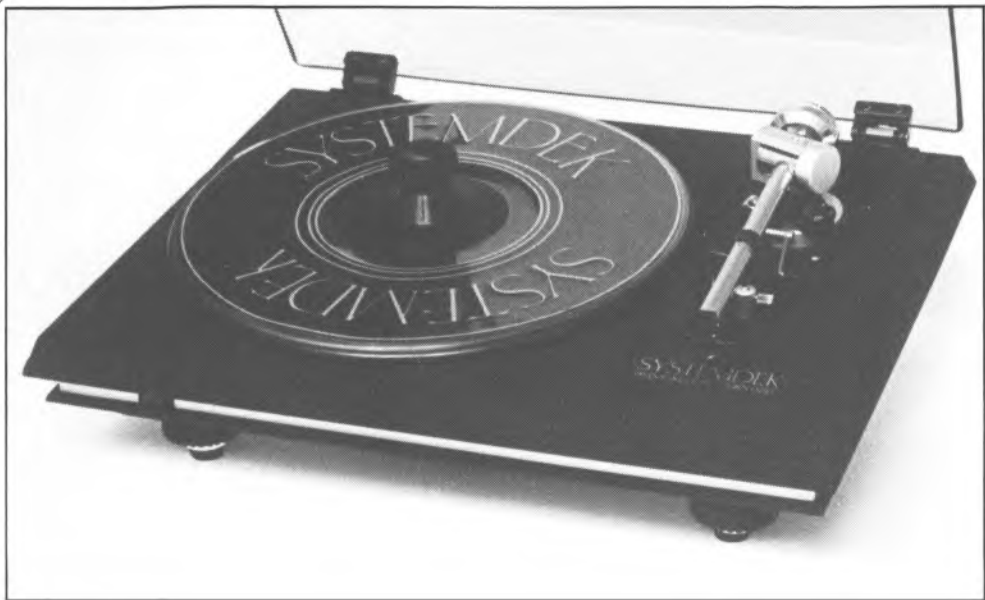
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*Dunlop*  
SYSTEMDEK II

# Dunlop Systemdek III

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



Since its introduction the *Systemdek* has begun to establish itself firmly in the quality category. The early minor teething problems have long ago been sorted out, and a number of detail refinements have been made to improve the performance and the ease of alignment/setting up.

Founded on a steel plate, the *Systemdek* subchassis has an aluminium extrusion reinforcement which runs beneath the main bearing through to the arm base. The original models were very softly sprung indeed, with an estimated 3.8Hz vertical and 3Hz lateral subchassis resonance, and gave rise to alignment problems. With the high 4.8 kg platter mass, this gave the unit a tendency to rock or sway from side to side, resulting in slightly high pure wow readings and some handling sensitivity.

In the later version, this situation has been improved – by the substitution of even more compliant springs! At first sight this might be expected to worsen matters, but in fact when properly adjusted the springs lie in a state of greater compression and are physically shorter. This considerably improved lateral stability, confirmed by the low wow figures in the last *HFC*. Alignment is made easier by the use of surface mounted crosshead screws, located beneath the top platter.

The fabricated plinth is a well damped wood composite steel structure, with open access for arm lead dressing beneath a detachable arm board, which is secured by two socket head bolts. Improved feet have been fitted and can be adjusted for levelling, while the low resonance lid is retained. The plinth is finished in a *Nextel* suede type coating.

The outer platter has benefited from the addition of a so called 'wave termination' ring: a high density absorbent rubber insert fitted into the rim. The dense lambswool felt mat bonded into position has been retained, but in practice it is easily enough removed if alternative mat types are desired. Two speeds are provided, using a simple manual belt change, which requires the (annoying) removal of the outer platter.

With the *III* designation, the *Systemdek* acquires a concave platter which in conjunction with the clamp supplied gives some reduction in record warps and also improves disc/platter contact.

## Lab results

The drive exhibited good torque, with only 0.1% slowing under load, and a fair start up time in view of the heavy platter. Wow and flutter was very satisfactory and better than

for earlier samples: likewise the rumble level, which is now at the threshold of measurement. A 100Hz component was noted on the spectrogram at -70 dB, but this proved to be inaudible as a specific effect when auditioned.

The results for vibration isolation and acoustic breakthrough, reprinted here from the last issues, were both very good, the slight lumpiness on the acoustic trace attributable to the disc and its supports. Two disc impulse responses were taken. First on X1 scaling and using the mat as supplied, the initial transient was large, but was quickly damped, and the longer term low frequency performance was fine. For comparative purposes the *Audio Ref* mat was also tried, and this reduced the impulse magnitude by almost a factor of 10, allowing X10 scaling for the superimposed (white) presentation – a very fine system response. Use of the record clamp on the new concave platter should equal or improve on these results.

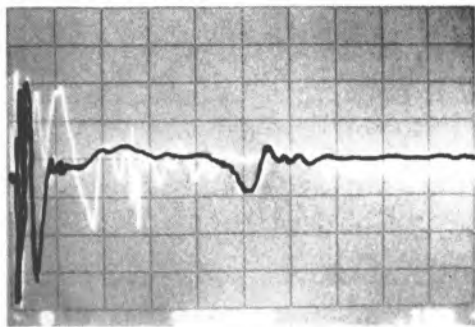
### Sound quality

When reviewed in previous issues, the *Systemdek* has been considered as setting a top class standard as a motor unit, with a firm and stable quality to the stereo image. The bass register was open, deep but slightly 'heavy' in balance, while coloration was very good, only showing a mild 'thickening' in the lower midrange (eg tenor), which also affected bass transients slightly. Though the *Systemdek* has always tolerant of arms, we nevertheless obtained the best results using the *Ittok*. The felt mat suited most moving coil cartridges (Asak, Supex and the like), but with 'flatter' models such as the *Karat* and the Technics *EPC205*, the *Audio Ref* mat gave a more relaxed perspective, with greater midband depth and ambience.

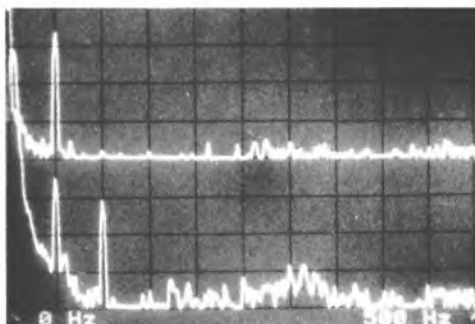
For this issue, the *III* was auditioned using an *Ittok* tonearm. The listening results were very good, and yet slightly disappointing in that the smaller *Systemdek II* was felt to be marginally 'clearer' with more musical 'attack'. The *III* set a high standard, but this time just failed to get the top rating by virtue of a shade of vagueness in the stereo presentation and stereo focus.

### Conclusion

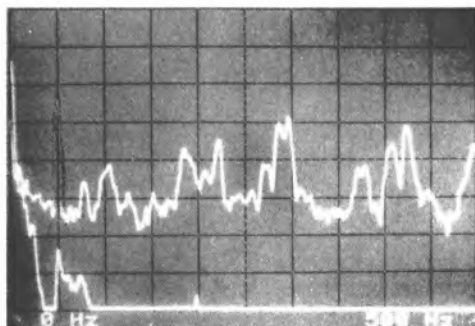
The *Systemdek III* remains a very fine turntable whose competitive pricing has been maintained, and consequently it continues to be recommended. It sets a high standard on all major parameters, is relatively easy to set up and possesses a well finished exterior, as well as proving largely uncritical of the choice of accompanying arm.



Disc impulse: black, felt X1; white, Audio Ref X10.



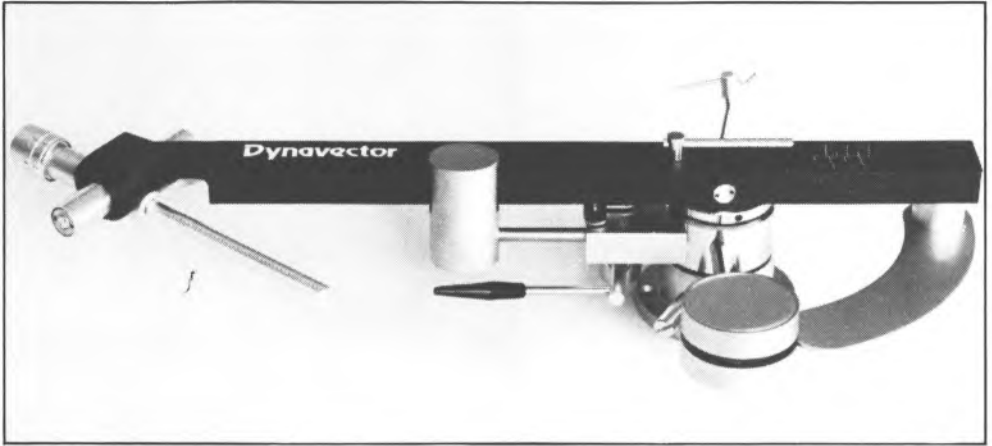
Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

# Dynavector DV 501

Dynavector Systems (UK) Ltd, 14 Wyndham Road, Kingston-Upon-Thames, Surrey KT2 5JS  
Tel 01-549 7645.



An earlier version of this remarkable creation was first assessed several issues back. Now relaunched in revised form, the Dynavector is rather more compatible with current turntables due to a great weight reduction in the mounting plate — nonetheless, the arm still weighs around a kilogram installed.

Classed as an adjustable audiophile design and costing a commensurate amount, this arm incorporates some unique design features. As Dynavector correctly note, it does in fact constitute virtually two arms in one — a medium mass vertically pivoted assembly at the front and a massive laterally pivoted carrier beam at the rear, and thus exhibits dramatically different effective masses between the lateral and the vertical planes. It is suggested that the lower mass in the vertical plane allows the cartridge to negotiate the usual record warps while milder, slower excitations of eccentricities in the horizontal plane allow a higher lateral inertia. This argument does however neglect lateral pitch warps whose natural frequency can be just as high as the vertical warps which are more often encountered.

To reduce the asymmetric load on the horizontal bearing the rear beam must be roughly balanced using a large sliding weight. The arm will handle cartridge weights in the 15g to 30g range — this including the headshell contribution, in this case a substantial 15g. To try and stabilise/damp the horizontal excitation, a magnetic eddy current damper is built on to the rear — a large arc-shaped plate moving in a narrow gap between two powerful magnets.

Horizontal moving mass is estimated at 50g, which in conjunction with the 20cu of a typical Dynavector cartridge, results in a lateral resonance of a rather low 5Hz — unfortunate for both warps and subchassis suspensions. In the vertical plane the front arm geometry prevents use of a large counterweight so that effective mass is still quite high at 25g, and so cartridges with compliance above 10cu at 10Hz are not well suited.

The headshell is a standard SME type fixing, strongly made from a solid aluminium block. The arm measures 300mm overall with a 240mm effective length and a 21.5 deg offset angle. The cable capacitance is low at 125pF, and the high-quality connector is gold plated.

## Lab report

The large differential arm mass has already been noted. Geometrical accuracy was very good with a top class finish and fine engineering, and it proved fairly easy to set up and use. In the vertical plane friction was very low, but it was a trifle high laterally, this relating to the bearing that supports the total pivoted mass. Downforce calibration was accurate and the cue rate well timed though exhibiting noticeable drift.

Considering the complex multipart structure we did not hold out much hope for a good resonance behaviour. In fact the first flexural mode at 100Hz was serious both in magnitude and as regards the lowness of its frequency. Many good tonearms achieve frequencies of 500Hz plus, indicative of a structural rigidity many times greater than that of the DV501.

Secondary resonances were inevitably suppressed following the major low frequency decoupling, the high headshell mass also proving to be a help here.

### Sound quality

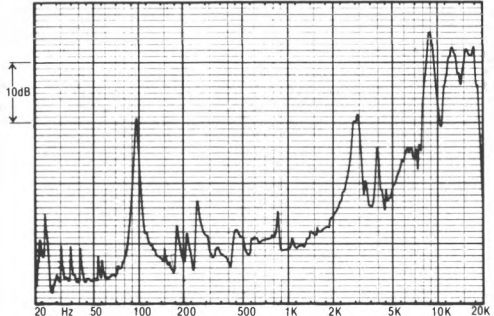
This arm provided a disappointingly defocused stereo sound stage, with limitations imposed on both depth and ambience. It did not sound very clean, showing mild coloration on voice, plus a blurring of bass transients, a brashness in the upper-mid/lower treble and a 'loud' forward quality. Transients did show some attack and life, but overall the sound appeared compressed — displaying less transparency and dynamics by comparison with established references.

### Conclusion

This arm has paid the penalty of its unnecessarily complicated design in terms of a confusion of both sound quality and definition. It does not attain the standard we would require, and in addition demonstrated a high level of incompatibility with many good cartridges as well as several motor units. As such and in view of its elevated price category, no recommendation is possible.

### GENERAL DATA

|  |   |
|--|---|
| Approximate effective mass, inc screws, excl cartridge | Tonearm<br>25g (vertical) 50g (lateral) |
| Type/mass of headshell                                 | detachable/16g                          |
| Geometric accuracy                                     | very good                               |
| Adjustments provided                                   | overhang/offset/height                  |
| Finish and engineering                                 | very good/good                          |
| Ease of assembly/setting-up/use                        | good/good/good                          |
| Friction, typical lateral/vertical                     | 45mg/10mg                               |
| Bias compensation method                               | pulley                                  |
| Bias force, rim/centre (set to 1.5g elliptical)        | 150mg/150mg                             |
| Downforce calibration error, 1g/2g                     | none/-0.05g                             |
| Cue drift, 8mm ascent/descent                          | noticeable, 0.7 secs/1.2 secs           |
| Arm resonances   | poor                                    |
| Subjective sound quality                               | average+                                |
| Lead capacitance/damping method                        | 125pF/magnetic lateral damper           |
| Estimated typical purchase price                       | £199                                    |



Structural arm resonances, audio band

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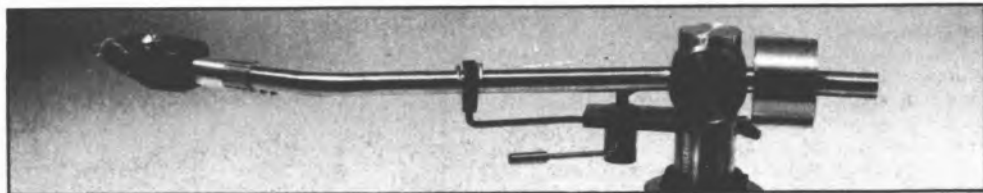
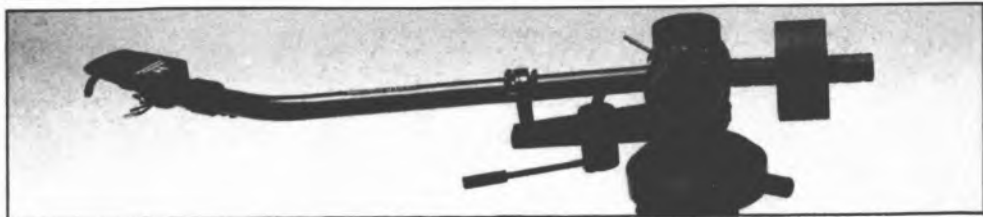
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# Fidelity Research FR64 FX/FR64S

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



## Features and design

Fidelity Research is a Japanese company with a good reputation for high quality moving-coil cartridges. As a natural adjunct they also manufacture tonearms, in the past usually of the heavy construction/high mass variety.

Currently there appear to be two diametrically opposed yet justifiable views on tonearm design. The European approach is characterised by a target of mechanical system compatibility, leading to optimum cartridge/arm resonance placement and consequent tracking consistency; benefits can include better shock resistance, stable stereo imaging, minimal frequency shift and intermodulation distortion. In the context of quality cartridges traditionally possessing medium to high compliances (20-60cu), mechanical compatibility has been achieved by reduction of the effective moving mass as seen by the stylus. The epitome of this approach is perhaps the elegant Ortofon/SME *Concorde* integration at just over 4g total effective mass, while B&O and Technics have employed this technique for their integrated combinations (effective masses in the 6-9g range).

Conversely, the pursuit of subsonic resonance control requires a reduction in arm strength and rigidity, which can in some cases worsen resonances and colorations. This is strikingly apparent with some of the very lightest designs (cf: *Black Widow*, now obsolete). And if using medium to low compliance cartridges, particularly moving-coils, the low mass requirement becomes less pressing, and instead arm coloration may be considered the top priority. While undoubtedly an oversimplification, higher mass allows greater strength and better audio range resonance

control, and this particular goal has clearly led to the development of the top FR design, the 64S, one of the highest mass arms in current production. This mass, together with the form and choice of the materials used, provides a firm high inertia platform, and gives a solidity and cleanliness to the sound reproduced by suitable cartridges, a benefit which for some listeners may outweigh the known compromise involved with respect to the subsonic arm/cartridge resonance.

The 64S possesses a 35g effective mass, and on grounds of compatibility alone should partner a cartridge in the 5-10cu range. There are only a few of these, and none from FR, whose own models tend to be about twice this value. Even with the thick 20g headshell removed, the arm alone with its stainless steel beam provides 15g, so except those of low compliance there is not much scope for integrated headshell cartridges.

Perhaps in recognition of this problem, the 64S has now acquired a partner, the 64FX, whose effective mass is almost halved to 20g. In contrast to the 'S' which is all silver, the 'FX' is immediately distinguishable by its handsome matt black finish. In mechanical terms the two arms do however have quite a lot in common: for example, the pillar diameters are the same for both, although the external size of the pillar mount is different for each. They also share a universal detachable headshell system, with finely tooled fixings to provide an unusually tight grip. The headshells may be interchanged, which allowed us scope for arm resonance investigation, to see how much of the behaviour was determined by the shell alone.

Both arms use pure silver internal wiring (for what it is worth); the size and locking of the counterweights differ, the 64S uses stainless steel while the FX uses aluminium alloy for the main tube; a thread-linked weighted bias lever is fitted to the FX instead of the simple lever in the 'S'; in fact the FX lever sticks out in the direction of the platter, which caused some problems when fitting the arm to the Image with its large platter, for example. Interestingly the geometry for the FX has been revised to obtain optimum low distortion tracking, by increasing the offset angle by a little less than two degrees.

### Lab results

The friction levels of the 'S' were excellently low, and the bias compensator worked well although the values were a little high. Downforce calibration set by a large dial with an internal spring was very accurate, and lead capacitance was low at 80pF, allowing maximum freedom for matching load-critical cartridges. A clamping screw is provided for the counterweight, and two audio resonance graphs were taken to assess the effect of this clamping, on the performance. From the results one might consider the loose counterweight to be superior, since the energy trend is smoother and the resonances are of smaller amplitude; however there are good reasons why this is not in fact the case. The damping afforded is of an uncontrolled and intermittent variety, as shown by the random 'noisy' nature of the fine resonance structure, and this cannot be to the arm's sonic advantage. With the counterweight screwed down, the behaviour is cleaner up to the first mode at 200Hz, while the resonances themselves are fewer in number and more clearly defined. Moreover the characteristically uniform energy trend is retained, suggesting good tonal balance.

Turning to the FX, the bias settings were less satisfactory, being excessive at the rim (X2) and slightly low as well as in the wrong ratio towards the centre; the user will have to find some compromise here. The resonance graph was different from the 'S' in the higher magnitude of the resonances and the slightly less uniform energy trend, though general similarities still exist. When the heavy 64S shell was substituted for the more open formed shell of the FX, the combination closely mimicked the 64S characteristic above 2kHz, but appeared to worsen the behaviour below this frequency. It was found that tight headshell clamping was essential to ensure repeatability of the curves as well as a consistent sound quality.

However, none of the graphs indicate that the arms are as rigid as their physical structures might suggest, and their quality clearly owes more to fine bearings and sheer inertia than anything else.

### Sound quality

In the context of detachable headshell designs, the 64 models came out the best of all those tried this time round – but they were also the most expensive. Difficult to convey in precise terms, the sound of both models was comparable, with the FX sounding a little more secure in terms of focus and image stability, the 'S' a little cleaner in coloration terms and possessing greater 'bass weight'. Both proved more tolerant of arm mounting arrangements than, for example, the Ittok, but their high mass led to problems with the suspension arrangements of some turntables.

Possessing a neutral and relaxed character with good integration of the various frequency ranges, space and ambience were well reproduced. However both models lacked the final degree of incisive precision, clarity and focus offered by the best super-rigid fixed headshell designs. This was noticeable both in the mid-range and also in the bass, where detail was 'softened' and lacked impact.

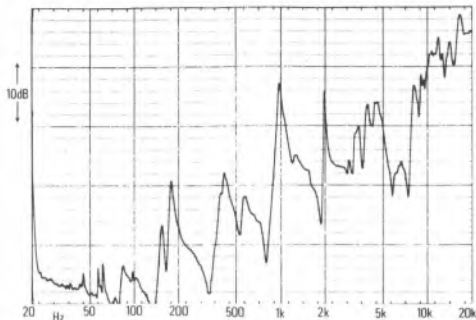
### Conclusion

These arms have their own special qualities, but in real terms cannot be said to offer very good value for money. In combination with the right motor unit however they can give a very good sound, our preference being for the high mass composite types such as the Marantz or big Luxman, rather than the more 'nervous' sub-chassis models. The detachable headshell is of course a convenience if the purchaser wishes to use more than one cartridge.

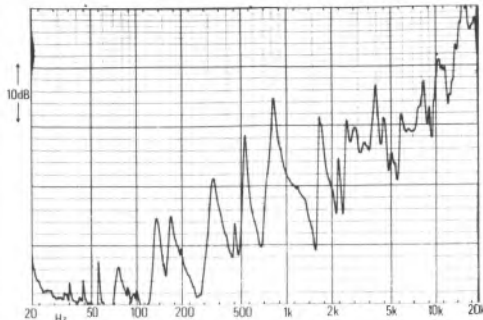
| GENERAL DATA  |       | Tonearm                                 |
|---|-------|---|
| Approximate effective mass inc screws, excl cartridge | ..... | 20g                                     |
| Type/mass of headshell                                | ..... | universal detachable/14g                |
| Geometric accuracy                                    | ..... | very good                               |
| Adjustments provided                                  | ..... | arm height, overhang, lateral angle     |
| Finish and engineering                                | ..... | excellent/excellent                     |
| Ease of assembly/setting up/use                       | ..... | very good/very good/good                |
| Friction: typical lateral/vertical                    | ..... | less than 10mg/less than 10mg           |
| Bias compensation method                              | ..... | weighted lever                          |
| Bias force: rim/centre (set to 1.5g elliptical)       | ..... | 375mg/165mg                             |
| Downforce calibration error: 1g/2g                    | ..... | -0.15g/-0.1g                            |
| Cue drift/8mm ascent/descent                          | ..... | negligible/less than controlled/3.5secs |
| Arm resonances  | ..... | good                                    |
| Subjective sound quality                              | ..... | good +                                  |
| Lead capacitance/damping method                       | ..... | 80pF/slight decoupling on counterweight |
| Estimated typical purchase price                      | ..... | £270                                    |

| GENERAL DATA  |       | FR64S                                |
|---|-------|--------------------------------------|
| Approximate effective mass inc screws, excl cartridge | ..... | 35g                                  |
| Type/mass of headshell                                | ..... | universal detachable/20.5g           |
| Geometric accuracy                                    | ..... | very good                            |
| Adjustments provided                                  | ..... | overhang, lateral angle, height      |
| Finish and engineering                                | ..... | excellent/excellent                  |
| Ease of assembly/setting up/use                       | ..... | very good/very good/very good        |
| Friction: typical lateral/vertical                    | ..... | less than 10mg/15mg                  |
| Bias compensation method                              | ..... | weighted lever                       |
| Bias force: rim/centre (set to 1.5g elliptical)       | ..... | 250mg/250mg                          |
| Downforce calibration error: 1g/2g                    | ..... | 0.02g/0.05g                          |
| Cue drift/8mm ascent/descent                          | ..... | negligible/0.5sec/3.0secs            |
| Arm resonances  | ..... | good                                 |
| Subjective sound quality                              | ..... | good +                               |
| Lead capacitance/damping method                       | ..... | 80pF/slight counterweight absorption |
| Estimated typical purchase price                      | ..... | £300                                 |

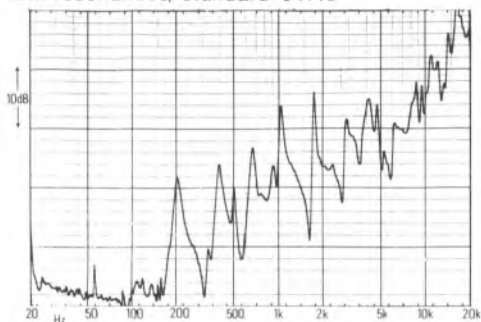
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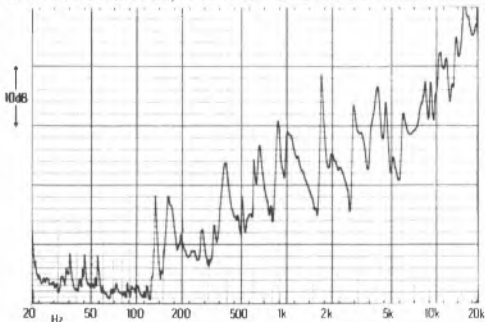
Arm resonances, standard '64FX.



Arm resonances, '64S with '64S shell substituted.



Arm resonances, FR64S, tight counterweight.



Arm resonances, FR64S, loose counterweight.

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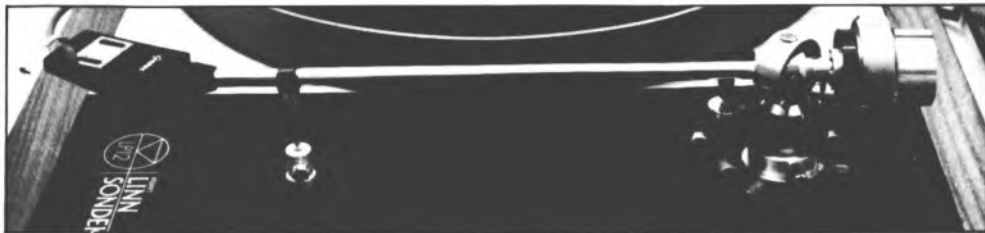
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This well-known and elegant arm is a rigid yet low mass design with a fixed plastic headshell (adjustable for tilt) and employs a straight chromed alloy tube with secure gimbal bearings free of play. Essentially little decoupling was provided on the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

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. However, the distributor, who also handles the Supex cartridges, will be well qualified to help here.

### Lab report

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 models (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’.

### Sound quality

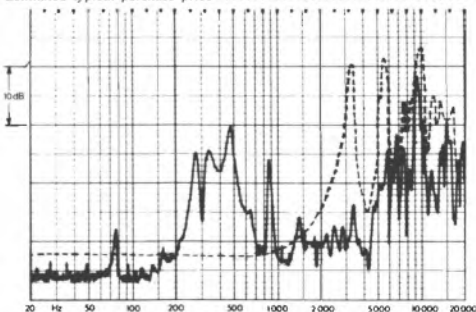
In assessment for previous issues a ‘very good’ rating was established using either a

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.

### Conclusion

Though the G707 remains worth considering, more recent introductions have reduced its competitiveness a little.

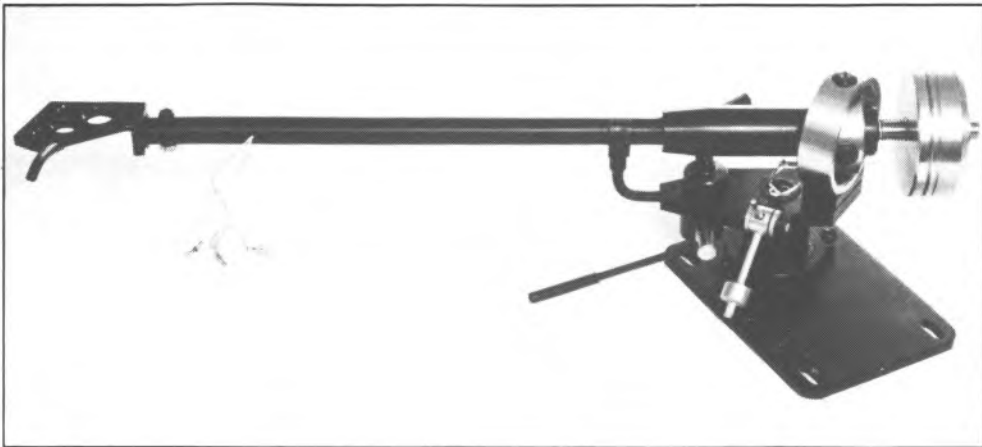
| GENERAL DATA  | Tonearm                                |
|---|--|
| Approximate effective moving mass (excl cart, inc screws) | 7 g                                    |
| Type of headshell   | Fixed                                  |
| Headshell mass (inc screws)                               | N/A                                    |
| 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<br>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                          | £144                                   |



Arm resonances (compared to cartridge resonances, dotted).

# Helius

Helius Designs, 11 Falstaff Way, Hartford, Huntingdon, Cambs  
Tel (0480) 59037



Reviewed in its provisional form in the last issue, the Helius arm is now in full production. Two distinct versions are available, one with the established sliding/detachable headshell (no plug system however for the leads) and a second called the *Aurum*, where the shell is permanently bonded to the arm. We did not test the latter, but the Helius designer had indicated that it shows improved audio band resonance control and consequently a 'smoother' sound.

A medium mass design, the arm tries to avoid any injurious decoupling between the firm, large-area cartridge mounting platform, and the arm mounting base. The full-circle nested gimbal bearing is finely adjusted for moderate friction and zero detectable play, a condition critical to sound quality. The arm should therefore be carefully handled if this condition is to be maintained. An unusual ball race is employed with only three balls per race aligned to maintain mutual contact as well as firm contact with the bearing needle and of course the race itself.

The sliding headshell does confer certain practical benefits, allowing for easy adjustment of both overhang and vertical tilt. In practice the fixing is quite strong, a vertical bolt firmly clamping the splined main tube onto the headshell stub. The main tube is anodised alloy with cross section and thickness varying along its length, the intention being to break up symmetrical vibrational modes.

The rear section comprises a threaded brass rod on which the counterweights are screwed.

Two weights are used in various combinations and when the appropriate downforce has been set — a downforce gauge is required — the weights are contra-tightened to lock them firmly on the arm. A thread and weight lever bias compensator is fitted, this also uncalibrated.

While the overall finish and constructional standard was very good, the wiring around the bearings was exposed and somewhat untidy — particularly the single strand third earth. Wires must be kept in a good state of adjustment if the arm sensitivity is not to be impaired.

## Lab report

At 12g effective mass including hardware the arm was well suited to cartridges in the 10-25cu compliance range. The bearings were well adjusted with a satisfactory 50mg lateral friction and fine vertical friction figures.

Set half way, the lever weight provided bias appropriate for a 1.5g-downforce elliptical stylus, measuring 160mg rim and 220mg centre. On our sample, cue descent was rather slow at 4.2 seconds.

The arm resonance graph illustrated some anomalies though the general trend put it in the 'good' category. The 100Hz mode was quite energetic, probably due to the rigid counterweight mounting, a point noted also in our earlier Helius review. Those clustered around 600Hz were likely to be main beam modes, their complexity relating to the distributed structure. Above 1kHz the unit remains well behaved.

## Sound quality

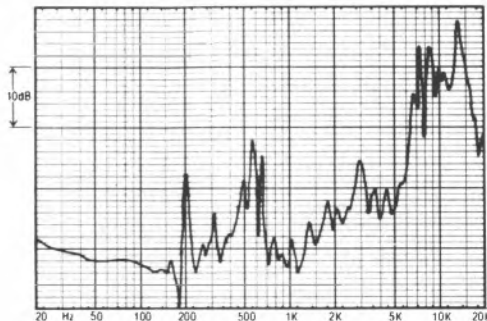
Loosely ranked in the 'good+' category, the Helius sound was found to be lively with good transient attack, while the bass lines were well portrayed with substantial weight. A good first impression was gained, but prolonged listening suggested some mid colouration on vocal sections, and although the standard of stereo was high, with promising depth, the treble register did not perfectly integrate with the mid, the whole sounding a trifle uneven. These results were confirmed when moving onto the more costly and superior *Orion*.

## Conclusion

The second time around we were less enthusiastic about the Helius although it undoubtedly achieves a high technical and subjective standard. Possessing its own particular character it is recommended.

## GENERAL DATA

|  |                       |                             |
|--|-----------------------|-----------------------------|
| Approximate effective mass, inc screws, excl cartridge | 12g                   | Tonearm                     |
| Type/mass of headshell                                 | special detachable/7g |                             |
| Geometric accuracy                                     | .....                 | excellent                   |
| Adjustments provided                                   | .....                 | overhang/height/lateral     |
| Finish and engineering                                 | .....                 | very good/very good         |
| Ease of assembly/setting up/use                        | .....                 | good/difficult/very good    |
| Friction, typical lateral/vertical                     | .....                 | 50mg/10mg                   |
| Bias compensation method                               | .....                 | thread and lever            |
| Bias force, rim/centre (set to minimum)                | .....                 | N/A                         |
| Downforce calibration error                            | .....                 | uncalibrated                |
| Cue drift, 8mm ascent/descent                          | .....                 | moderate, 0.9 secs/4.2 secs |
| Arm resonances   | .....                 | fairly good                 |
| Subjective sound quality                               | .....                 | good +                      |
| Lead capacitance/damping method                        | .....                 | 70pF/none                   |
| Estimated typical purchase price                       | .....                 | £150                        |



Structural arm resonances, audio band

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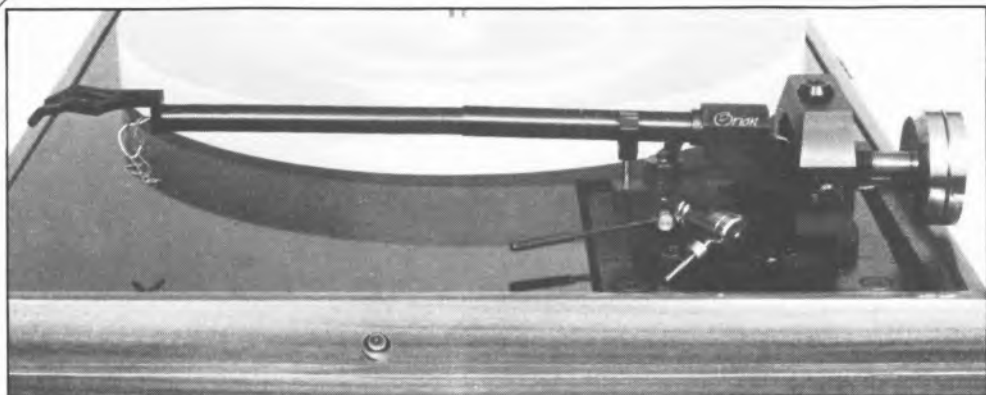
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## Helius Orion

Helius Designs, 11 Falstaff Way, Hartford, Huntingdon, Cambs  
Tel (0480) 59037



Since the introduction of their first arm, Helius have continued development of an advanced model, taking some of their concepts to a further level of refinement. The result is the *Orion*, supplied to us at short notice in an early form, and soon to be updated in some minor respects.

The most obvious feature of the *Orion* is the massive bearing assembly milled from substantial aluminium block, and as with Audio-Technica models, the pivot plane has been placed below the stylus tip to aid tracking stability. The bearing is an unusual design whereby the horizontal and vertical components are effectively concentrated on a single point, use being made of the Helius 'tri-ball' system, which when correctly set provides zero play and no secondary rattles. Inertial masses may be designed to balance around this unified pivot (not to be confused with a 'unipivot' since this one is rigid except in the two desired planes), conferring benefits as regards the wider distribution of structural resonances.

A large section threaded rod provides the rear counterweight extension, the multiple weights screwed on and contra-locked for final setting. Synthetic inserts in the counterweights damp the interface between the rod and counterweight mass.

The main arm beam, in alloy tube, has an extended larger diameter first section to distribute vibrational modes. At the front the standard Helius right-angled alloy cartridge platform is fitted, here rigidly bonded in place. A revision to the shell, which is in hand at the time of writing, includes a curved section to reinforce the right angle and marginally

increase the mass — probably by 2-3 grams only.

Both the arm base, which has an improved pillar lock, and the cue device are made of solid metal, possessing minimum self-resonance. Thread-and-weight level bias compensation is fitted and, as with downforce, this is uncalibrated.

### Lab report

Approximate effective mass was 11g, increasing to 13-14g with the production headshell revision, and the arm is therefore classed as medium.

Geometric accuracy was excellent, the slotted headshell providing ready adjustment of offset angle and overhang. Although no slack whatsoever was detectable in the bearings, the friction levels in both planes were exemplary. The arm was however not so easy to set up, and for final clamping of vertical height it needed to be removed from the turntable to gain access to the socket head bolts below the baseplate — this arrangement may be improved.

Set to 'minimum' the bias was found to be appropriate for a 1.5g downforce, and little extra will be required for the usual 1.8-2.0g downforce moving coil cartridge. Cue descent was however too slow at 8 seconds, this encouraging groove damage as the stylus slides slowly into record contact. Overall engineering and finish was very good, but the gold plating on the counterweights was suspect and not adhering well on the review samples.

The resonance graph portrayed well ordered behaviour, showing a highly-favourable energy trend. It did however demonstrate some res-

onances, with that at 200Hz probably a bearing/counter counterweight mode, and that at 800Hz the main tube — a worthwhile high value. The remainder were more difficult to pin down as to exact origins. Low in capacitance, the leads were usefully flexible and carried good quality plugs.

### Sound quality

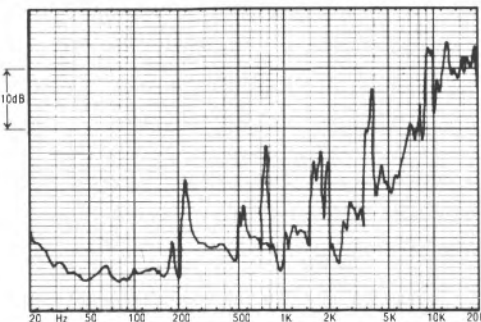
On audition there was no doubt whatsoever concerning the high calibre of this tonearm. The bass was particularly good, showing depth, weight, evenness and good articulation. The midband was neutral as well as transparent, matching the unexaggerated musical treble register. Stereo effect was very good and the overall sound sweet and well-balanced tonally. Compared with certain other models however the Orion could sound less 'sharp', which could be interpreted as 'softness' on its part.

### Conclusion

Engineering and sound quality meet the required standard but considering the high price, the arm can hardly be described as good value for money in the accepted sense! But it can be strongly recommended on the basis of its overall performance.

### GENERAL DATA

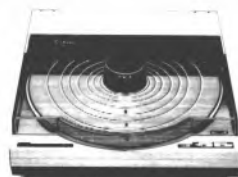
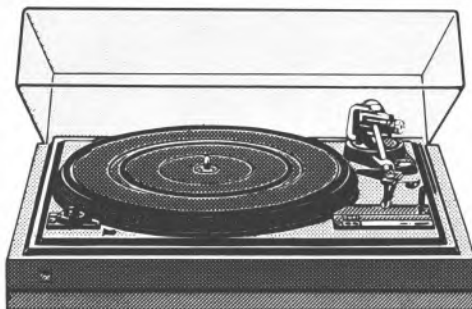
|   |                             |
|---|-----------------------------|
| Tonearm                                 | 11g                         |
| Type/mass of headshell                  | non-detachable              |
| Geometric accuracy                      | excellent                   |
| Adjustments provided                    | overhang/offset/height      |
| Finish and engineering                  | very good/very good         |
| Ease of assembly/setting-up/use         | good/difficult/very good    |
| Friction, typical lateral/vertical      | less than 5mg/less than 5mg |
| Bias compensation method                | thread and lever            |
| Bias force, rim/centre (set at minimum) | 175mg/225mg                 |
| Downforce calibration error             | uncalibrated                |
| Cue drift, 8mm ascent/descent           | none, 1.0 secs/8 secs       |
| Arm resonances                          | very good                   |
| Subjective sound quality                | very good                   |
| Lead capacitance/damping method         | 73pF/none                   |
| Estimated typical purchase price        | £395                        |



Structural arm resonances, audio band

## Recommended Turntables from Technosound

- ADC
- Alphason
- Ariston
- Audio Technica
- Bang & Olufsen
- Dual
- Dunlop Systemdek
- Helius
- Heybrook
- Michell
- Mission
- Pink Triangle
- SME
- Technics
- Thorens



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## Technosound

3 The Gallery, Arndale Centre, Luton. Tel: 30919

55 Silbury Arcade, Central Milton Keynes. Tel: 604949

RECOMMENDED

## Heybrook TT2

Mecom Acoustics, Knighton Hill, Wembury, Plymouth, Devon  
Tel (0752) 863188



Noted for their specialist speaker designs, Heybrook have made their first foray into the turntable field with the *TT2*. It is a comprehensively-designed full subchassis model in the UK audiophile tradition. The price is placed in the middle sector, substantially undercutting the audiophile decks, and yet hopefully solving important design problems.

Every manufacturer has his own approach, and in the case of the *TT2* rigidity and solidity appear to be key factors. The subchassis is a heavy cruciform of thick gauge welded steel, box section, a heavy nylon coating protecting the surface and adding some damping. By comparison the platter is of moderate mass at 2.6kg — a fine-quality cast component in the familiar two-piece form; it comes with the increasingly popular dense felt mat.

The arm board is made of a wood composition material secured to the chassis by a large concealed bolt. The whole thing is suspended at three points on three deep multi-turn (8-9 turns) coil springs, whose adjustment points are conveniently located on the top surface of the deck. Belt-driven by the usual synchronous slow-speed motor, the pulley has two diameters, speed being selected by hand after removal of the outer platter. The combination of heavy chassis and compliant springs resulted in a rather low suspension resonance of a little under 4Hz. Recovery was fairly slow

after excitation and evidence of a rather higher-frequency rotational mode was seen and estimated at 8-10Hz, possibly due to the proximity of two of the suspension centres to the arm board, an area of reduced mass compared with the platter centre.

The high constructional quality, generous use of materials and thought that has gone into such aspects as adjustment access and alignment was much appreciated, and in contrast to many other models, useful instructions were also included — a critical factor with this type of turntable. Our sample came with a Heybrook arm accessory called the *AK-1* comprising a kit of steel sockethead cartridge bolts, a wrench and spanner plus a two-point cartridge alignment protractor.

### Lab report

The disc impulse response showed poor damping of the initial transient but thereafter the decay was rapid and clean, an above-average result overall. Weighted wow and flutter was fine at 0.08% with very low flutter while pure wow was also good at 0.09%. It ran close to absolute speed and slowing under load was well within the accepted subjective tolerance. Start up was slow, as is usual for this type of turntable.

Rumble was excellent at -79dB DIN weighted and with only the merest trace of

mains related signal at 150Hz — this was insignificant. Despite the number of turns on the suspension springs, vibration rejection was truly excellent as was acoustic breakthrough. Hum was very low and the unit was also highly resistant to acoustic feedback, while shock was also quite well rejected.

### Sound quality

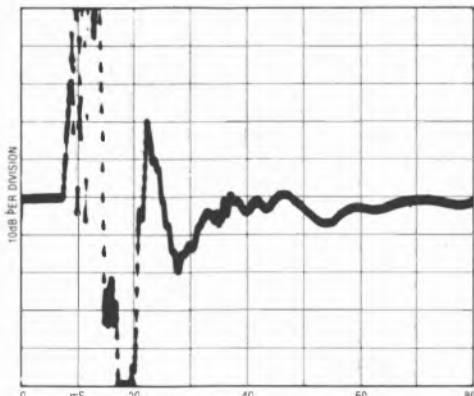
With a top class lab performance and its fine constructional quality we had high hopes of a good subjective result. In the event the findings were encouraging, particularly on lab related parameters, but the TT2 failed to make the top grade. Before criticising, it is worth pointing out the model's merits; namely in terms of feedback, tonal balance, integration and pitch stability. It proved less rewarding in the more subtle areas of dynamics where, strangely, the sound seemed mildly compressed and as regards clarity where some 'veiling' and muddle were noted in the mid and lower mid/upper bass range. The sound was suggestive of a mild but continuing low-level hangover (acoustic not physiological!) and somehow the attack and momentum of the programme appeared diluted. I have no proof but only a suspicion that the heavy steel beam subchassis was acting as a longer term energy store — an unwanted reverberator — while the chassis rotational mode may also have been a factor.

### Conclusion

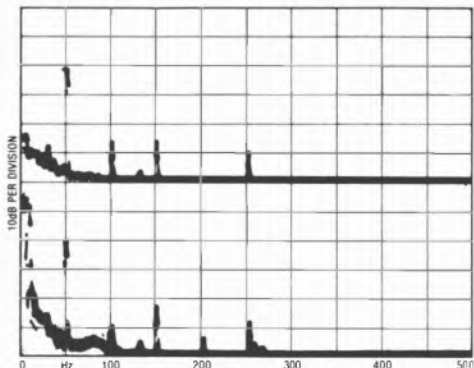
If the subjective report seems tough, it should be viewed in the context of the competitive pricing of this model for what is, after all, a well made well finished turntable of excellent lab performance, durable construction and reliable, stable alignment. I suspect that with a lower mass arm and less resonance-inducing cartridge the sound quality would improve still further. Despite our criticisms, as it stands the subjective performance was sufficient to merit recommendation.

### GENERAL DATA

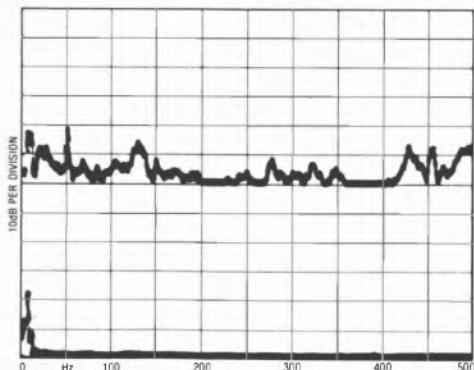
|  |                                   |
|--|-----------------------------------|
| Type   | Motor unit                        |
| ..... belt-driven, synchronous motor, subchassis |                                   |
| Platter, mass/damping                            | ..... 2.6kg/average +             |
| Finish and engineering                           | ..... very good/very good         |
| Type of mains/connecting leads                   | ..... 3-core                      |
| Speed options                                    | ..... 33/45 rpm                   |
| Wow and flutter (DIN peak wtd, sigma 2)          | ..... 0.08%                       |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)   | ..... 0.09%/0.05%                 |
| Absolute speed error                             | ..... -0.15%                      |
| Speed drift, 1 hour/load variation               | ..... synchronous/ -0.18%         |
| Start-up time to audible stabilisation           | ..... 6 sec                       |
| Rumble, DIN B wtd L/R average (see Spectrum)     | ..... -79 dB                      |
| Size/clearance for lid rear                      | ..... 44(w) x 37(d) x 15.5(h)/6cm |
| Ease of use                                      | ..... fairly good                 |
| Typical acoustic breakthrough and resonances     | ..... excellent                   |
| Subjective sound quality of complete system      | ..... good +                      |
| Hum level/acoustic feedback                      | ..... very good/very good         |
| Vibration sensitivity/shock resistance           | ..... excellent/good              |
| Estimated typical purchase price                 | ..... £195                        |



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Hitachi HTL70

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



The *HTL70* is an attractive little record-jacket-sized unit finished in a handsome metallic dark grey, the hinged lid carrying an LED display and a push-button control panel which lends it a 'technical' appearance. However with detailed investigation we discovered that in this case, beauty was only skin deep, and in several respects this deck left a lot to be desired.

Essential features include a linear-tracking lightweight tonearm mounted in the lid underside, a *la Technics SL10*, with, to quote 'an extremely sensitive gimballed support bearing unit working tracking wonders!' The matched cartridge includes an infra-red track sensor, and track selection is also linked to record size detection and thus to automatic speed change. Multiple track programming is not possible, the system being used essentially as an auto cue, moving the arm to the one selected track indicated on the LED numerical display. The cartridge is claimed to possess a high sound quality while the motor is a direct-drive with the now ubiquitous quartz lock servo speed control. The *L70* was considered very easy to use.

The various facilities worked well, in marked contrast to earlier track-detector models. The

enclosed nature and the high level of automation of this design made life rather difficult during lab testing, and several parameters could not be measured, but only inferred. As the consumer is unlikely to give up the track selection feature by changing to another cartridge, the cartridge supplied was also subjected to a brief assessment.

## Lab report

Disc damping was considered to be only fair, but the motor delivered an exemplary speed and wow performance with speed accuracy and wow and flutter comfortably at the limits of measurement. Rumble was judged very good, the test record used preventing and figures of better than  $-73\text{dB}$  — thus the spectrogram produced was misleading in this respect and so is not reproduced here.

Arm effective mass was low at an estimated  $6.7\text{g}$ , while geometry was excellent and most sections worked well. Arm resonances could not be graphed but from subjective 'tap' tests seemed to be unpromising.

Cartridge frequency response was charted and while it was flat more or less up to  $5\text{kHz}$ , it illustrated an astonishing rise in response to



+ 14dB at 20kHz. Separation was quite satisfactory even at high frequencies.

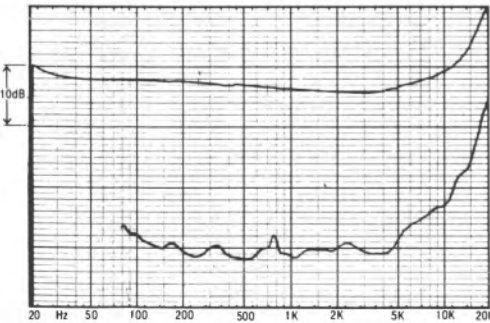
Acoustic breakthrough resistance was just a little better than average, as was the vibration isolation. This level of performance has been noticed before in the case of 'jacket size' models, and is partly due to their small size and consequently denser and more rigid construction. Shock resistance was good, again a feature of low mass parallel tracking units, and acoustic feedback margins were quite reasonable.

**Sound quality**

Unfortunately the L70 found little favour on audition. The searingly bright upper treble was a clear factor in this judgement but did not tell the whole story — the deck exhibited little transparency or stereo depth while the low bass was lacking and the upper bass was lumpy and lacking in definition. As supplied and tested here it could not truly be classed as hi-fi. Perhaps a sample with a 'sweeter' cartridge would help matters but such a substitution could not provide a complete solution.

**Conclusion**

Packed with features and lights, this model appears to reflect a lack of interest on the part of its designers in the final sound quality produced. No recommendation is possible.



Frequency response and separation, cartridge

**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

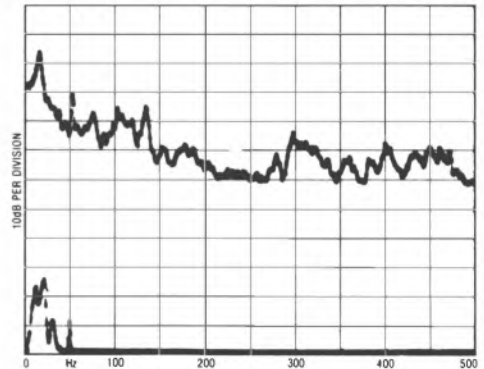
Type . . . . . fully auto, linear-tracking, quartz-lock direct-drive  
 Platter mass/damping . . . . . —/fair  
 Finish and engineering . . . . . excellent/good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . less than 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz 6-300Hz) less than  
 . . . . . 0.06%/0.05%  
 Absolute speed error . . . . . none  
 Speed drift, 1 hour/load variation . . . . . quartz-locked/none  
 Start-up time to audible stabilisation . . . . . 1.6 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . better than -73dB

**Arm Section**

Approximate effective mass, inc screws, excl cartridge . . . 6.5g  
 Type/mass of headshell . . . . . integrated cartridge  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . none  
 Finish and engineering . . . . . very good/good  
 Ease of assembly/setting-up/use . . . . . very good/excellent/excellent  
 Friction, typical lateral/vertical . . . . . —  
 Bias compensation method . . . . . N/A  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . not required  
 Downforce calibration error, 1g/2g . . . . . N/A  
 Cue drift, 8mm ascent/descent . . . . . none, 0.3 secs/0.4 secs  
 Arm resonances . . . . . N/A  
 Subjective sound quality . . . . . poor  
 Lead capacitance/damping method . . . . . —/none

**System as a whole**

Size/clearance for lid rear . . . . . 31.5(w) x 31.5(d) x 8.5(h)/0.5cm  
 Ease of use . . . . . excellent  
 Typical acoustic breakthrough and resonances . . . . . average +  
 Subjective sound quality of complete system . . . . . poor  
 Hum level/acoustic feedback . . . . . good/fairly good  
 Vibration sensitivity/shock resistance . . . . . fairly good/good  
 Estimated typical purchase price . . . . . £172



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# From the b

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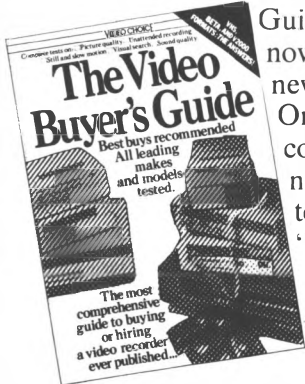
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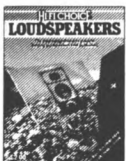
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# HI-FI CHOICE

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# Input Design ID600

Input Design Ltd, Victoria House, Shortmead Street, Biggleswade SG18 0AP  
Tel (0767) 316655



This UK-designed and built turntable came with literature claiming it to be sonically superior to comparably priced Japanese decks, although I noted that no mention was made of European competitors!

In some respects the *ID600* resembles the Rega *Planar* designs. It comprises a wooden plinth unit with a synchronous motor, rubber cord drive to a plastic centre hub and a plate glass main platter, with felt mat. There is no sprung subchassis, the lid being coupled to the plinth/chassis and the whole supported on fairly compliant rubber feet. Two speeds are provided and changeover is effected by hand on the pulley.

The unit supplied for review was finished in black stained veneer with a good-quality lid, although the latter did show a tendency to slide laterally in its hinge slots. Our sample came fitted as standard with an ADC *ALT1* tonearm, but future production will be equipped with the Linn *Basik LVV* arm at the same price, this including the Linn *Basik* cartridge at no extra cost. In the absence of such a sample, and since the *Basik* is sonically superior to the *ALT1*, some allowance was made in the review for this proposed change-over.

## Lab report

Full data on the *Basik LVV* arm can be obtained from the relevant review in this book. As regards the motor unit, platter mass was modest at 1.2kg, while the result for disc damping was somewhat below average with a

severe primary and secondary resonance. Wow and flutter exceeded the accepted limit for audibility at 0.15%, with excessive linear wow at 0.5%. The speed was fairly accurate at 0.2% slow but fell an excessive 0.45% under our standard loading. DIN-weighted rumble was poor at -55dB, essentially comprising breakthrough from the noisy and only partly isolated motor. It is with units such as this that I tend to despair of some UK manufacturers' quality control. A second sample, though promised, did not arrive in time for evaluation.

Acoustic breakthrough was average or below, with a prominence at 250Hz, and the vibration isolation was also flawed. An average shock resistance was noted, with a similar result for acoustic feedback.

## Sound quality

To some degree the auditioning confounded the middling results obtained in the laboratory. An 'average' rating was achieved — better than expected. While low bass was attenuated, the upper bass was reasonably articulate, and the midrange relatively clear with fairly good stereo. However wow was audible to a mild degree with a slow tempo and on quiet passages some mild motor drone was also evident.

## Conclusion

The *ID600* would have come closer to its sonic claims had the rumble and wow been up to accepted hi-fi standards. Unfortunately a recommendation is not possible as it stands.

## GENERAL DATA

### Motor Section

Type . . . . . manual, belt-drive, synchronous motor  
Platter mass/damping . . . . . 1.2kg/average  
Finish and engineering . . . . . good/average  
Type of mains/connecting leads . . . . . 2-core/phonos and earth  
Speed options . . . . . variable, 33/45 rpm  
Wow and flutter (DIN peak wtd. sigma 2) . . . . . 0.15%  
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . 0.5%/0.08%  
Absolute speed error . . . . . -0.2%  
Speed drift, 1 hour/load variation . . . . . synchronous/ -0.45%  
Start-up time to audible stabilisation . . . . . 3.5 secs  
Rumble, DIN B wtd L/R average (see spectrum) . . . . . -55dB

\*Integrated turntable

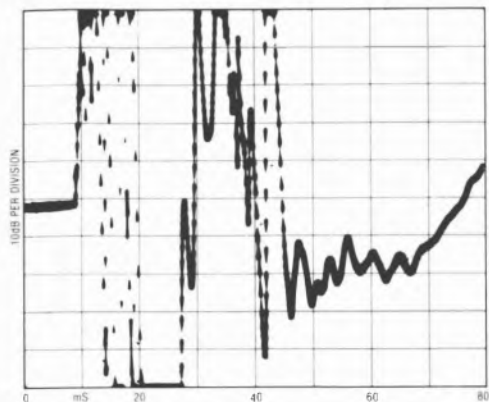
### Arm Section

See ADC *ALT1* and Linn *Basik LVV* reviews.

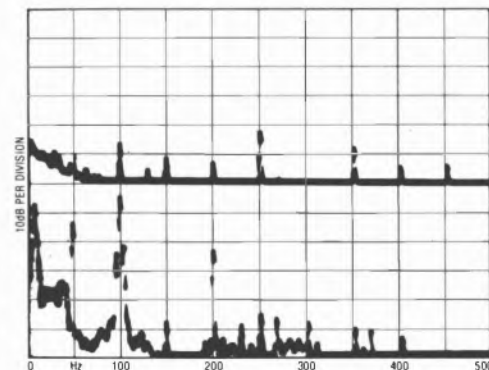
### System as a whole

Size/clearance for lid rear . . . . . 46(w) x 38(d) x 16(h)/7cm  
Ease of use . . . . . fairly good  
Typical acoustic breakthrough and resonances . . . . . average  
Subjective sound quality of complete system . . . . . average  
Hum level/acoustic feedback . . . . . average/average  
Vibration sensitivity/shock resistance . . . . . fairly good/average  
Estimated typical purchase price . . . . . £118  
\*includes Linn *Basik LVV* with cartridge (sample supplied with ADC *ALT1*)

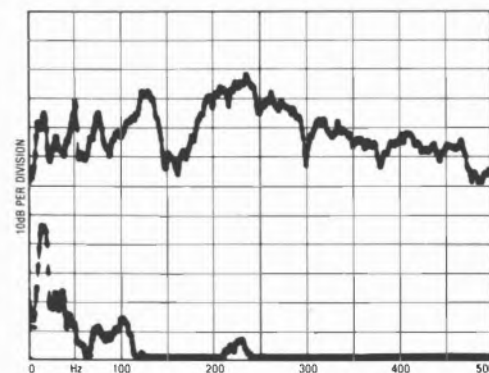
# Linn's Sound Advice



*Disc impulse transmission showing damping*

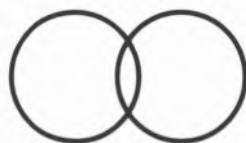


*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*



sound advice

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# JVC LA10

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



An inexpensive Japanese lightweight, the JVC LA10 lies on the hi-fi borderline, being a simple auto return, belt-drive model powered by a synchronous motor. It came fitted with a modest plastic-cantilevered cartridge which was not considered good enough to justify review here. In fact, as supplied, the cartridge was poorly aligned and over 1 deg out in the headshell.

The lightly constructed plinth and lid are of rather resonant plastic and this non sub-chassis design shows little attention to vital aspects such as vibration and acoustic breakthrough, although a marginal attempt to reduce acoustic feedback has been made by the inclusion of compliant rubber feet. The arm is one of the new generation lightweights, possessing a total effective mass of 8g, a far cry from the 'Dreadnoughts' in the 16-20g range that were fitted to almost all Japanese turntables a few years back.

## Lab report

Platter mass was low at 0.6kg with poor damping evidenced by the disc impulse response, the low-frequency ringing proving particularly serious. Competently engineered, the LA10 gave good wow and flutter results, with speed reasonably accurate and torque very good. The light platter attained operating

speed in a rapid 1.5 seconds but the rumble level of -60dB DIN B weighted puts it out of the 'serious audio' running. Spectrum analysis confirmed the source as predominantly poorly damped motor frame vibration.

Low in mass at 5g, this including hardware, the arm with headshell offered quite good intrinsic geometry. The arm was well finished and gave fine vertical friction values although horizontal friction was on the high side at 75mg. Bias compensation values were slightly low, but the mechanism was effective and cue operation was fine, apart from a slight 'kick' as the arm neared the end of its lift arc.

The arm resonance graph for this model was unfortunately of impaired measurement resolution, but suggests an average performance, with a 400Hz mode showing some prominence. Measured acoustic breakthrough was poorer than average as was the vibration isolation while below average results were obtained for most other parameters.

## Sound quality

Rated fairly poor on the listening tests, the LA10 proved to have no great resistance to footfall shock. The bass was sadly deficient and that bass which remained was inarticulate. Although the arm's contribution to the sound was considered fairly neutral and

unfatiguing, the overall lack of transparency and detail was disappointing. Some motor drone was also audible on quiet passages.

### Conclusion

Perhaps JVC were right in their reservations concerning the suitability of this deck for HFC – it could be argued that an inexpensive model such as this, designed primarily as part of a rack system, does not necessarily have to meet hi-fi standards. However notwithstanding the low price, in the context of HFC, the LA10 cannot be recommended.

### GENERAL DATA

Integrated turntable

#### Motor Section

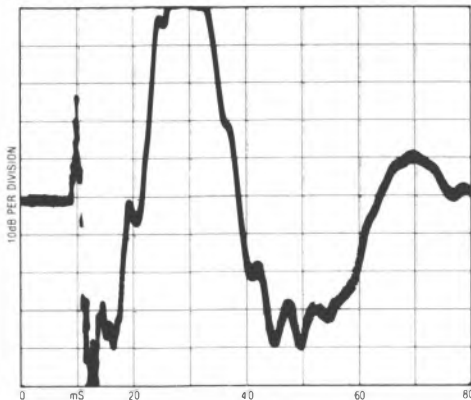
Type . . . . . semi-automatic, belt drive synchronous motor  
 Platter mass/damping . . . . . 0.6kg/poor  
 Finish and engineering . . . . . good/average  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . 0.08%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . 0.09%/0.06%  
 Absolute speed error . . . . . -0.3%  
 Speed drift, 1 hour/load variation . . . . . synchronous -0.1%  
 Start-up time to audible stabilisation . . . . . 1.5 sec  
 Rumble, DIN B wtd L/R average (see Spectrum) . . . . . -60 dB

#### Arm Section

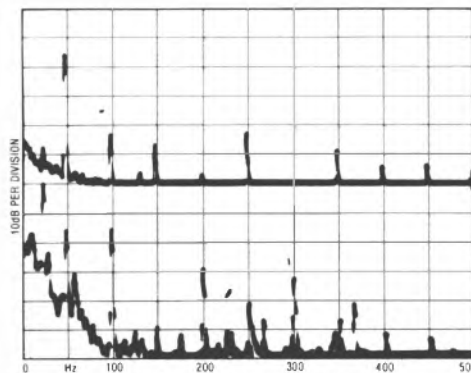
Approximate effective mass, inc screws, excl cartridge . . . . . 8.0g  
 Type/mass of headshell . . . . . special detachable/5g  
 Geometric accuracy . . . . . good  
 Adjustments provided . . . . . overhang/offset  
 Finish and engineering . . . . . very good/good  
 Ease of assembly/setting-up/use . . . . . very good/very good/very good  
 Friction, typical lateral/vertical . . . . . 75mg/25mg  
 Bias compensation method . . . . . internal spring  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . 150mg/170mg  
 Downforce calibration error, 1g/2g . . . . . +0.025g/-0.05g  
 Cue drift, 8mm ascent/descent . . . . . none, 1.5 secs/1.4 secs  
 Arm resonances . . . . . average  
 Subjective sound quality . . . . . average  
 Lead capacitance/damping method . . . . . 135pF/counterweight decoupling

#### System as a whole

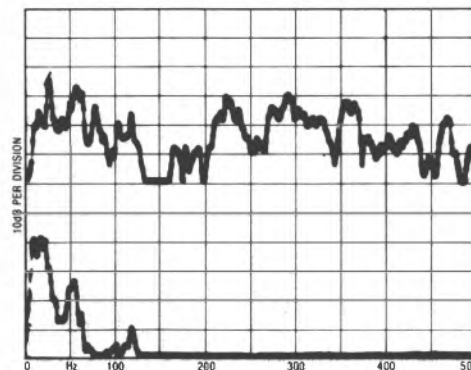
Size/clearance for lid rear . . . . . 42(w) x 35.5(d) x 11.5(h)4cm  
 Ease of use . . . . . very good  
 Typical acoustic breakthrough and resonances . . . . . fairly poor  
 Subjective sound quality of complete system . . . . . average –  
 Hum level/acoustic feedback . . . . . good/average –  
 Vibration sensitivity/shock resistance . . . . . average/average –  
 Estimated typical purchase price . . . . . £55



Disc impulse transmission showing damping

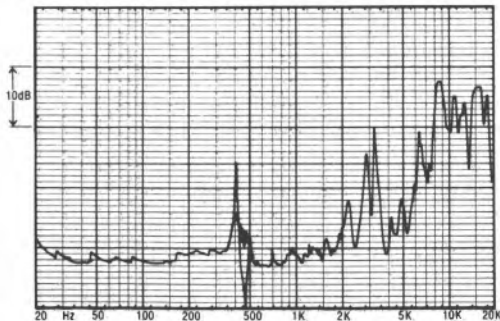


Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques



Structural arm resonances, audio band

# JVC LF71

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



The *LF-71* is a highly automated model with a number of special features. Microprocessor controlled, the track-selection 'play' and skip facilities are intended to also be available on a matching remote control unit, wired in by a special connector on the rear, and associated with other equipment in a matching system.

This turntable is one of the usual integrated plinth/chassis types, with little precaution taken against vibration or acoustic feedback. The direct-drive motor is not quartz-locked and instead the deck is provided with an illuminated stroboscope plus variable adjustment of the two speeds.

The arm is distinguished by its use of JVC's servo-control system whereby the lateral motion is under the control of a linear motor with electronic damping. The essentially 'fixed' cartridge carries a sensor head for track location, providing an automatic track selection feature, while auto-start and return are standard with this type of model. Since the cartridge is unlikely to be discarded, it was also subjected to a brief appraisal; described as a moving-magnet type, a 10Hz to 25kHz overall frequency range is claimed, with a 25dB midband separation and a low 8cu compliance. A shank mounted elliptical stylus is provided, with an 8 x 18 $\mu$ m tip radius.

## Lab report

With the platter mass fairly low at 1kg, the disc impulse was quite good with a quiet initial transient but some low frequency excitation. The motor was an excellent example of the

type, reflecting JVC's long experience in this field; not only was the rumble level very low, but it demonstrated fine dynamic characteristics, the second-order speed control servo providing virtually zero overshoot. Wow, flutter, and torque plus speed stability were all very good and start up was rapid.

The arm headshell is a special type with a seven pin connector for the photo-electric sensor, but the supplied cartridge was not very well aligned. Friction was difficult to measure because of the electronic damping, and was estimated to lie in the 75-50mg range. Cartridge downforces of below 1.5g are thus less suitable. The bias compensation worked well with downforce calibration accurate and the cue operation well judged.

Taken with the cartridge supplied, the resonance characteristic showed a severe mode at 200Hz but was clean thereafter. Possessing satisfactory separation, the cartridge met  $\pm 1.5$ dB response limits from 25Hz to 20kHz, and should give a fairly neutral, if slightly rich sound.

Both acoustic and vibration rejection were rather below average though the servo-damping gave a respectable feedback resistance as well as very good footfall shock immunity.

## Sound quality

Demonstrating an unpromising sound quality, the bass register was judged thick textured and lumpy, while the stereo lacked precision and focus, with little development of the depth image. Tonally the mid balance was rather thin and brash, with a larger than life 'loud' effect, which could prove misleading on initial listening.

## Conclusion

Bristling with features and endowed with an excellent direct drive motor, the *LF-71* still demonstrated an overall sound quality that was clearly unworthy of recommendation. However, as a shock-resistant auto design for disco-type applications, it could be useful, and would be improved in such applications if the lid were discarded altogether.



**GENERAL DATA**

Integrated turntable

**Motor Section**

Type ..... 'Musicscan' fully-automatic direct drive  
 Platter mass/damping ..... 1.0kg/fairly good  
 Finish and engineering ..... very good/good  
 Type of mains/connecting leads ..... 2-core/phonos and earth  
 Speed options ..... variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) ..... less than 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) less than

0.05%/0.04%  
 Absolute speed error ..... - 0.02%  
 Speed drift, 1 hour/load variation ..... approx. 0.1%/- 0.05%  
 Start-up time to audible stabilisation ..... 1.3 secs  
 Rumble, DIN B wtd L/R average (see spectrum) ..... - 77 dB

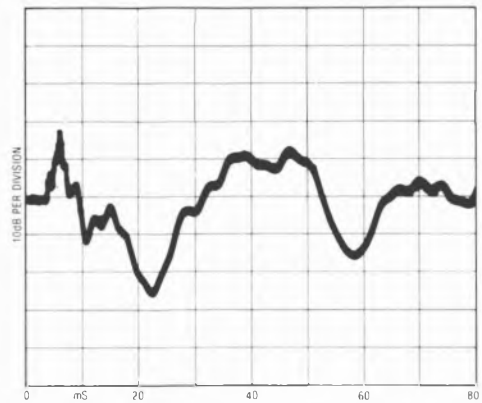
**Arm Section**

Approximate effective mass, inc screws, excl cartridge ..... 8.5g  
 Type/mass of headshell ..... special detachable, 7 pin/4.5g  
 Geometric accuracy ..... above average  
 Adjustments provided ..... overhang/offset  
 Finish and engineering ..... excellent/good  
 Ease of assembly/setting-up/use

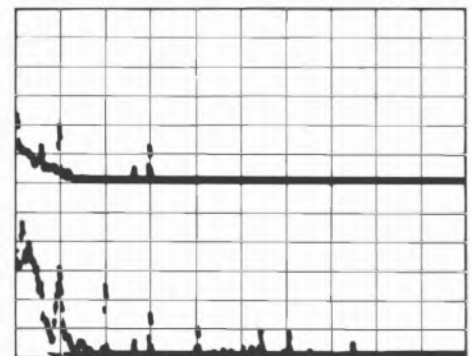
very good/very good/very good  
 Friction, typical lateral/vertical ..... 75mg/50mg  
 Bias compensation method ..... internal spring  
 Bias force, rim/centre (set to 1.5g elliptical) ..... 200mg/150mg  
 Downforce calibration error, 1g/2g ..... none  
 Cue drift, 8mm ascent/descent ..... negligible, 1.8 secs/2.2 secs  
 Arm resonances ..... average  
 Subjective sound quality ..... average -  
 Lead capacitance/damping method ..... pF/

**System as a whole**

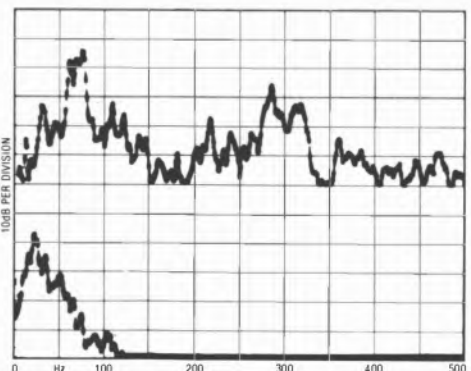
Size/clearance for lid rear ..... 42(w) x 37(d) x 11.5(h)/4cm  
 Ease of use ..... excellent  
 Typical acoustic breakthrough and resonances below average  
 Subjective sound quality of complete system ..... poor  
 Hum level/acoustic feedback ..... good/average  
 Vibration sensitivity/shock resistance ..... average - very good  
 Estimated typical purchase price ..... £160



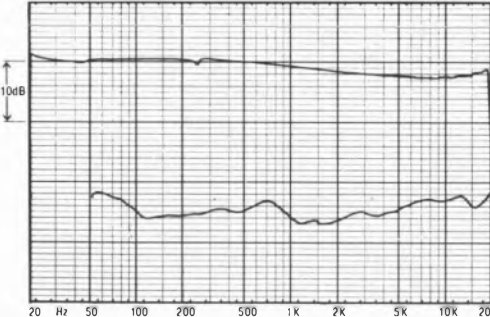
Disc impulse transmission showing damping



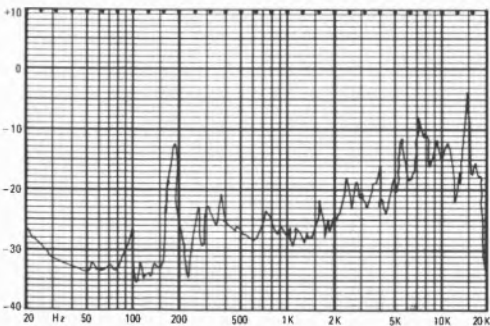
Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)



Frequency response and separation, cartridge



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# JVC QLY5F

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



## Features and design

A top model from the JVC range, the *QLY5F* incorporates this company's version of the 'electronic' tonearm using linear force 'motors': one is visible at the side of the arm in a flat box section; the other is located within the plinth and handles motion in the horizontal plane. Servo connection for feedback control allows simple arm adjustments to be made *via* two dials: one is for *Q* (variable electronic damping of the sub-sonic resonance); the other controls downforce, which automatically sets the bias compensation proportionally. In other respects the arm is straightforward, possessing a universal shell, and offering a highish 19g effective mass suited to lower compliance cartridges, in this case of 8-20cu due to the damping provided (see graph).

Fitted with a fairly solid 2.6kg platter, the substantial plinth and rubber sprung feet construction carries a quartz lock direct drive motor. Pitch control is absent, and instead JVC provide automatic arm cueing with power traverse. The plinth has a high gloss rosewood type finish, but unfortunately a tinted lid made of one of those rather resonant grades of polystyrene is fitted; this forms an effective acoustic trap and echo chamber, feeding unwanted energy into the disc and arm bearings *via* the rigid hinges and plinth.

The platter is fitted with a sensible flat rubber mat which offers good disc support, and the internal operating sequences are organised under microprocessor control to ensure a freedom from damaging sequences. However these systems can prove frustrating, as manual override is impossible, and one has to wait for a particular sequence to finish before trying something else.

## Lab results

The platter damping was sufficient to allow the expanded 'X10' presentation of the impulse

response; while the mid frequencies seemed well damped, the upper range was less so, and the response was dominated by a platter rocking mode at around 22Hz, which was also coincident with the higher order plinth/foot lateral resonance.

The motor gave a fine set of results - state of the art in fact - and the high torque provided a rapid start up, free of overshoot or instability.

The arm was geometrically well-aligned, and unusually for an automatic it offered variable height and headshell tilt as well. Friction was sensibly small - certainly below 30mg - and is thus suitable for tracking at as low as 1g downforce. The measurement of bias levels was complicated by the simultaneous presence of downforce, but the figures at a 1g setting gave 140mg edge and 110mg centre - rather low and in the wrong ratio. Only internal adjustment could correct for this imbalance and error. Downforce calibration was 20% high when set at 1g, but improved to +2.5% at 2g, and the automatics operated very smoothly. The variable damping was plotted with the number corresponding to appropriate downforce, '0' representing zero damping; in this instance a setting between 1 and 2 seemed optimal. As shown by the graph, the arm resonance behaviour was not very clean in the audio range, which probably relates to the electronic gadgetry attached to it; the trend proved both complex and 'lumpy', and defied simple analysis. Acoustic breakthrough was barely average, with the lid the main offender, while the rubber feet were comparatively ineffective at blocking vibration below 150Hz.

## Sound quality

Considering the *QLY5F's* elevated position in JVC's range, and its highish price, the listening test results were well below the expected standard, rating average or slightly below

average. The sound was considered to be midrange dominant, lacking in bass depth of weight, and with a susceptibility to feedback and 'boom'. A disappointing resolution of fine detail and stereo focus was demonstrated, with a subdued and somewhat 'grainy' treble.

### Conclusion

Once again we have evidence that good 'engineering' plus a high level of finish and attainment on traditional technical performance parameters is no guarantee of decent sound quality when assessed critically. Mechanically the 5F plays records well, but if sound quality is the main priority for the purchaser, it represents poor value.



Disc impulse transmission, magnified X10.

### GENERAL DATA

Integrated Turntable. Servo Arm

#### Motor Section

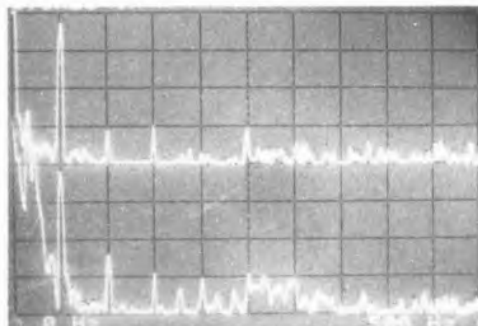
|  |                                      |
|--|--------------------------------------|
| Type   | quartz direct drive, fully automatic |
| Platter mass/damping                           | 2.6kg/fairly good                    |
| Finish and engineering                         | very good/very good                  |
| Type of mains lead/connecting leads            | 2 core/phonos + earth                |
| Speed options                                  | variable 33/45rpm                    |
| Wow and flutter (DIN peak wtd sigma 2)         | <0.05%                               |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | <0.1%/<0.05%                         |
| Absolute speed error                           | <0.01%                               |
| Speed drift 1 hour/load variation              | <0.01%/<0.01%                        |
| Start up time to audible stabilisation         | approx 1sec                          |
| Rumble: DIN B wtd L/R av (see spectrum)        | -77dB                                |

#### Arm Section

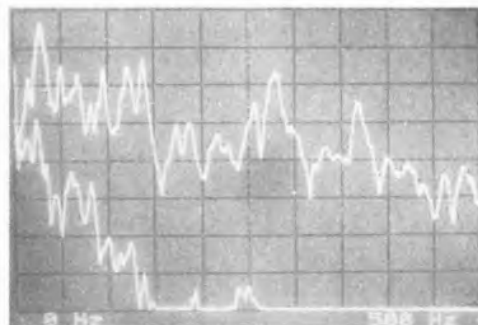
|   |  |
|---|--|
| Approximate effective mass inc screws, excl cartridge | 17g  |
| Type/mass of headshell                                | universal detachable/11g                   |
| Geometric accuracy                                    | very good                                  |
| Adjustments provided                                  | overhang, lateral angle, arm height, tilt  |
| Finish and engineering                                | very good/very good                        |
| Ease of assembly/setting up/use                       | very good/very good/very good              |
| Friction: typical lateral/vertical                    | less than 30mg/less than 30mg              |
| Bias compensation method                              | electronic                                 |
| Bias force: rim/centre (set to 1.5g elliptical)       | 140mg/110mg                                |
| Downforce calibration error: 1g/2g                    | +0.2g/+0.05g                               |
| Cue drift/8mm ascent/descent                          | negligible/0.5sec/1.5secs                  |
| Arm resonances  | average +                                  |
| Subjective sound quality                              | average +                                  |
| Lead capacitance/damping method                       | 95pF/variable electronic, damping subsonic |

#### System as a whole

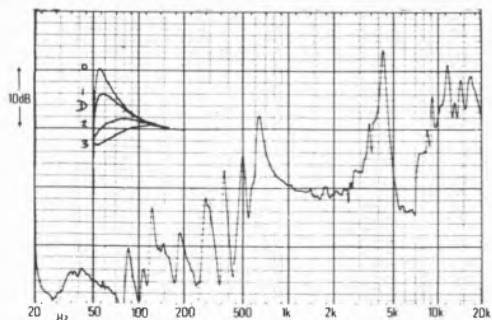
|  |                                 |
|--|---------------------------------|
| Size/clearance for lid rear                  | 48 Q(w) x 43.5(d) x 14.5(h)/7cm |
| Ease of use                                  | excellent                       |
| Typical acoustic breakthrough and resonances | average                         |
| Subjective sound quality of complete system  | average                         |
| Hum level/acoustic feedback                  | very good/fair only             |
| Vibration sensitivity/shock resistance       | fair/good +                     |
| Estimated typical purchase price             | £220                            |



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Arm resonances and damping

## Linn Sondek LP12

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ  
Tel 041-634 0371



With a decade or so of production behind the *Sondek*, the 'Nirvana' modification covered by the review in the last *HFC* 'Turntables' edition has now been augmented by a further development called 'Valhalla' (as with the 'Nirvana', this is an easy retrofit). For years now, the popular slow-speed synchronous motors generally fitted to the sub-chassis belt drive turntables have been at the mercy of the mains supply. The latter's frequency, distortion, noise level, transient fluctuations and voltage all affect the motor's output and also the level of vibration emitted from the motor frame.

Ideally such motors should be run from a two phase supply, but the second phase-shifted line has generally been optimised in a less-than-ideal fashion by using a phase shifting capacitor. When a turntable is intended for UK and for US markets, a pulley change is also required to account for the 20% mains frequency difference, in addition to the 2:1 change in voltage.

'Valhalla' solves these problems by effectively isolating the motor electronically from the mains supply. Mains power is rectified and smoothed to feed a bi-phase 100V low distortion power amplifier acting as the motor

source. The exact 50Hz frequency is synthesised from a quartz oscillator. When fed clear, stable 50Hz, the motor generates less vibration and mains harmonic components, attaining a near perfect pulley speed stability over both the long and the short term. Power into the belt is more stable, with (in theory at least) a lower rumble and reduced subchassis vibration resulting from the power feed. For simplicity's sake the single 33 rpm speed has been retained.

General alignment has also been improved with the recent introduction of larger and more accurate suspension springs and deckplate bolts. However the deck is still at present subject to suspension settling with use, and thus requires occasional realignment though new low-fatigue springs are promised to solve this problem in the near future.

To return to basic features, the *LP12* comprises a straightforward full sub-chassis belt driven turntable unit capable of accepting a variety of high quality tonearms. Deceptively simple in design, long experience with the product has shown that it has been subjected to such a high level of detailed development and refinement that almost every component down to the humblest screw fixings can be

shown to have a significant effect on the performance of the whole.

A substantial main bearing is used, with a hardened spindle ground to a slightly radiused point bearing on a thrust plate. High density PTFE sleeves in the bearing provide sufficient rigidity and very low rotational noise levels. The two piece platter is of considerable mass, cast in Mazak and turned to close tolerances, with a special grade of black felt used for the platter mat. Even now, considerable care is needed in setting up an LP12 in a final installation, and the help of an experienced dealer is virtually mandatory.

Other minor improvements concern the light touch on-off switch with LED indicator, as well as extra screws front and back to help keep the baseboard in position.

The well damped platter weighs some 4.1kg. Our assessment of disc damping was revised for this issue, and while the initial transient was certainly poorly damped by the felt mat, the impulse died away quickly thereafter, this a good result. A measurement taken last year showing the frequency transform of the felt mat versus an absorbent one has assumed greater significance this time round, inasmuch as it can be seen that while the 'composition' mat produced greater attenuation, its frequency response was uneven, while that of the felt was more uniform, suggesting lower overall coloration.

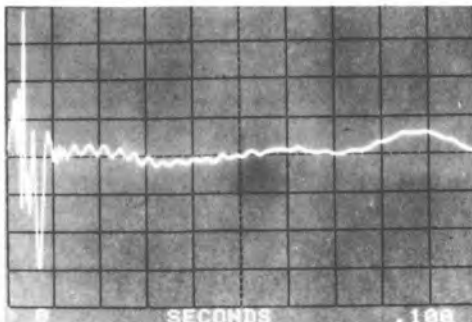
'Vallahalla' made its mark on the motor results with excellent wow and flutter, plus significantly lower linear wow. Absolute speed and accuracy was satisfactory, while loss under load was very good at 0.13%, another important result. DIN weighted rumble improved to a superb -80dB. In fact the spectrograms for residual measuring system noise and for the *Sondek* were very similar and to check this result the two were submitted to subtraction providing the second rumble photo - no mains related rumble components remain!

The LP12 was not the very best in the issue as regards vibration isolation or acoustic breakthrough but the curves did confirm a high standard for these parameters nonetheless. Shock resistance was also quite good, with both acoustic feedback and hum very good.

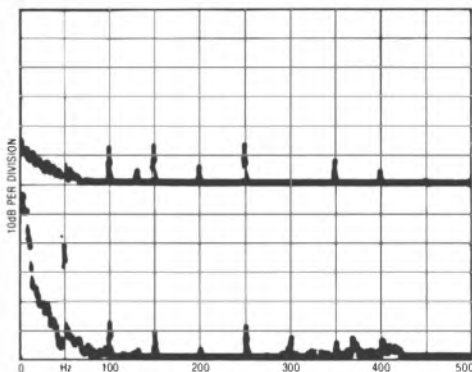
### Sound quality

A few years ago it was considered heresy to suggest that turntables could make a 'sound' at all, but meanwhile the *Sondek* has been a leading exponent in demonstrating just how different the subjective performances can actually be. It scored an excellent rating on audition, notwithstanding some mild spectral

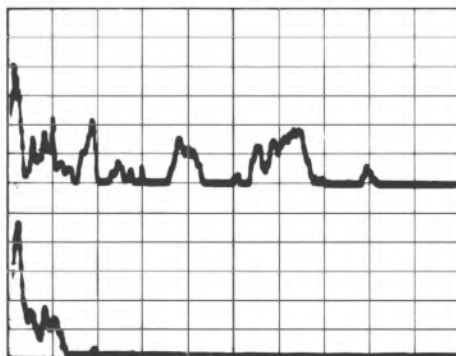
*Continued on page 108*



*Disc impulse transmission showing damping*



*Rumble, electrical (above) and total (below)*



*Breakthrough, acoustic (above) and vibration (below)*

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

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### LINN SONDEK *continued*

imbalance and coloration; a consumer who feels that absolute tonal neutrality is paramount is entitled to reject the LP12 but should be made aware of the importance of certain other factors. For example the LP12 has long generated a feeling of 'involvement' with the music for reasons that are only partly becoming understood — some of these are becoming clearer now with the improvement afforded by 'Valhalla'.

After careful and prolonged listening the LP12 was found to excel in its ability to retain the timing, tempo, rhythm and pitch of complex percussive sections, failure here producing some loss of interest on the part of the listener. Additional qualities included rapid post-transient decay producing 'transparent silences' between successive notes and these were all too often obscured by hangover in other models. The felt mat also provided a level of tonal integration of bass and treble now considered optimum for the deck. However some anomalies were heard — a mild upper bass richness with marginally 'loud' and forward midband, although when the latter effect was identified, it was not felt to be important enough to affect the high subjective ranking. The *Ittok* arm still produces a spectacularly good sound with the *Sondek*, and to my ears at least, the Alphason arm also matched it well, providing in some respects a sweeter and more neutral balance.

### Conclusion

The *Valhalla* Linn costs more than before but the increase is not far out of line with inflation over the last year or two. Now better than ever, the LP12 had no trouble in maintaining its virtually pre-eminent ranking for its price category; many can pick holes in its performance but few can actually do better.

### GENERAL DATA

Motor unit

#### Motor Section

|  |  |
|--|--|
| Type   | manual, belt-drive, synchronous motor, sub-chassis |
| Platter mass/damping                           | 4.1kg/good   |
| Finish and engineering                         | excellent/excellent                                |
| Type of mains/connecting leads                 | 2-core   |
| Speed options                                  | 33rpm  |
| Wow and flutter (DIN peak wtd, sigma 2)        | 0.06%  |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.09%/0.05%  |
| Absolute speed error                           | -0.2%  |
| Speed drift, 1 hour/load variation             | quartz-locked/-0.13%                               |
| Start-up time to audible stabilisation         | 6 secs   |
| Rumble, DIN B wtd L/R average (see spectrum)   | -80 dB   |
| Size/clearance for lid rear                    | 44.5(w) x 36(d) h/5.5cm                            |
| Ease of use                                    | good   |
| Typical acoustic breakthrough and resonances   | very good  |
| Subjective sound quality of complete system    | excellent  |
| Hum level/acoustic feedback                    | very good/very good                                |
| Vibration sensitivity/shock resistance         | very good/good                                     |
| Estimated typical purchase price               | £374   |

# *Put your turntable on a pedestal*

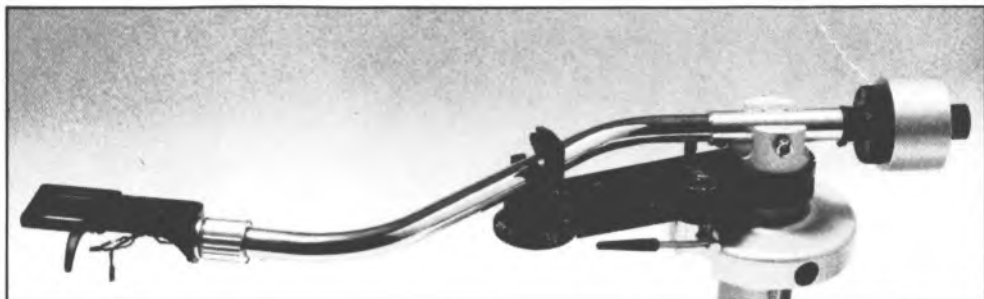


*The Sound Organisation stand has been designed to allow your turntable to work to its maximum capability. Without it you'll never know quite how good your system can sound. In fact, since this stand improves every turntable on the market you might say that all the systems in this book have been underperforming.*

Used by: **Linn Products, Naim Audio, A & R (Cambridge)**. Stocked by: **The Sound Organisation**, 1 Cathedral Street, London SE1, 01-403 2255 or 01-403 3088. **Grahams Electrical**, 86-88 Pentonville Road, London N1, 01-837 4412. **Studio 99**, 81 Fairfax Road, London NW6, 01-624 8855. **KJ Leisure Sound**, 48 Wigmore Street, London W1, 01-486 8263. **Jeffries Hi-Fi**, 69 London Road, Brighton. **Chris Brooks Hi-Fi Consultant**, 29 Gaskell Street, Stockton Heath, Warrington, Cheshire, 0925 61212. **Clearstone Hi-Fi**, 156-158 Blackburn Road, Bolton, Lancs. 0204 22636. **Purkiss Hi-Fi Systems**, 51-53 Piccadilly, Hanley, Stoke-on-Trent, Staffordshire, 0782-265010. **Chichester Hi-Fi Centre**, 40 Little London, Chichester, West Sussex, 0243-776402. **The Audio Source**, 139 Waterbeach Road, Landbeach, Cambridge. **Naim Music**, 1 Greig Street, Inverness, Scotland, 0463-220440. **Billy Vee Sound Studio**, 248 Lee High Road, Lewisham, SE13, 01-852 8263. **Kernow Audio**, 39 Pargolla Road, Newquay, Cornwall, 06373 6380.

# Linn Basik LVV

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ  
Tel 041-634 0371



## Features and design

For years Linn have been plagued with requests for a less expensive turntable, and while experimental designs have been produced, so far they have found the compromises involved unacceptable. However a positive step in the direction of economy has now been taken with the introduction of a less expensive alternative to their pricey tonearms, aptly called the *Basik*. A tolerably good, compatible cartridge is also thrown in for good measure.

There are several points of interest, including the massive arm pillar (of latest *Ittok* diameter and dimensionally compatible), which fits a version of the familiar *Ittok* base. The bearing assembly and 'S' arm tube resemble those on the ADC 1500 (both arms originate from Japan), although the bearing quality on the *Basik* is much better. A visually flimsy universal detachable pressed alloy headshell is fitted, which does not accept the *Asak* (probably intentional on the part of Linn); interestingly the substitution of a 'better' shell worsened the results (see graphs), so the one supplied must be a good match.

A new set of fixing holes are required for mounting the *Basik* on the Linn, rotated from *Ittok* requirements using the same centre; the base also has a cut-out to accept the arm-lift cylinder. A rotating scale counterweight is fitted and the biasing uses internal spring mechanism.

The *Basik* cartridge is an inexpensive moving magnet affair with a shank-mounted spherical tip stylus of good alignment. The moderate compliance gives rise to a satisfactory 7.8Hz, +10dB subsonic resonance in the *Basik* arm, at a 1.8g tracking force. However the output is slightly on the low side, and may not give full power with preamps possessing a low sensitivity.

## Lab results

With a medium to high effective mass of 13.5g, including steel screws, the arm is best suited to

cartridges in the 8–20cu range. The geometry was fine, and the headshell locking was more secure than is usually found in this price range. The arm was well finished with accurately set bearings, and was both easy to set up and use. In view of the intended tracking force of 1.5 to 2.5g, friction levels were tolerably low, while the bias accuracy and trend were just right. Downforce calibration was accurate to within 8% (slightly on the low side), and the cue worked well, while the same low 100pF capacitance *Ittok* cable was used.

Plotted as supplied, the resonance graph showed good counterweight control and relatively few resonances (the headshell socket flexure at 200Hz is obvious, of course). Interestingly, substitution of a more rigid *ATH-8* headshell gave a different result, showing more numerous breaks and on balance proving less favourable.

In the bass and midrange at least the cartridge was a surprisingly good tracker, providing Supex-like response, but with rather poor channel balance on our sample. Separation was quite good, as was the generator geometry, giving well balanced distortion readings. It proved relatively unaffected by electrical loading.

## Sound quality

Auditioned using an *EPC205* cartridge the *Basik* gave a fine account of itself. The tonal balance was pretty good, with a pleasant midrange rendition of vocals, while the stereo image was fairly well developed. The bass, though slightly softened, was more than satisfactory in terms of both definition and extension.

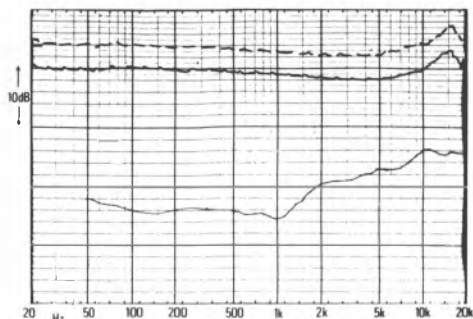
Using the supplied cartridge there was clearly a touch of the '*Asak/Ittok*' sound, though with a degree of veiling in terms of detail and transient 'sharpness'. The combination was quite truthful in the bass, had a pleasant vocal register, but tended to brashness and slurred sibilants in the



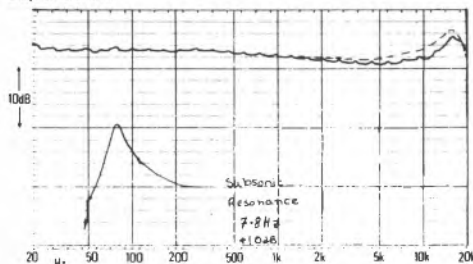
high treble, although not unacceptably so. Considering the 10:1 price difference involved, the *Basik* with its supplied cartridge stands up well.

### Conclusion

The *Basik* can be recommended, and will win many friends amongst prospective Linn customers, as well as purchasers of other manufacturer's turntables. In its own right the *Basik* is a fine value for money arm, and the supplied cartridge provides a convenient and compatible starting point.



Cartridge response, channel balance and separation.



Cartridge response: solid 130pF, dotted 500pF, plus subsonic resonance (X decade).

### GENERAL DATA

|   |                                     |         |
|---|-------------------------------------|---------|
| Approximate effective mass inc screws, excl cartridge | 13.5g                               | Tonearm |
| Type/mass of headshell incl 'S' cartridge             | universal/detachable/7g             |         |
| Geometric accuracy                                    | very good                           |         |
| Adjustments provided                                  | overhang, lateral angle, height     |         |
| Ease of assembly/setting up/use                       | good/very good/very good            |         |
| Friction: typical lateral/vertical                    | 60mg/35mg                           |         |
| Bias compensation method                              | dial and internal spring            |         |
| Bias force: rim/centre (set to 1.5g elliptical)       | 180mg/220mg                         |         |
| Downforce calibration error: 1g/2g                    | -0.08g/-0.17g                       |         |
| Cue drift/8mm ascent/descent                          | negligible/0.7sec/2.8secs           |         |
| Arm resonances  | good                                |         |
| Subjective sound quality                              | good                                |         |
| Lead capacitance/damping method                       | 100pF/some counterweight decoupling |         |
| Estimated typical purchase price                      | including cartridge £45             |         |

### BASIK CARTRIDGE

|                                      |                                  |
|--------------------------------------|----------------------------------|
| Cartridge type                       | moving magnet                    |
| Cartridge mass                       | 5g                               |
| Estimated dynamic compliance at 10Hz | 23cu (X10 <sup>-6</sup> cm/dyne) |
| Specified downforce: range           | 1.75g to 2.25g; tested at 1.8g   |
| LF resonance in Basik arm            | +10dB at 7.8Hz                   |
| Sensitivity at 1kHz                  | approx 0.65mV/cm/sec             |
| Relative output (0dB=1mV/cm/sec)     | -3.5dB                           |
| Subjective sound quality             | satisfactory                     |
| Recommended loading                  | 47K ohms plus 500pF*             |
| Recommended arm mass                 | 6-12g                            |
| Recommended arm damping              | not essential                    |
| Induced hum level                    | good                             |

### Stylus data

|  |                          |
|--|--------------------------|
| Stylus type                                | shank mounted, spherical |
| HF resonance (tip mass/vinyl)              | 16kHz                    |
| Frequency response, separation and balance |                          |
| 30Hz-20kHz±                                | +3, -2dB                 |
| 100Hz-5kHz±                                | +0, -2dB                 |
| Stereo separation, 100Hz, 1kHz, 10kHz      | 24dB, 25dB, 15dB         |
| Channel difference at 1kHz, 10kHz          | 4dB, 4dB                 |

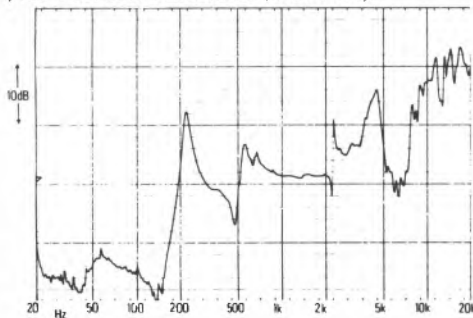
### Trackability

|                                    |       |
|------------------------------------|-------|
| 300Hz lateral ±15dB                | 1.5g  |
| 300Hz vertical ±12dB               | 1.1g  |
| 300Hz lateral +18dB ('Supertrack') | 1.85g |

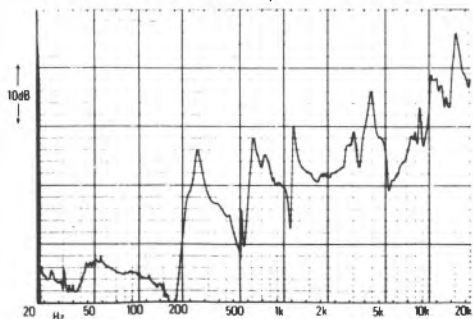
### Distortion

|                                 |                     |
|---------------------------------|---------------------|
| 300Hz lateral +9dB              | 0.6%                |
| 300Hz vertical +6dB             | 3.0%                |
| High frequency waveform quality | fair                |
| Typical selling price incl VAT  | Free with Basik Arm |

\*Uncritical of loading in practice



Structural arm resonances, audio band.

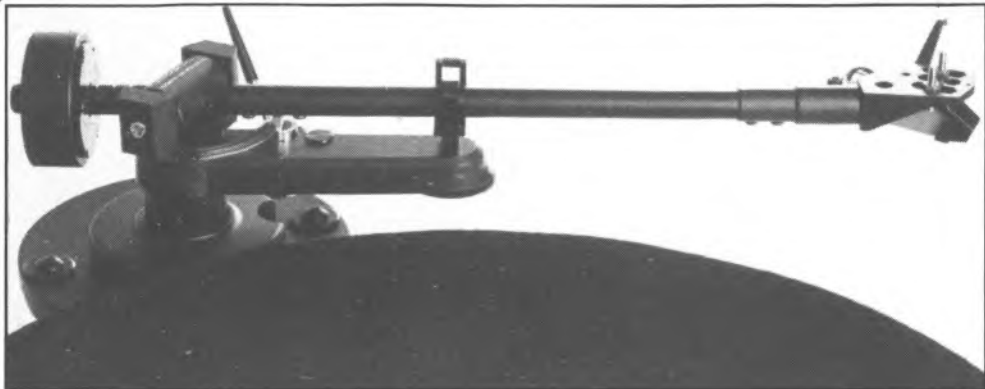


Arm resonances with ATH-8 shell substituted.

# RECOMMENDED

## Linn Basik LVX

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ  
Tel 041-634 0371



Encouraged by the runaway success of their low-cost *Basik LVV* arm, Linn have now introduced a second, which is Scots-designed and Japanese manufactured. Costing rather less than one-third the *Ittok* price, the *LVX* nonetheless manages to return something of the former's features as well as adding some of its own.

An all-black creation, it is distinguished by its moderate arm mass — estimated at 12.5g — and yet it still offers a cast headshell of near-*Ittok* quality, secured by a split-shaft lock, tensioned by a socket head bolt. This arm is an obvious choice for those wishing to undertake a comparative evaluation, be they reviewer or dealer demonstrator.

The *LVX* is fully calibrated, with a partially decoupled rotating counterweight providing the usual second slide scale. Closed loop bearings are used, these adjusted for zero play, an unusual characteristic where such an inexpensive arm is concerned. However there are bound to be repercussions — we examined a number of samples (several other manufacturers decks were fitted with a *LVX*) and we found variability with respect to pivot friction. The arm is also a little fragile, much more so than the *Ittok*. It should be handled with care and never subjected to shock — not that this isn't good advice where any quality product is concerned. Our Linn-supplied *LVX* delivered 150mg of lateral friction which I consider to be in the reject class; however the sample used for audition was satisfactory.

The *LVX* uses the new large arm pillar but the baseplate is still unique to the *Basik* series inasmuch as a cutout is required to accommodate the cue damper cylinder. The low cap-

acitance output cable is to *Ittok* specification though the headshell tags and pins are not gold plated. However the 'giveaway' Linn Basic cartridge is included with the arm, and could be regarded as a no-cost 'starter' (see review).

### Lab report

Estimated effective mass had been noted at 12.5g including hardware, this suitable for cartridges on the 10-20cu range. A special design with metal plug insert, the detachable headshell weighs 7g inclusive of screws, and a limited adjustment for vertical tilt is possible due to the takeup tolerance in the headshell lock overhang, height and lateral angle adjustments are standard. Both finish and engineering were very good, and the arm was easy to use. The usual internal spring system was used for bias, but levels were slightly on the low side, with no apparent differentiation from rim to centre. Downforce was slightly low, while the cue worked well with sensible rates. On our 'good' sample lateral friction was around 50mg, while in the vertical plane it was excellent at less than 10mg. Rated good on arm resonance, the graph showed a well controlled behaviour up to the first major break at 750Hz, a commendably high frequency. A trifle disjointed thereafter (literally!), the remaining aberrations were nonetheless very mild, and suggested a smooth treble, tidy bass and generally clean midband.

### Sound quality

Awarded a promising 'good' on the listening tests, the *LVX* did not compare too favourably with the *LVII* but was nonetheless a fine arm in its own right. Subjectively, it was not as

'involving' as the former model but at the same time there was very little obviously wrong with it.

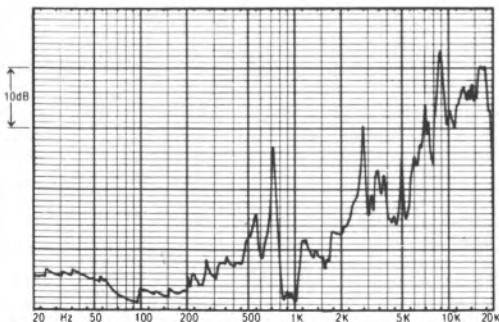
The overall tonal balance was very satisfactory, and as a whole the stereo image was well defined with both depth and ambience. It sounded a little 'thin' in the midrange, and the bass lacked some tautness, tending to appear a little 'boppy'. Treble was sweet and musical but lost some detail and stereo precision.

### Conclusion

While Linn are unable to make a satisfactory 'cheaper' turntable, the *LVX* does make for a less expensive arm/deck combination. To my way of thinking the alternative *LVV* is not really acceptable unless viewed as a starter component only. The *LVX* represents a welcome medium-mass tonearm of fine quality with a detachable headshell, and both moving magnet and moving coil types work well in it. With our reservation concerning pivot friction variability noted, the *LVX* is nonetheless well recommended; indeed many consumers will never need to go beyond it.

### GENERAL DATA

|  |                                |
|--|--------------------------------|
|  | Tonearm                        |
| Approximate effective mass, inc screws, excl cartridge | 12.5g                          |
| Type/mass of headshell                                 | special detachable/7g          |
| Geometric accuracy                                     | very good                      |
| Adjustments provided                                   | overhang/offset/height         |
| Finish and engineering                                 | very good/good                 |
| Ease of assembly/setting-up/use                        | very good/good/very good       |
| Friction, typical lateral/vertical                     | approx 50mg/less than 10mg     |
| Bias compensation method                               | internal spring                |
| Bias force, rim/centre (set to 1.5g elliptical)        | 150mg/150mg                    |
| Downforce calibration error, 1g/2g                     | - 0.1gm/0.1g                   |
| Cue drift, 8mm ascent/descent                          | negligible, 1.0 secs/3.3 secs  |
| Arm resonances   | good                           |
| Subjective sound quality                               | good +                         |
| Lead capacitance/damping method                        | 100pF/counterweight decoupling |
| Estimated typical purchase price                       | £74 inc. cartridge             |



Structural arm resonances, audio band

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### STUDIO 99

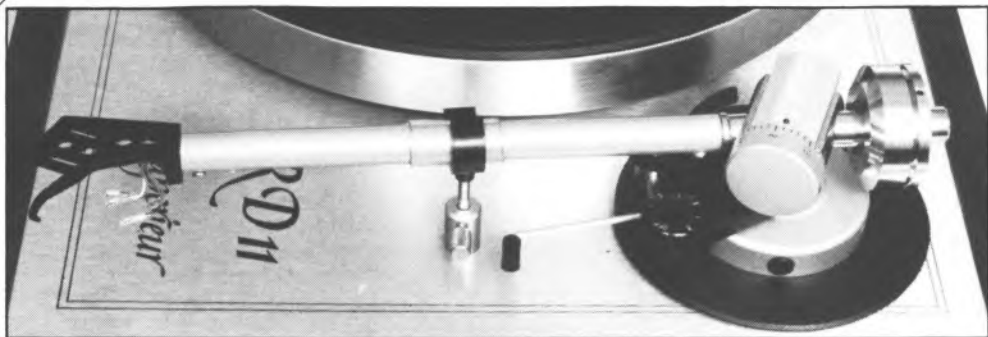
|                        |                       |
|------------------------|-----------------------|
| <b>81 Fairfax Road</b> | <b>82 High Street</b> |
| <b>Swiss Cottage</b>   | <b>Harpenden</b>      |
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**CREDIT CARDS — ENQUIRE FOR FREE CREDIT**

RECOMMENDED

## Linn Ittok LVII

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ  
Tel 041-634 0371



When first released, the *LVII* immediately established an enviable reputation for excellent engineering, sound quality and technical performance. The current version still resembles the original arm, despite some minor constructional changes which have helped maintain a competitive state of 'tune', and the original is by no means rendered obsolete.

A rigid fixed head tonearm, it carries the relatively truthful label 'Direct Coupled' this referring to the ability of this arm to directly couple the cartridge mounting to the subchassis as board. Considering the requirements for high sensitivity in two planes of freedom at the bearings, this is no mean feat of engineering. While I would not encourage careless handling, my experience of a number of *Ittoks* suggests that not only are they consistently well adjusted but they are also fairly robust compared with many other models.

At close on a 14g effective mass including hardware, the design fits the upper end of the medium-mass group and is best suited to cartridges in the 8-16cu compliance range. Providing a strong foundation for cartridge mounting, the cast magnesium headshell carries a very well designed and non-resonant finger lift and the more recent counterweights exhibit a pretty tight fit on their slightly resilient synthetic bore liners; the importance of this particular aspect may be seen in the improved damping of the resonances at 400Hz, 900Hz and 1.6kHz, when a deliberately loose but non rattling counterweight was substituted.

This arm proved convenient to use, the effective cueing system controlled by a lengthened finger lever fitted with a roller at the top. This aids cueing on floppy subchassis turntables and reduces unwanted spurious shock effects post cueing. In marked contrast to the majority

of upmarket audiophile designs, the *Ittok* comes fitted with a well calibrated and respectably accurate dials for both downforce and bias, the latter adjustable during play. A precision low-torque flat coil spring is used for downforce, with a linear coil spring for bias correction. The small but worthwhile improvements noted with later models include an increase in diameter of the main pillar cylinder together with a larger socket head clamping bolt allowing an unrivalled strength three-point lock to be obtained between arm and base. The main tube is now hard anodised in a darker shade of grey with a lacquer coating and the bonding of various parts has also been uprated by the use of larger bolts with heads capable of accepting greater tightening torque.

### Lab report

Geometric accuracy was considered excellent, with a properly square headshell and adjustment provided for overhang, lateral angle and height. The alignment is in fact virtually optimised for our two point minimal subjective distortion criterion. Finish and engineering were both excellent and the arm proved easy to assemble, set up and use. Friction was superb at around 10mg or less in both planes, with no detectable slack. Biasing was in the correct ratio if marginally low in our estimation (based on a normal elliptical stylus), but downforce was well within the required tolerance. The cue worked well with a sensible rate and negligible drift. Arm resonances were classed as very good with the first main flexure deferred to a high 1kHz, this suggesting a remarkable rigidity.

As has been noted previously, the close nature of the coupling between arm and mounting board meant that the latter becomes

influential as regards final sound quality.

### Sound quality

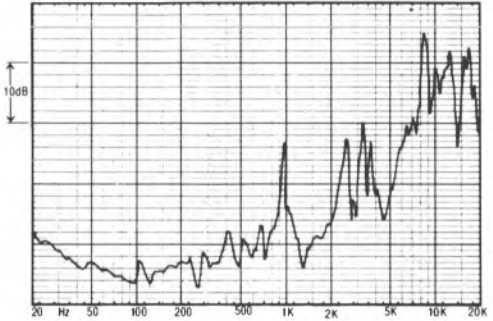
The overall rating is a secure 'very good, but as with all acoustic components the final result obviously represents some sort of balanced compromise. In our view the *Ittok's* strengths lie in its subjective speed of response to transients, its fine transparency and its ability to reveal atmosphere, depth and fine detail. The bass was to a fine standard with good extension and drive, while the treble was also revealing of detail if very slightly brash and forward at times. A trace of upper-mid hardness was also noted, where the stereo focus suffers a mild dilution. The importance of this depends on the final combination of equipment chosen.

### Conclusion

In its price category the *Ittok* remains an outstanding design with a fine combination of technical performance, sound quality and finish, plus ease of adjustment and use. While this is a fine universal tonearm, working well with many decks, it excels on the Linn *LP12*, where its minor faults appear to be significantly ameliorated. Likewise it is well suited to the standard Linn *Asak* cartridge, these three components in combination providing a disc player of virtually unrivalled performance for the price.

### GENERAL DATA

|  |                               |
|--|-------------------------------|
| Approximate effective mass, inc screws, excl cartridge | Tonearm                       |
|  | est 13.5g                     |
| Type/mass of headshell                                 | non-detachable                |
| Geometric accuracy                                     | excellent                     |
| Adjustments provided                                   | height/overhang/lateral angle |
| Finish and engineering                                 | excellent/excellent           |
| Ease of assembly/setting-up/use                        | very good/very good/very good |
| Friction, typical lateral/vertical                     | less than 10mg/less than 10mg |
| Bias compensation method                               | internal spring               |
| Bias force, rim/centre (set to 1.5g elliptical)        | 175mg/195mg                   |
| Downforce calibration error, 1g/2g                     | less than 0.03g/0.033g        |
| Cue drift, 3mm ascent/descent                          | negligible, 0.8 secs/1.8 secs |
| Arm resonances   | very good                     |
| Subjective sound quality                               | very good                     |
| Lead capacitance/damping method                        | 100 pF/none                   |
| Estimated typical purchase price                       | £253                          |



Structural arm resonances, audio band

# WARNING

When buying a turntable always insist on a demonstration comparing at least two decks in your price range.

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# Logic DM101

Logic Ltd., 6 Guy Street, Leamington Spa, Warwickshire CV 32 4RT.  
Tel (0926) 20302

RECOMMENDED



First reviewed in the last *HFC* 'Turntables' edition, the Logic *DM101* design has undergone considerable modifications since then and accordingly has been completely reassessed for this issue.

In several respects the performance in previous tests was very good indeed, but a weakness was present in the subchassis springing which was believed to have limited the ultimate performance attained.

The subchassis is open, fitting in a recess in the upper surface of the semi-solid plinth. Sawn from a thick, stress-free 8mm aluminium alloy plate, and asymmetrically shaped to reduce self resonances, the chassis is suspended at its three extremities on a total of six small diameter coil-springs acting as a sort of 'web'.

However, Logic have subsequently added a large central coil spring to the subchassis around the bearing housing, bringing the total number of springs used to seven.

A useful feature with the Logic design is the ability to lift the subchassis right out for arm fitting and lead dressing, while the levelling points are locking socket-head bolts, conveniently adjustable from above and clear of the platter. The precision machined two-part alloy platter of this belt drive model weighs 3kg. It is fitted with a bonded baize mat, and runs on an impressive-looking main bearing. This has a 12mm shaft and a single point (thrust ball), plus a rigid phosphor-bronze sleeve exhibiting excellent tolerances. Speed change is effected manually after removing the outer platter.

## Lab results

In previous tests, weighted wow and flutter

was an excellent 0.06%, following stabilisation after start-up. The time required for the chassis to settle down after starting was a rather long five seconds. Flutter and rumble were also very good when separately measured. The speed ran 0.05% slow — significant in A/B comparisons — and this had to be taken into account during auditioning. The slowing under load was a satisfactory 0.35%, and the DIN B weighted rumble was a first rate — 77 — 78dB. From the spectrum analysis it can be seen that the suppression of mains-related rumble components was very good, with barely any visible difference between the static electrical breakthrough and the total rumble content.

We also obtained promising disc impulse responses, allowing X10 scaling; noteworthy is the scarcity of the low frequency long wavelength components which were often encountered with other models, confirming the considerable bearing/platter rigidity. The Logic's previously standard disc support gave quite good transient damping, but the alternative *Audio Ref* showed a superior control in the mid/treble range.

Both acoustic breakthrough and vibration isolation were excellent and proved to be a strong point with this model, endowing it with a very high feedback immunity.

On the latest version the original low-slung suspension has been restored, affecting the rotational mode stiffness and giving a very low resonance (too low perhaps in my view) has been attained of around 2.5Hz. The turntable now takes some time to stabilise after shock and pure wow has also doubled to 0.22%, a

significant result and believed due to this revised suspension.

A felt mat is fitted to current production models (see the new graphs for isolation and impulse) and this was thought to slightly worsen the performance, although the vibration isolation remained excellent.

### Sound quality

On the listening tests the original and promisingly high standard was still demonstrated, with the previously-noted slight stereo stage defocusing (believed attributable to the old suspension) now absent. However prolonged audition suggested another effect — a subtle instability of pitch which was believed to be associated with the measured slow wow, a contributory cause being the 0.3% of load variation. As before, the low frequency range was unusually clear, even, detailed and well extended, while feedback was held well at bay, and the general tonal balance with the standard mat was both neutral and yet at the same time sufficiently 'lively'. The *Ittok* worked well, though it demonstrated greater midrange 'hardness' than when partnering the *Sondek*; the *Helius* or *Mission* arms gave 'sweeter' results.

### Conclusion

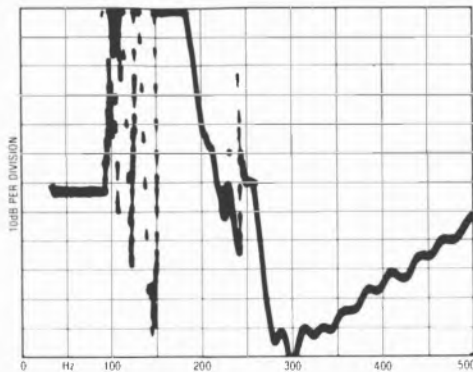
When last tested, the *Logic* demonstrated many strong points in its technical and subjective performance, and can be recommended for its exceptional bass neutrality and good isolation. This time, the previous comments still hold true; generally pretty good and demonstrating a good potential, the *Logic's* development is, I feel, not yet complete. Undeniably good sounds can be produced in its present state, but it still fails to meet the top grade in my view.

*(Note: the manufacturer states that production models from early 1983 will have an electronic power supply with two-speed switching.)*

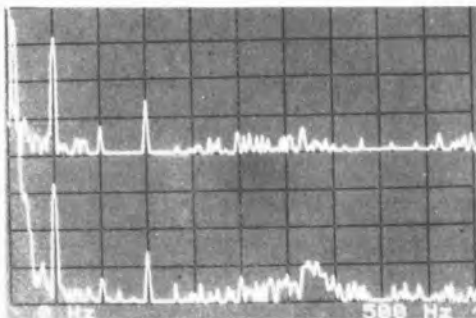
### GENERAL DATA Motor Section

Motor unit

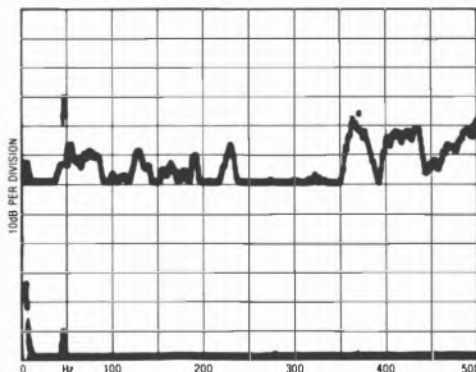
|  |  |
|--|--|
| Type   | ..... manual, belt-drive, synchronous motor, sub-chassis |
| Platter mass/damping                           | ..... 3.0kg/fairly good                                  |
| Finish and engineering                         | ..... excellent/very good                                |
| Type of mains/connecting leads                 | ..... 2-core   |
| Speed options                                  | ..... 33/45 rpm  |
| Wow and flutter (DIN peak wtd, sigma 2)        | ..... 0.07%  |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | ..... 0.22%/0.05%  |
| Absolute speed error                           | ..... +0.01%   |
| Speed drift, 1 hour/load variation             | ..... synchronous/ - 0.3%                                |
| Start-up time to audible stabilisation         | ..... 55 sec   |
| Rumble, DIN B wtd L/R average (see Spectrum)   | ..... - 77 dB  |
| Size/clearance for lid rear                    | ..... 48(w) x 39.5(d) x 15(h)/6.5cm                      |
| Ease of use                                    | ..... fairly good  |
| Typical acoustic breakthrough and resonances   | ..... excellent  |
| Subjective sound quality of complete system    | ..... very good  |
| Hum level/acoustic feedback                    | ..... very good/excellent                                |
| Vibration sensitivity/shock resistance         | ..... excellent/fairly good                              |
| Estimated typical purchase price               | ..... £345   |



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

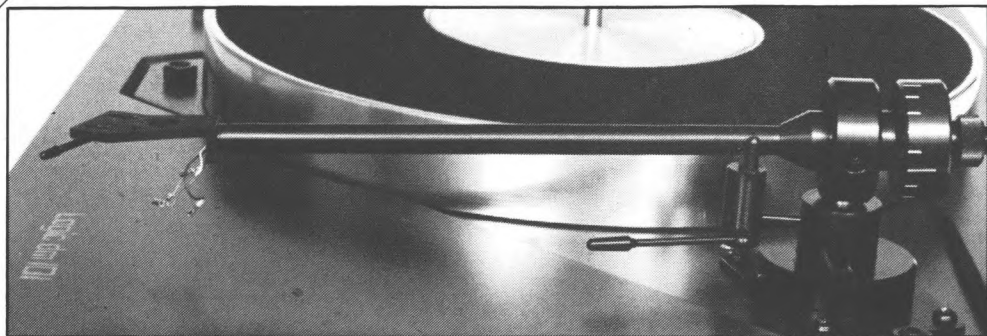


Breakthrough, acoustic (above) and vibration (below)

*Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques*

# Logic Datum

Logic Ltd, 6 Guy Street, Leamington Spa, Warwickshire CV32 4RT  
Tel (0296) 20302



Designed in conjunction with, and initially manufactured by Scott Strachan of Syrnix fame, the Datum will be made by Logic themselves from now on, although I suspect that my sample was in fact of Scottish origin.

Logic also state that two versions will eventually be available — one with a permanently fixed headshell (as supplied for *HFC*), and the other with a detachable shell, though whether the latter will be a plug-and-socket type is not yet decided. The detachable version is quoted at 2.3g higher effective mass than the fixed-head test figure of 10.5g including hardware.

The headshell is the usual fairly thick perforated aluminium mounting platform. The generous diameter main tube is also of aluminium, strongly coupled to a thicker section comprising the pivots. Circular gimbals are used with the ball races presumably set for tightness and low friction. A rotating counterweight is fitted but not decoupled and once balance has been achieved, the instructions quote each graduation as 0.15g, allowing setting of downforce. Once set a small locking ring is contra-rotated to lock the counterweight into position. Setting controls the bias compensation, which incidentally could not be set to zero, a fact which complicated the measurement of friction.

Arm effective length is 228mm, with an overhang of 17.3mm and although a mounting template was supplied it was rather inaccurate, the hole punched for the centre pillar being way off centre. The pillar/base requires a 30.5mm diameter hole and is fixed via a large clamping nut in the conventional manner. SME mounting plates are also available as accessories.

An unusual high-quality connector is fitted to the arm base and provides low profile as well as a right angled connection. The arm lead

is reasonably compliant, has a moderate capacitance of 135pF but was fitted with phono plugs of inferior quality.

## Lab report

With an all-up effective mass of 10.5g, the *Datum* fits neatly in the medium-mass group and is suited to cartridges in the 12-24cu compliance range. Geometrical accuracy was very good, as was the finish. The arm was considered to be well engineered though the final adjustment of the review sample (brought by hand) left something to be desired. A trace of looseness was evident in the lateral bearing while it was overtight in the vertical, with a measured results of 25mg lateral and a marginal 100mg vertical reading (in fact these values were not judged significant as regards the auditioning with a 2000mg stylus downforce, but ought to be taken care of in future).

Biasing was confusing since at the zero setting values appropriate to a 1.5g downforce were measured, with the 'centre' value on the high side. Downforce calibration was also inaccurate — we noted a 20% excess at both 1 and 2g settings. The cue exhibited some drift and the descent was almost too fast at 0.8 seconds. Arm resonance measurement showed some moderate breaks early on at 190Hz and 300Hz, with the expected main break strongly dissected from 600Hz to 1.2kHz possibly due to the bearing condition, while further modes were present at 1.8kHz and 3.6kHz. The overall result was however quite good, demonstrating a smooth energy trend.

## Sound quality

Rated 'good' on audition, the *Datum* sounded fairly transparent with fairly even bass plus areas of very presentable stereo depth in the



frequency range. Tonally it was a trifle 'brittle' or 'toppy', with the treble a touch obvious and forward, while a loss of stereo focus was also noted in the upper frequency range.

**Conclusion**

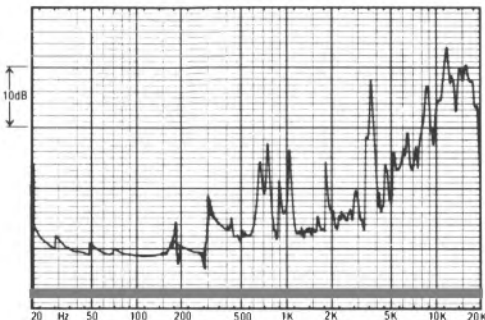
On sound quality grounds, the *Datum* qualifies as a good value-for-money arm and can be put forward for recommendation. However the state of adjustment and inaccurate calibration did not say much for its quality control, and until these areas are properly attended to a final judgement must be withheld.

*(Note: we have been informed that current and future production arms will include revised bearing location to enable 100% quality control on bearing fit; a revised bias compensator giving more consistent bias load and easier adjustment; and the cueing device will have adjustable height and an integral arm rest.)*

**GENERAL DATA**

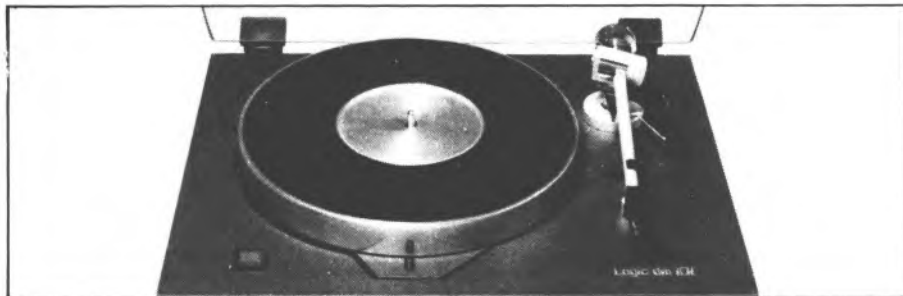
|  |                          |
|--|--------------------------|
| Tonearm  | 10.5g                    |
| Approximate effective mass, inc screws, excl cartridge |                          |
| Type/mass of headshell                                 | non-detachable           |
| Geometric accuracy                                     | very good                |
| Adjustments provided                                   | overhang/offset/height   |
| Finish and engineering                                 | very good/good           |
| Ease of assembly/setting-up/use                        | very good/good/very good |
| Friction, typical lateral/vertical                     | 25mg/100mg               |
| Bias compensation method                               | internal spring          |
| Bias force, rim/centre (set to 1.5g elliptical)        | 175mg/300mg              |
| Downforce calibration error, 1g/2g                     | + 0.2g/ + 0.45           |
| Cue drift, 8mm ascent/descent                          | none, 0.7 secs/0.8 secs  |
| Arm resonances   | good                     |
| Subjective sound quality                               | good +                   |
| Lead capacitance/damping method                        | 135pF/none               |
| Estimated typical purchase price                       | £70                      |

*\*bias compensator being improved in current production*



*Structural arm resonances, audio band*

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FOR OUR NEW DEMONSTRATION ROOM**



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**Moorgate Acoustics Limited  
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Tel: Rotherham (0709) 70666**

RECOMMENDED

# Lux PD370

Howland-West Ltd, 3-5 Eden Grove, London N7 8EQ  
Tel 01-609 0293



By virtue of a remarkably ingenious mechanism installed as a functional part of the platter and actuated only when required by a power drive built into the plinth, Lux have managed to bring a 'vacuum' platter to an integrated turntable costing less than £300.

The underside of the platter has a strong integral bellows which when actuated suck the disc onto the platter, the interface slightly cushioned by a thin liner 'mat'; (a thicker non vacuum mat is also provided.) By removing the need for an airtight airline main bearing, a standard direct drive motor can be used, and this is the key to the major price saving.

Superbly finished in the Lux tradition, the PD370 is fitted with an attractive fixed headshell tonearm. The headshell clamp allows rotation for vertical tilt angle adjustment, but the arm is not adjustable for height, this achieved instead by using cartridge packing spacers. The plinth design is of rigid form, lacking an isolating sub-chassis, although semi-compliant feet are fitted to help reduce vibration feedback. The above average quality lid is coupled directly to the plinth and thence the playing system. The motor is a two-speed quartz-locked type with a good quality bearing though the rigidity of the platter/plinth interface was not too high.

### Lab report

The substantial aluminium platter weighed 2.6kg and demonstrated very good impulse damping. However two components were superimposed on the photo, namely the slight one at 600Hz (a ringing internally) and the other at 20Hz — a platter rocking effect.

Wow and flutter were excellent, with good overshoot-free torque and excellent speed stability, while rumble was also very good, though with an unusual kind of low frequency 'noise' present below 150Hz. The arm was quite well adjusted showing little bearing play and good geometry, and effective mass was in the medium range at approximately 13g including hardware. Lateral friction was however slightly high and the bias compensation on the low side, set in the inverse ratio. Downforce calibration was fine, but some cue drift was observed. Arm resonances were classed as slightly better than average, their main flaw being the energy 'break' at 1.5kHz.

Reasonably good on acoustic breakthrough, the vibration isolation was just average, shock resistance only fair. Feedback immunity was fairly good.

### Sound quality

Just making the 'good' category, the 370



# Lux PD 300

Howland-West Ltd., 3/5 Eden Grove, London N7 8EQ.  
Tel 01-609 0293



Like the costly *PD555*, this Lux turntable also has an inbuilt suction pump quite conveniently operated by a front mounted hand lever. On this model Lux have taken the subchassis principle to heart, incorporating a superbly engineered die-cast example of unusually complex design. Much attention has been paid to such details as provision for a massive main bearing and its mounting, the symmetrical disposition of the three support components, and the webbed and reinforced arm mounting with its face-machined interchangeable alloy tonearm plates. The subchassis proved easy to level using knobs accessible on the plinth underside, but at some stage the designer(s) appeared to have had second thoughts, since the very good isolation afforded by the coil spring suspension has been compromised — probably in the interests of improved shock resistance and handling stability — by the addition of plastic foam spring sleeves and silicone damping washers on the moving components. The potential performance of this deck was such that we auditioned and measured it first as supplied, and secondly with freed suspension and springs.

The *300* is a two-speed belt drive model, using an electronically controlled high quality DC motor. A quartz oscillator reflector type stroboscope is fitted for reference, since the drive is not quartz-locked, and fine variable speed control is *via* thumbwheels mounted underneath near the front edge. One complication in previous assessments arose with the solid flat platter, as the suction pump supplied an equivalent of 30kg pressure, and any dust or grit on the record underside or platter surface

will tend to impress itself onto the record surface when the vacuum is engaged. However, a very thin rubber platter mat is now available which does not impair the *300*'s excellent disc damping (see *PD370* review) but effectively negates any worry over hard disc contact and damage. Furthermore the model now costs around two thirds of what it did.

## Lab report

With its substantial 3.4kg platter and high torque drive, the wow and flutter, torque and rumble results were all excellent. Speed drift was more than I would like at the price level, but start up was fine at 2.8 seconds, with no overshoot effects. Rated as good on shock prior to the modification, the acoustic and vibration isolation were also very good above 75Hz, while freeing the suspension produced 10-12dB acoustic improvement from 25 to 75Hz, and an even better 15 to 20dB improvement in vibration isolation; but shock resistance was somewhat impaired.

Lux have not made special provision for consistently dressing the arm leads, and an adhesive clip was added. X10 scaling was possible for the disc impulse tests, showing the transient was totally suppressed, leaving only minor low frequency ripples.

## Sound quality

Setting a high subjective standard at all times, the *PD300* showed much of the '555 midrange neutrality and transparency, particularly on percussive sounds and the ambience surrounding them. At times it was almost clinically clear, and in tonal balance seemed

slightly 'cold' and faintly 'glassy'. A trace of high frequency 'forwardness' and 'disembodiment' was encountered with several cartridges. The *Asak/Ittok* worked better than the *Koetsu/Ittok*, and a 'softer' sounding arm would suit best — for example, the Sumiko.

The chassis was slightly nervous in stability terms once 'free', but conversely as supplied the bass range lost some of the precise and open sound with good depth extension

### Conclusions

One of the best engineered and certainly one of the best finished turntables covered in this issue, the *PD300* offers many valuable facilities and continues to be strongly recommended.

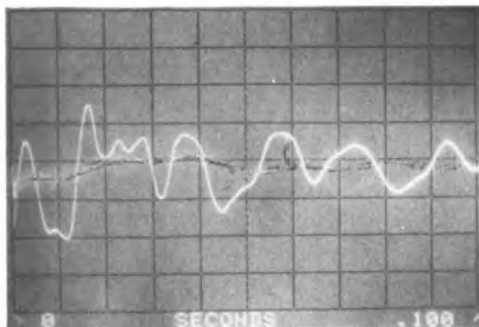
Careful matching of system components is necessary for the best performance, and it is capable of accepting a wide range of tonearms; genuine alternatives to the *Ittok* are slowly emerging, and their tonal characteristics may suit the *300* better — for example, Alphason, Mission, Orion and Zeta.

Its good alignment stability remains an important feature — it should not need resetting after installation.

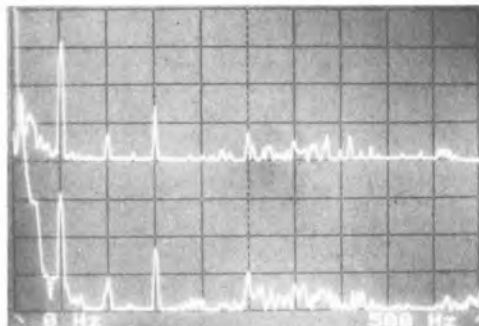
### GENERAL DATA

|  |                                       |
|--|---------------------------------------|
| Type   | Motor Unit                            |
| .....  | ..... belt drive                      |
| Platter mass/damping                           | ..... 3.5kg/excellent                 |
| Finish and engineering                         | ..... both excellent                  |
| Type of mains lead/connecting leads            | ..... 3 core + earth                  |
| Speed options                                  | ..... variable, 33/45rpm              |
| Wow and flutter (DIN peak wtd sigma 2)         | ..... <0.05%                          |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | ..... <0.1%/<0.05%                    |
| Absolute speed error                           | ..... quartz referenced               |
| Speed drift 1 hour/load variation              | ..... +0.25%/<0.1%                    |
| Start up time to audible stabilisation         | ..... approx 2.8secs                  |
| Rumble: DIN B wtd L/R av (see spectrum)        | ..... -78/-77dB                       |
| Size/clearance for lid rear                    | ..... 49.0(w) x 42.0(d) x 18.8(h)/6cm |
| Ease of use                                    | ..... good                            |
| Typical acoustic breakthrough and resonances   | ..... very good                       |
| Subjective sound quality of complete system    | ..... very good+                      |
| Hum level/acoustic feedback                    | ..... very good/very good             |
| Vibration sensitivity/shock resistance         | ..... very good+/fairly good          |
| Estimated typical purchase price               | ..... £500                            |

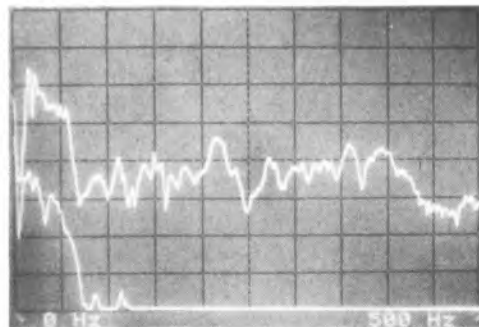
\*see text



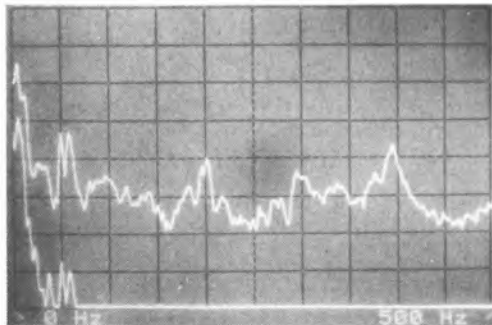
Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin) as supplied: above, acoustic; below, vibration.



Breakthrough as modified (see text!): above, acoustic; below, vibration.

# Lux PD 555

Howland-West Ltd., 3/5 Eden Grove, London N7 8EQ.  
Tel 01-609 0293



## Features and design

Of limited availability, the PD555 is the most exotic turntable Lux have produced to date. It achieved worldwide fame on its introduction by featuring a domestic innovation in the form of a platter equipped with a vacuum operated record flattening system, similar in principle to that employed in studio cutting lathes. It uses an auxiliary vacuum pump which is interfaced pneumatically and electronically with the turntable, to allow easy operation via the usual stop/start controls. The platter is exceptionally heavy at 8.5kg, providing 1.2 ton/cm inertia, which is many times the average. Two screw-in handles are supplied for fitting temporarily to the platter in order to lift and lower it onto the main bearing and its support plate. The three speeds provided include 78 rpm, and when under vacuum the record is clamped by atmospheric pressure to a claimed 250kg over the surface, the vacuum quality indicated by a dial gauge mounted in the plinth.

The large solid plinth offers facilities for two tonearms, and the arm sub bases are alloy sections which slide on runners to give easy geometric alignment, and which can then be locked in place. A problem did however arise with SME arms, since the 'oval' arm mount hole runs along the width axis, resulting in awkward placement of the bias mechanism and other parts; clearly the arm must be chosen with this in mind.

The overall quality of construction and engineering was excellent - as indeed it should be considering the high price. Lux have forsaken direct drive for this design, probably because of the difficulties involved in arranging the airways and seals required as well as a drive motor coincident with the main bearing. The strobe is

accurately referenced to a quartz oscillator, but the drive is via a polyurethane belt from a large and quiet DC Servo motor.

## Lab results

The vacuum hold down occasionally needed some assistance to sufficiently flatten a record in order to engage the rubber sealing rings. Once 'caught', however, the discs were strongly clamped, effectively bonding them to the massive platter for several hours without need for any further pumping. Wow and flutter results were very good, speed drift was low, and variation under load negligible. Despite the platter inertia, stable speed was attained in under 4 seconds for 33 $\frac{1}{3}$  rpm, but 78 rpm understandably took longer. Rumble was excellent at -77dB or better (DIN B weighted), and the spectrogram revealed little of significance; electrical components were present but there was nothing mechanical of importance above -95dB, referred to 10cm/sec at 1kHz.

Succeeding more by sheer inertia and rigidity than by design, the acoustic breakthrough was quite good, the low resonance heavy acrylic lid being helpful here. Working well above 150Hz, the complex silicone-damped feet were 10 to 15dB less effective than a good sprung sub-chassis at lower frequencies. The feedback contribution of the lid was revealed by the second acoustic graph, which portrays the breakthrough in the turntable with and without the lid fitted, showing up to 10dB of improvement in certain areas. Shock resistance was very good, the X10 disc impulse testifying to the magnificent disc damping and termination offered - clearly the best in the issue, and contributing to a very clean 'vinyl' sound.

## Sound quality

In the 'coffee table' location the sound was marred by a degree of softness in the bass register, caused by floor-borne vibration breakthrough. But transfer to a large rigid wall-mounted shelf restored the bass clarity, and provided fine quality in this range. Sounding better with the lid off, in the latter condition the subjective quality was excellent, with a power and solidity that was unrivalled by other models in the issue. The sound was distinctly clean in terms of coloration, providing great ambience, depth, transparency and musical detail, plus stable, clear stereo focusing.

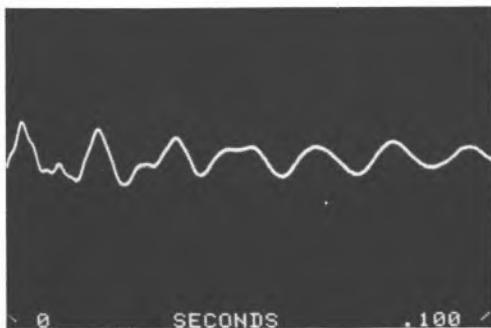
## Conclusion

The PD555 is a very good turntable when optimally sited, and in absolute terms it can be recommended on the basis of its performance. In real life the price makes value for money recommendation impossible to justify, but this was clearly neither part of the designers brief, nor their intention. As a flagship in a luxury range of hi-fi equipment it succeeds pretty well. It has its particular strengths, and might well suit a millionaire audiophile with space, a valued 78 rpm record collection, and the desire to run more than one pickup arm!

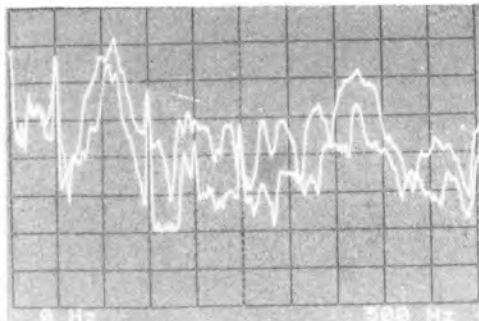
## GENERAL DATA

|  |                                     |            |
|--|-------------------------------------|------------|
| Type   | belt drive, suction platter, 2 arms | Motor Unit |
| Platter mass/damping                           | 8.5 kg/excellent                    |            |
| Finish and engineering                         | both very good                      |            |
| Type of mains lead/connecting leads            | 3 core w/ pneumatics                |            |
| Speed options                                  | variable, 78, 45, 33 rpm            |            |
| Wow and flutter (DIN peak wtd sigma 2)         | <0.05%                              |            |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.1%/0.09%                          |            |
| Absolute speed error                           | quartz referenced strobe            |            |
| Speed drift 1 hour/load variation              | +0.1%/-0.2%                         |            |
| Start up time to audible stabilisation         | 3.8secs                             |            |
| Rumble: DIN B wtd L/R av (see spectrum)        | -77 dB                              |            |
| Size/clearance for lid rear                    | 66.4(w) x 39.2(d) x 17.5(h)/4cm     |            |
| Ease of use                                    | very good                           |            |
| Typical acoustic breakthrough and resonances   | good                                |            |
| Subjective sound quality of complete system    | excellent*                          |            |
| Hum level/acoustic feedback                    | excellent/very good                 |            |
| Vibration sensitivity/shock resistance         | fairly good/very good               |            |
| Estimated typical purchase price               | £999                                |            |

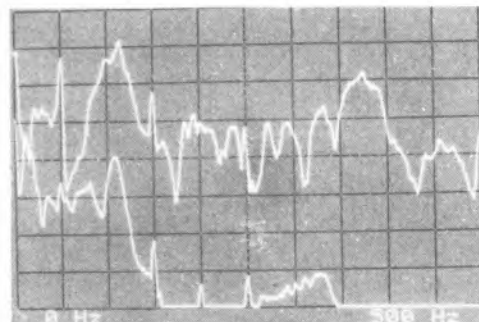
\*if well sited



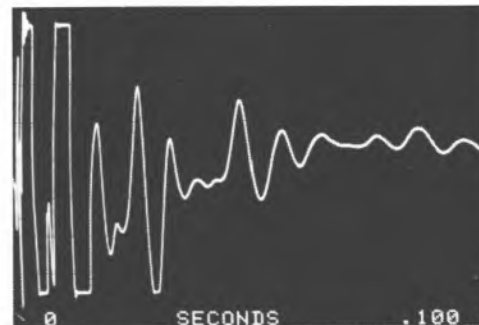
Disc impulse transmission with vacuum (X10) (graticule not shown).



Acoustic breakthrough, lid up/down (see text).



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Disc impulse transmission without vacuum (X10) (graticule not shown).

# Marantz TT120

Marantz (UK) Ltd, 15-16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex  
Tel 01-897 6633



An inexpensive design built specially for Marantz by a division of Philips, the *TT120* comes complete with a medium-quality moving magnet cartridge — a Philips *GP500 II* equipped with a shank mounted spherical stylus.

Lightly built, the design lacks any special provision for environmental isolation, such as a sub-chassis. The plinth and chassis are integrated with the hinged and rather resonant lid directly attached to the base, and compliant feet are fitted, offering a modicum of vibration attenuation. The arm carries a small moulded detachable headshell and the whole is of low effective mass, measuring 8g inclusive of hardware. This makes for a fairly good match with the fairly compliant cartridge fitted but noticeable play was apparent on the arm bearings, and the design as a whole not very rigid.

Semi-automatic in operation, the player is belt driven by a small synchronous motor, offering two speeds.

## Lab report

Finish was considered very good with satisfactory engineering, but platter mass was low at 0.5kg with barely average damping of the disc impulse. Wow and flutter was marginally on the high side at 0.15% and mainly composed

of wow, while the unit also ran slightly fast and was found to slow significantly under load. Rumble levels were however satisfactory at -70dB DIN, with mainly 100 and 200 Hz vibration components.

Arm geometry was uninspiring, with the supplied cartridge fitted inaccurately. Friction was just satisfactory at 75mg lateral and 50mg vertical — suitable for tracking forces of 1.75 to 2.5g. The bias compensation was rather high, around 30% up on the required level, but the downforce was accurate. Unfortunately this arm resonance graph suffers from poor resolution, but nonetheless demonstrates a weak performance, with serious resonances at 100Hz, 400Hz and 2kHz. Lead capacitance was higher than usual at 185pF, and while the acoustic breakthrough response looked fairly even, the vibration equivalent was quite poor, showing very little isolation.

Shock resistance was tolerable, but feedback was not this model's strong point; it will need careful siting particularly if high volume levels are required.

## Sound quality

Bass sounded weak with impaired definition, while left/right positional information was subject to blurring. Stereo image showed a



lack of precision with little depth, and the tonal balance appeared uneven though not particularly aggressive. The cartridge was quite reasonable in this price context, and was free of the oft-encountered 'zippy' treble.

### Conclusion

'Low price rules OK'. Considering the cost of this, a complete and satisfactory turntable, retailing at around one tenth to one twentieth of the price of the top-line models in this issue, the *TT120* must be rated as worth considering. In fact, things only improve significantly when one spends twice as much.

### GENERAL DATA

Integrated turntable (inc. cartridge)

#### Motor Section

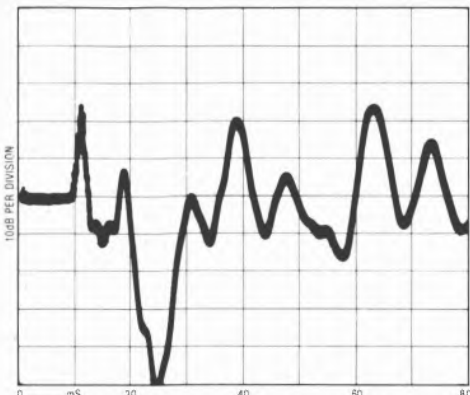
Type..... semi-automatic, belt-drive synchronous motor  
 Platter mass/damping..... 0.5kg/average  
 Finish and engineering..... very good/average  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... 0.15%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.14%/0.05%  
 Absolute speed error..... + 0.6%  
 Speed drift, 1 hour/load variation..... synchronous/ - 0.5%  
 Start-up time to audible stabilisation..... 3.0 secs  
 Rumble, DIN B wtd L/R average (see spectrum)..... - 70 dB

#### Arm Section

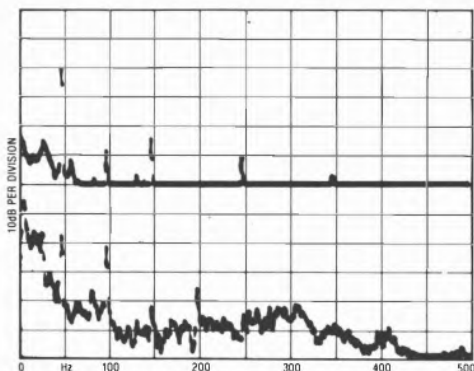
Approximate effective mass, inc screws, excl cartridge..... 8g  
 Type/mass of headshell..... special detachable/5g  
 Geometric accuracy..... average -  
 Adjustments provided..... overhang/offset  
 Finish and engineering..... very good/below average  
 Ease of assembly/setting-up/use..... very good/good/very good  
 Friction, typical lateral/vertical..... 75mg/50mg  
 Bias compensation method..... internal spring  
 Bias force, rim/centre (set to 1.5g elliptical)..... 350mg/300mg  
 Downforce calibration error, 1g/2g..... none/ - 0.1g  
 Cue drift, 8mm ascent/descent..... slight, 1.1 secs/3.0 secs  
 Arm resonances..... below average  
 Subjective sound quality..... below average  
 Lead capacitance/damping method..... 185pF/none

#### System as a whole

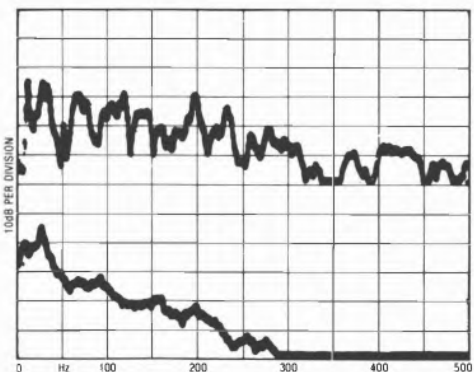
Size/clearance for lid rear..... 41.5(w) x 39(d) x 12.5(h)/4cm  
 Ease of use..... very good  
 Typical acoustic breakthrough and resonances..... average  
 Subjective sound quality of complete system..... below average  
 Hum level/acoustic feedback..... good/poor  
 Vibration sensitivity/shock resistance..... poor/fairly good  
 Estimated typical purchase price..... £54



Disc impulse transmission showing damping

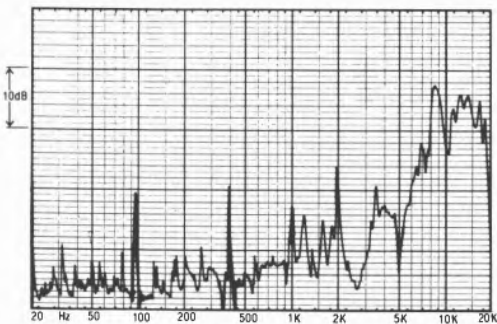


Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques



Structural arm resonances, audio band

# Marantz Esotec TT1000

Marantz (UK) Ltd, 15-16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex  
Tel 01-897 6633



## Features and design

Marantz' move back into the 'superfi' market is spearheaded by their new *Esotec* range, which includes a turntable costing close on £1000 and offered as a universal motor unit. 'Simplicity' best describes this remarkable creation, comprising a heavy plate on feet fitted with a motor and platter. Subscribing to the ultra-rigid, ultra-heavy approach to chassis design, the deck plate is composed of a massive laminate 38mm thick - two 15mm plate glass panels covering an 8mm aluminium alloy interlayer. This assembly alone weighs 25.3kg and forms a strong inert foundation for the motor and tonearm. As no lid is provided, the elimination of acoustic energy coupling from this source at least is eliminated.

In theory a super-rigid and massive deck such as this, equipped with a dynamically balanced tonearm, should not require vibration isolation in the dominant 5-200Hz range, since the deck section comprises a mechanical closed loop. Provided that the arm mount does not flex with respect to the platter this condition should be fulfilled. In fact, the Marantz 1000 does come quite close to achieving this theoretical objective.

An external power supply, built into a veneered box, feeds the quartz-lock direct drive motor, which is fitted with a 3.4kg balanced aluminium

alloy platter. A glass mat fits securely on this platter, and may be augmented by any other suitable mat of felt or silicone type rubber as desired. Glass is itself a good medium, but needs to be kept clean to prevent disc abrasion by micro grit, etc, during handling.

The operating controls comprise subtle electronic touch pads on the deck plate - on/off and 33/45 rpm speed change - with control of mains on the power box. The large diameter adjustable feet have some inbuilt rubber isolation which is likely to be effective in the higher frequency range. One aspect which could be very important to some purchasers is the good resistance this type of turntable affords to footfall shock on springy floors, achieved by its high total mass and overdamped suspension.

## Lab results

Marantz have selected an exceptional motor for use in this model; one which provides state of the art figures on all measurement modes for wow, flutter and rumble, both weighted and unweighted. The motor's dynamic behaviour was very good with no speed overshoot on load change, while the high torque was confirmed by the rapid 1.5 second start up. When subjected to spectrum analysis mechanical rumble was very low; on this graph the total energy and the trace for static

electrical breakthrough have been superimposed, showing a negligible difference right down to -100dB.

Disc termination was sufficiently good to allow X10 scaling of the impulse response, and the result was fine in all respects, the mid/low frequency component around 35Hz probably relating to a platter rocking flexure. Breakthroughs were pretty good, though the vibration isolation was fading below 100Hz and the acoustic component showed some unevenness; the peak at 35Hz was probably again associated with the platter.

### Sound quality

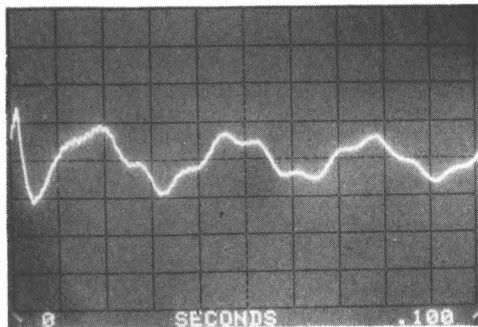
Tried with several tonearms including the Mission 774, the Helius and SME III, the TT1000 performed very well subjectively. Demonstrating very good stability with regard to low frequency floor movements, some loss of bass attack and low frequency extension was apparent on our coffee table location, but transfer to a more substantial wall-mounted shelf provided a great improvement. The sound was characterised by a feeling of relaxed security, with accurate pitch and comfortable stylus tracking, while tonally it was well balanced and integrated. The standard glass mat and in particular the Mission arm gave fine results in this location, proving capable of accepting the Asak. But many other cartridges are also suitable, including the Karats and the more delicate Denons.

### Conclusion

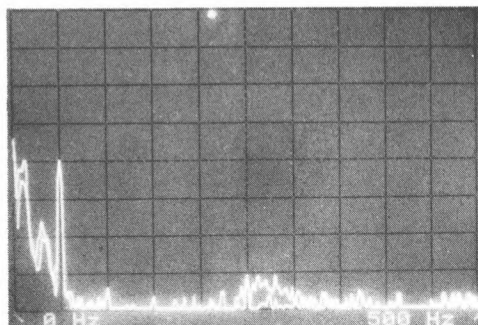
Admittedly very costly, the TT1000 offers a high quality shock resistant motor platform which is tolerant of tonearms. Well sited, the reproduction is excellent, demonstrating low coloration levels. If you can afford it and like its looks, there are few objections that can be raised against its purchase, but in value for money terms recommendation is not appropriate. Like the big Luxman this is more of a design/engineering exercise than an attempt to put BSR out of business, and it succeeds well in attaining the desired prestige.

### GENERAL DATA

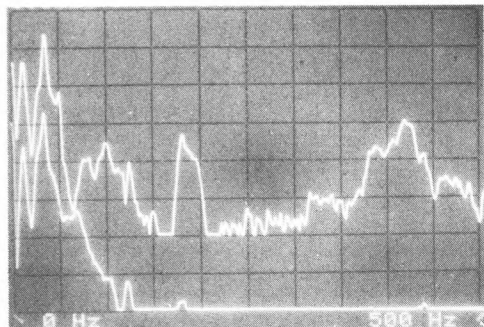
|  |                                     |            |
|--|-------------------------------------|------------|
| Type .....   | direct drive, manual quartz lock    | Motor Unit |
| Platter mass/damping .....                           | 3.4kg/fairly good                   |            |
| Finish and engineering .....                         | excellent/excellent                 |            |
| Type of mains lead/connecting leads ...              | 2 core, power box/N/A               |            |
| Speed options .....                                  | 33/45rpm                            |            |
| Wow and flutter (DIN peak wtd sigma 2) .....         | <0.05%                              |            |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... | 0.1%/0.08%                          |            |
| Absolute speed error .....                           | <0.01%                              |            |
| Speed drift 1 hour/load variation .....              | <0.01%/<0.01%                       |            |
| Start up time to audible stabilisation .....         | approx 1.5secs                      |            |
| Rumble: DIN B wtd L/R av (see spectrum) .....        | -78dB                               |            |
| Size/clearance for lid rear ...                      | 51.0(w) x 43.0(d) x 16.0(h)/ no lid |            |
| Ease of use .....                                    | very good                           |            |
| Typical acoustic breakthrough and resonances .....   | good+                               |            |
| Subjective sound quality of complete system .....    | very good                           |            |
| Hum level/acoustic feedback .....                    | very good/good                      |            |
| Vibration sensitivity/shock resistance .....         | good/very good                      |            |
| Estimated typical purchase price .....               | £999                                |            |



Disc impulse transmission, magnified X10.



Rumble (0-500Hz line), (electrical component superimposed).



Breakthrough (0-500Hz line): above, acoustic; below, vibration.

# RECOMMENDED

## Michell Focus Motor

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



### Features and design

Now in its third year of production, the price of the *Focus* has remained competitive over this period, and the deck has undergone several refinements. The main improvements include an enlarged main bearing with a strengthened fixing to the deck plate, plus a revised drive assembly and motor decoupling to give reduced rumble and improved wow and flutter. Our lab measurements verified the value of all these changes.

The unit comprises a two-speed rubber cord drive design powered by a synchronous motor, and the flat 2.0kg platter is fitted with an effective 'suede' mat bonded into position. The high quality acrylic lid is hinged directly to the wood/plastic laminated chassis, which is not an ideal situation, but the whole is suspended on quite effective steel springs with absorbent rubber cushions, giving an overall low resonant frequency around 5Hz.

### Lab results

As the figures show, this model now provided exemplary results for wow and flutter, both separately assessed and weighted. Torque and speed accuracy were both good, and although the weighted rumble figures were also fine at near -75dB (several dB better than before), spectrum analysis did reveal a 100Hz component

at -73dB, which is poorer than average. The disc impulse response was quite good allowing X10 scaling and demonstrating good high frequency damping. Acoustic breakthrough was above average and vibration isolation fine, but shock immunity was not spectacular.

### Sound quality

For some reason the deck never seemed quite at home with the *Focus* arm, but it provided pleasantly balanced and relaxed results in partnership with the Linn *Basik*. Above average with the lid installed, the bass was reasonably clean, the midrange quite transparent and detailed, and the stereo presentation above average. The sound was distinctly cleaner however with the lid removed, and for critical listening this is worth doing.

### Conclusion

Possessing a fine handcrafted finish and distinctive styling, the *Focus* has improved significantly in mechanical terms since its introduction. It is now available at an attractive package price (£170), factory fitted with the Linn *Basik* arm/cartridge. This package gains a comfortable recommendation, and indeed the motor unit alone is worth considering at around £130.

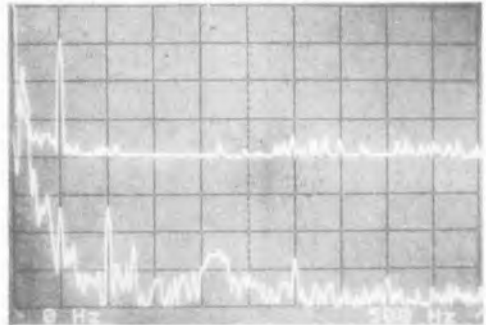
(Note: On the latest version of the Focus, retested for this edition, Michell have revised the motor mounting as well as the plinth/chassis material. Lab figures are very similar this time except for a slight worsening in mains rumble component, but overall conclusions remain unaltered.)

**GENERAL DATA**

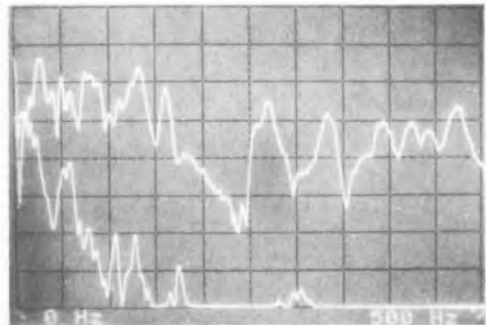
|  |   |            |
|--|---|------------|
| Type   | ..... manual, belt-drive, synchronous motor | Motor unit |
| Platter mass/damping                           | ..... 2.1kg/good                            |            |
| Finish and engineering                         | ..... very good/very good                   |            |
| Type of mains/connecting leads                 | ..... 3-core                                |            |
| Speed options                                  | ..... 33/45 rpm                             |            |
| Wow and flutter (DIN peak wtd, sigma 2)        | ..... 0.08%                                 |            |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | ..... 0.06%/less than 0.04%                 |            |
| Absolute speed error                           | ..... + 0.25%                               |            |
| Speed drift, 1 hour/load variation             | ..... synchronous/ - 0%                     |            |
| Start-up time to audible stabilisation         | ..... 7.5 secs                              |            |
| Rumble, DIN B wtd L/R average (see Spectrum)   | ..... 75 dB                                 |            |
| Size/clearance for lid rear                    | ..... 43(w) x 37(d) x 15(h)/10cm            |            |
| Ease of use                                    | ..... good                                  |            |
| Typical acoustic breakthrough and resonances   | ..... average +                             |            |
| Subjective sound quality of complete system    | ..... good                                  |            |
| Hum level/acoustic feedback                    | ..... very good/above average               |            |
| Vibration sensitivity/shock resistance         | ..... good/fairly good                      |            |
| Estimated typical purchase price               | ..... £135                                  |            |



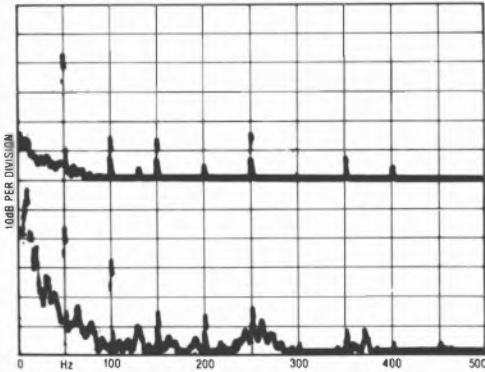
Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Rumble, electrical (above) and total (below) on latest sample — compare previous result.

# Michell GyroDec

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



A recently developed model, the *Gyrodec* represents Michell's concept of a top-quality no compromise turntable. A large design fitted with a costly hand fabricated glass-clear acrylic case and lid, the *Gyrodec* has provision for the symmetrical attachment of one or two arms as required. Carrying a five-year guarantee, it has been well thought out with regard to setting-up and all parts are accessible without the need for the removal of baseplates and so on.

Representing Michell's first subchassis design, the massive spoked 'wheel' chassis casting is preloaded with lead weights to largely counterbalance the arm masses. The whole is suspended in compliant coil springs resiliently mounted within the three suspension towers adjacent to the platter, and as previously mentioned, the system is readily adjusted from above upon removal of the spring covers. Special mounting plates of thick alloy are provided for individual arms, these of different mass to give a constant state of balance without recourse to changing springs. The alloy platter is loaded for both mass augmentation and for resonance distribution by an array of weights on the underside, these heavily gold plated.

A one piece component, the platter is driven at its grooved periphery by a thin rubber cord powered via a large hysteresis synchronous motor made by Papst. This is a low voltage type, fed via a small transformer in the mains supply lead. Two speeds are provide via the motor pulley, with the appropriate section easily selected by hand, since the drive is entirely exposed in this model.

A key feature is the incorporation of a full clamp absorption system for record damping. A polymer mat is used, in conjunction with a record label clamp, this bearing over a central washer and thus tensioning out all but the most stubborn of warps. In this respect the *Gyrodec* bears a great similarity to the Oracle.

## Lab report

The platter weighed some 4.5kg and proved to be well damped with respect to the disc impulse response. The initial transient was well trapped, but a low frequency aftershock was present at about 40Hz — probably platter rock on the main bearing total compliance. Wow, flutter and integrated wow and flutter were all very low particularly for a belt drive. Absolute speed was about 0.2% slow while a further 0.3% slowing (slightly high) occurred on

standard loading. Start-up time to audible pitch stabilisation took a very long 9.5 seconds, mainly due to oscillation of the platter inertia against the belt compliance. Poorly damped, this could be an influence on subjective pitch stability on transient programme.

Rumble was very good at -77dB, showing just the slightest incidence of motor rotational components, and its resistance to acoustic and vibration breakthrough was so extraordinary that the scales had to be magnified by 10dB to bring the residual coupling into sight. Hum levels were fine and acoustic feedback excellent, while shock resistance was also very good.

### Sound quality

Just failing to make the top grade the Gyrodec scored a very high mark on audition. It sounded very neutral and transparent, producing stable and spacious stereo images with impressive depth. Bass was substantially even with weight, power and attack. Our one reservation concerned a something which may in practice prove less important to other listeners, namely dynamic wow. On rock programme with heavy transients a trace of pitch instability was evident, believed due to this effect.

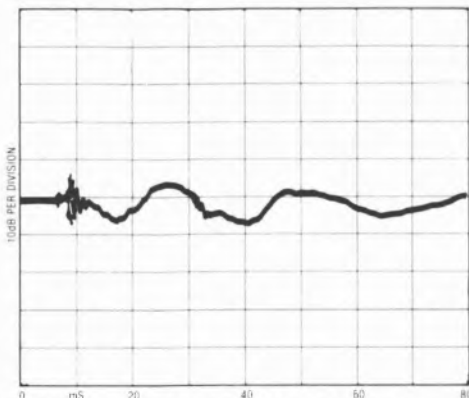
### Conclusion

At this price level a turntable has to be virtually perfect to succeed. The Gyrodec excels in so many areas and yet suffers from a minor problem in the drive system, and if this were to be solved, then it could rightfully win a full recommendation even at its elevated price level.

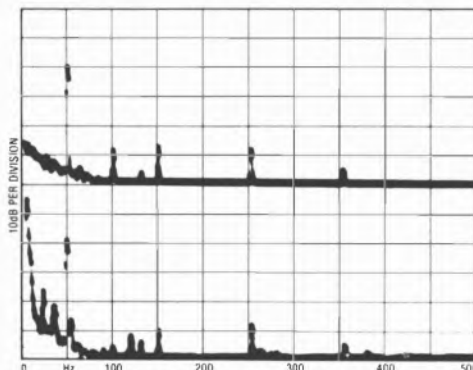
*(Note: As we go to press, developments are in hand as regards improving the Gyrodec. The belt stiffness has been increased, reducing start-up time and the drive elasticity.)*

### GENERAL DATA

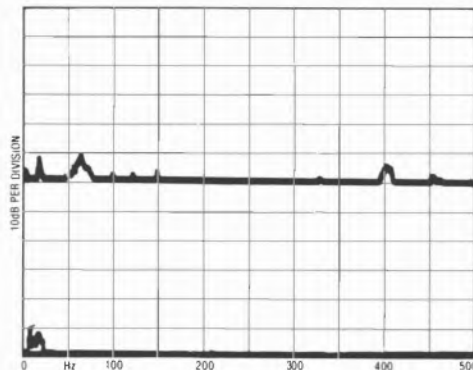
|   |   |            |
|---|---|------------|
| Type  | manual, belt-drive, synchronous motor, subchassis | Motor unit |
| Platter mass/damping                                    | 4.5kg/very good                                   |            |
| Finish and engineering                                  | very good/excellent                               |            |
| Type of mains/connecting leads                          | 2-core, line transformer                          |            |
| Speed options   | 33/45 rpm   |            |
| Wow and flutter (DIN peak wtd, sigma 2)                 | less than 0.04%                                   |            |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)          | less than 0.06%/0.04%                             |            |
| Absolute speed error                                    | -0.2%   |            |
| Speed drift, 1 hour/load variation                      | synchronous/-0.3%                                 |            |
| Start-up time to audible stabilisation                  | 9.5 secs  |            |
| Rumble, DIN B wtd L/R average (see spectrum)            | -77 dB  |            |
| Size/clearance for lid rear                             | 53(w) x 42(d) x 19(h)/4cm                         |            |
| Ease of use   | good  |            |
| Typical acoustic breakthrough and resonances            | excellent   |            |
| Subjective sound quality of complete system             | very good   |            |
| Hum level/acoustic feedback                             | very good/excellent                               |            |
| Vibration sensitivity/shock resistance                  | excellent/very good                               |            |
| Estimated typical purchase price                        | £595  |            |
| *includes dealer set-up, arm fittings, clamp mat system |   |            |



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Mission 775SM

Mission Electronics Ltd, Stonehill, Huntingdon, Cambs  
Tel (0480) 57477



Mission claim a radical departure in design for this turntable, though personally I would dispute this to some degree. Built like a heavy-weight version of the Rega, the 775 is founded on a massive and weighty composition plinth of MDF board, this intended to provide a 'totally rigid' link between stylus and record via the arm/plinth/platter loop. Mission have claimed extraordinary low levels of mechanical and electrical hum due to new methods of mounting and driving the slow speed synchronous motor, but unfortunately these claims were not fulfilled over three test samples; the final one, though failing spec did at least achieve a satisfactory result for rumble. Differences in mains supply distortion between Canada and the UK are said to be the blame.

Platter and sub-platter are superbly machined in alloy, the outer component containing a lead filled rim and the whole weighting a substantial 6kg. The platter surface is ground to a matt finish on which the record directly bears directly. The surface tends to fingerprint rather easily. A significant 1 deg concavity is incorporated which with the aid of push-on centre clamp flattens the record against the

platter. The arm mounting gives compensation for the 1 deg vertical tilt error which would otherwise be seen at the cartridge, and be enough to take 5dB off the separation of a top class cartridge. Speed change is manual and a little awkward due to the need to remove the heavy outer platter, which is a very close fit on the hub.

The main bearing on the first sample showed some slack or rocking at the platter rim, but was improved on later samples. The 70mm deep bearing comprises a steel shaft running in a PTFE sleeve, and carries a tungsten carbide ball in point contact with a fixed thrust plate of the same ultra-hard material.

Mission have made use of a spongy grade of the high loss damping polymer Sorbothane for the three thick half sphere feet, the applied force distributed by metal pads (these can scratch varnished shelves!). Described as 'pretty compliant' they were in fact fairly stiff. The second sample used blue Sorbothane of rather greater compliance, these feet tending to crush with the passage of time into a sort of indeterminate doughnut shape.

The lid fitted to this deck is rather less



resonant than usual with strong shaping and internal ribbing. It is opaque but for a small window which allows sight of the cartridge/platter region. A special arm mounting plate with an adjustable collar is provided, and is suitable for most pillar models.

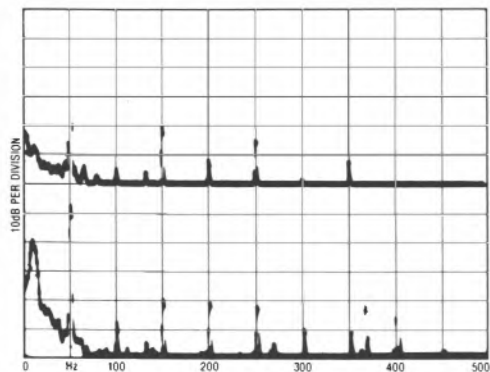
### Lab results

This deck was considered to be very well made and finished. The disc impulse response was spectacularly good though with a tiny, but long duration rim mode superimposed at approximately 450Hz. Weighted wow and flutter was a low 0.08%, with some linear wow content. The sample measured ran 0.4% slow, the speed showing a further 0.3% slowing under our standard load — not altogether satisfactory at this price level. Start-up at 10 seconds was also very slow while rumble was well below spec at an unsatisfactory 66.5dB, this due to motor breakthrough. The reading for the platter bearing alone was -80dB. A second sample gave -74/-59dB, left/right, while a third measured -75/-70dB and was good enough for serious listening tests. Acoustic isolation was fairly good and was improved significantly by removal of the lid (see graphs for lid contribution). Vibration isolation was not outstanding, the result differing a little depending upon foot type; the softer version is shown in the single expanded +10dB graph, while the other is given on the combined photo for breakthrough. Shock was handled well and fine resistance to feedback was demonstrated.

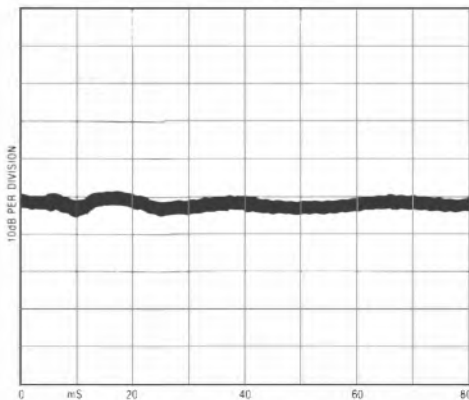
### Sound quality

In some respects the 775 was convincing. It gave a softened rounded effect with slight mid coloration (450Hz?), while the bass was extended and weighty, if lacking ultimate attack and articulation (better on a rigid wall shelf).

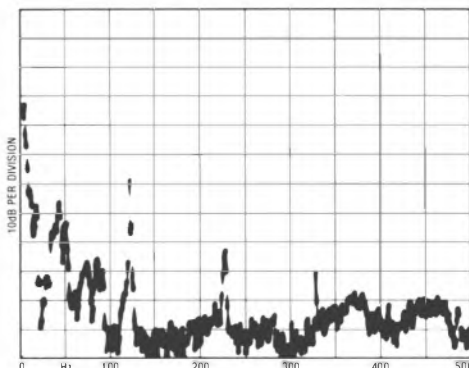
*Continued on page 136*



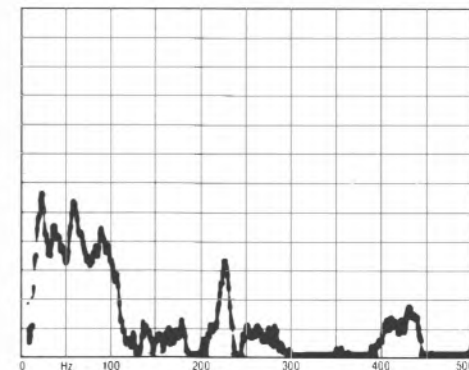
Rumble, electrical (above) and total (below)



Disc impulse — see also platter spectrogram



Platter spectrogram from impulse on disc



Vibration breakthrough, soft feet (expanded 10dB)

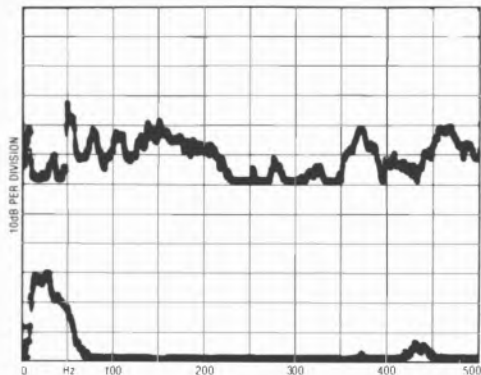
Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques

## MISSION 775SM *continued*

The treble was pleasant with a neutral disc sound. On the debit side, a mild veiling of stereo transparency and depth was apparent, plus a marginal uncertainty of pitch and tempo.

### Conclusion

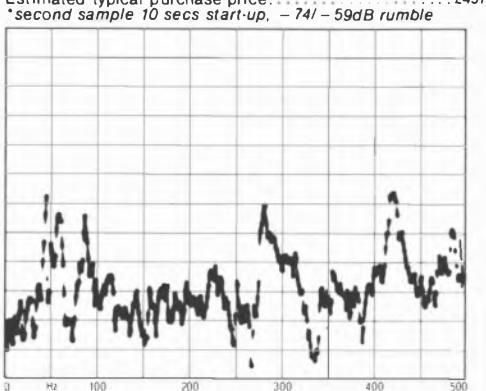
Personally I do not consider that the development of this costly turntable is complete, and as it stands it exhibits too many problems to be considered for the recommended listings.



Breakthrough, acoustic (above) and vibration (below)

### GENERAL DATA

|  |  |
|--|--|
| Type   | Motor unit manual, belt-drive, synchronous motor |
| Platter mass/damping                           | 6.0kg/very good                                  |
| Finish and engineering                         | very good/very good                              |
| Type of mains/connecting leads                 | 3-core IEC socket/phono sockets, earth           |
| Speed options                                  | 33/45 rpm  |
| Wow and flutter (DIN peak wtd, sigma 2)        | 0.08%  |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.18%/0.07%                                      |
| Absolute speed error                           | -0.4%  |
| Speed drift, 1 hour/load variation             | synchronous/-0.3%                                |
| Start-up time to audible stabilisation         | *10 secs   |
| Rumble, DIN B wtd L/R average (see spectrum)   | -67/-66dB  |
| Size/clearance for lid rear                    | 45.5(w) x 35.5(d) x 15(h)/3.5cm                  |
| Ease of use                                    | fairly good                                      |
| Typical acoustic breakthrough and resonances   | good   |
| Subjective sound quality of complete system    | good   |
| Hum level/acoustic feedback                    | very good/very good                              |
| Vibration sensitivity/shock resistance         | fairly good/fairly good                          |
| Estimated typical purchase price               | £497   |



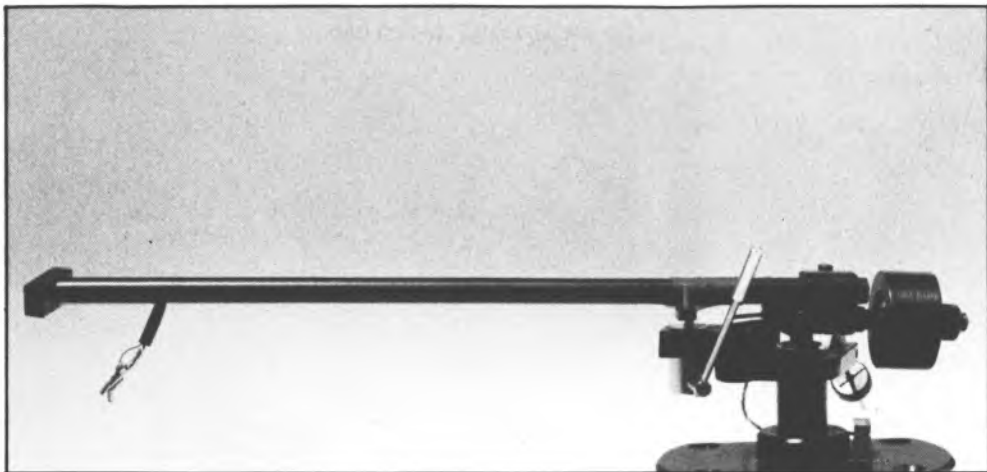
Breakthrough added by cover (scale expanded 10dB)

# "HEAVY On The Competition"



Ambience

Ambience (Audio) Ltd.  
 "Holly Bank", 145B Buxton Road,  
 Heaviley, Stockport, Cheshire.  
 Tel: 061-483 9656  
 Telex: 665706 AMBIEN G



### Features and design

Arguably one of the finest low mass tonearms in current production (5.5g effective), the rigidity of this design is such that many cartridge types may be used, including the whole spectrum of high quality moving magnet models, as well as those high trackability high compliance moving-coils such as the AT32 or the fine Denon 303 and 305. The more temperamental low compliance moving-coils can also be successfully accommodated, but in this case some precautions must be taken: for example, if using the *Asak* (a 6g mass model of around 12cu at 10Hz), the low frequency resonance appears at 15Hz, which is enough to noticeably increase the bass register even with Mission's variable fluid damping. For this and other similar cartridges, I would suggest a steel interplate of between 5 and 10g in weight to mass-load the cartridge and headshell assembly.

Employing easily detachable straight alloy tube carriers, with the connections made via a flying lead fitted with a miniature gold-plated plug, the headshell has been reduced to a rather small contact rectangular block in the interests of low mass. This head block is internally threaded, the cartridge bolted up from below; in the case of the Dynavector *Karat* series, the block must be drilled through to give access to the threaded holes in the cartridge body itself (a special version is available).

A rigid arm design, all the components are tightly clamped together, and the precision ball-race bearings are pre-stressed by an offset

technique which eliminates play. The counter-weight resonance problem encountered with many tonearms has been solved here by the use of a new synthetic engineering polymer called *Sorbothane*, a cast insert of this decoupling the counterweight from its threaded adjustment bush. The very high loss characteristics of the insert provide strong damping of the main resonance as well as some secondary beam effects.

### Lab results

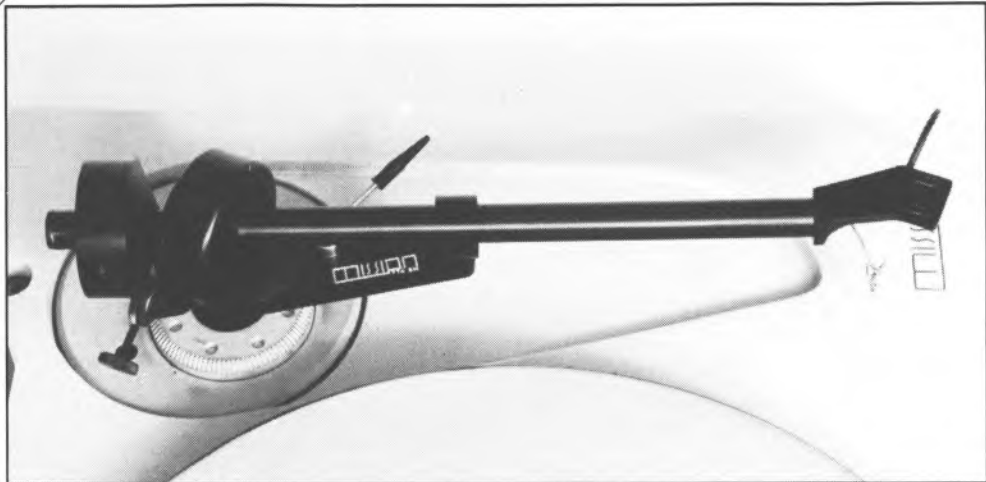
Good geometric alignment has been maintained on the latest samples, and the design offered a full range of adjustments except for cartridge lateral angle (which is determined by the headshell block fixings). Provided that the flying lead on the arm carrier was carefully dressed, friction was low in both planes with no detectable notching. Bias compensation was uncalibrated, and we found an approximate setting for 1.5–2.0g was one weight at the lever extremity, or alternatively two set a little less than half way out. The bias lever was not always well fixed in its pulley, and the linking thread adjustment could be quite fiddly to set properly. Ample damping was provided, though not much difference was observed between the various paddle sizes; excess damping is more damaging than none at all, and we would suggest using the smallest paddle, and then only where a very compliant and/or lively cartridge is concerned.

The resonance graph showed excellent control over a wide range, with a notably even energy

*continued on page 139*

# Mission 774 SM

Mission Electronics Ltd., PO Box 65, London SW7 1PP.  
Tel 01-589 0048



Partly developed by Mission and built for them by GB Engineering the 774SM tonearm is the company's second arm model, augmenting rather than displacing the existing design. The latter comprises a low mass rigid pivot arm with optional fluid damping, while the SM is an entirely new design, lacking damping and possessing much higher mass — we estimated it at about three times higher.

At the time of writing, the high-mass SM was incompatible with the current range of Mission cartridges, but we were told that compatible low compliance types would shortly be available. A compliance range of 6-14cu would seem appropriate for this 16g arm.

The front end of the SM parallels that of the Zeta, with a massive unperforated slotted headshell milled from solid and thermally bonded to a large diameter black anodised aluminium tube — the main beam. Full circle gimbals are used, set for zero play and with moderate friction. The whole is a strong structure with a low-resonance 'feel'. The large counterweight is uncalibrated and fitted with a spring-loaded locking arrangement — insufficiently tight to prevent minor rattles on our sample, which admittedly was a prototype.

Connection is made by a standard Japanese-type plug and arm lead — a fairly stiff for correct dressing on a sub-chassis turntable, and needing some care to minimise the height required below the pillar. The gold-plated phono plugs were good quality, with a low lead capacitance of 85pF — much lower than that

of the old 774.

An *Ittok*-compatible arm mounting base is expected to be made available for this design.

## Lab report

The medium-high mass has been noted already. Once a sample error had been corrected, the geometry was judged to be very good, with adjustments for height, overhang and offset angle. Easy to assemble and use, setting up was however more difficult due to the lack of calibration for bias compensation and downforce. Friction was commendably low on this design. A thread-and-weight bias compensator was fitted, which when set to its mid position gave readings of 100mg, and 200mg when close to 'maximum'; the bias correction could be increased to advantage in this design. The cue worked well, with satisfactory rates of ascent and descent.

Charted for structural resonances, the arm's behaviour was judged very good, particularly as regards the even energy trend. The main break appeared at a high 1kHz, with minor effects preceding this and, apart from a 'ring' at 3.3kHz, the rest was pretty smooth.

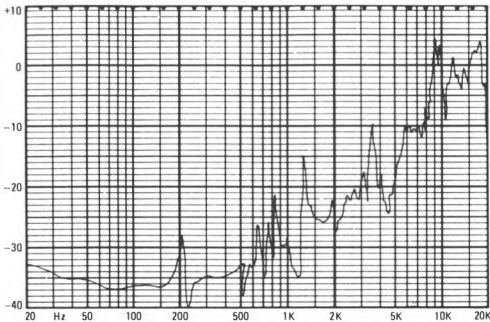
## Sound quality

Rated highly on the listening tests the 774SM was felt to offer a tonally neutral performance with good clarity and stereo focus throughout the frequency range. The bass was notably deep, powerful and articulate while the treble was lively but free of harshness. The whole

effect was one of relaxed security.

### Conclusion

Mission have provided us with a genuine advance in arm performance and sound quality with this new product. Well suited to top-performance, low-compliance moving-coil cartridges it offers fine sound quality at a most realistic price and is therefore warmly recommended.



Structural arm resonances, audio band

### MISSION 774 continued

trend. Main resonances occurred at 500 and 750Hz but these were well disguised on the reproduced curve, with the break at 350Hz representing a mild pillar/bearing flexure.

### Sound quality

Perhaps due to its low mass the 774 showed an ability to provide a consistently good standard of reproduction using a wide range of motor units from a Linn to a Thorens, from a Marantz TT1000 to a Lux PD555. Many tonearms have a strong tonal character, exhibiting 'richness', 'brightness' or simple coloration; but the 774 was distinguished by its dry and controlled neutrality. If anything the upper midband was slightly hard in the manner of the *Ittok*, but it lacked the latter's comparative upper range brightness; whether or not this is an advantage will depend on the balance of the cartridge being used. The bass was slightly reduced in power by comparison with some, but conversely it offered a fine transient performance with excellent control.

### Conclusion

The 774 continues to provide an exceptional performance for a low mass design, proving unusually versatile as regards the choice of player and cartridge on the grounds of both sound quality and mechanical compatibility. In consequence our established recommendation holds, though we would like to see marginally higher standards of quality control.

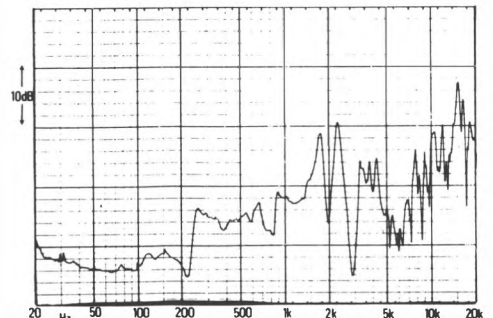
### GENERAL DATA

|  |                               |         |
|--|-------------------------------|---------|
| Approximate effective mass, inc screws, excl cartridge | 16g                           | Tonearm |
| Type/mass of headshell                                 | non-detachable                |         |
| Geometric accuracy                                     | very good                     |         |
| Adjustments provided                                   | overhang/offset/height        |         |
| Finish and engineering                                 | excellent/very good           |         |
| Ease of assembly/setting-up/use                        | very good/difficult/very good |         |
| Friction, typical lateral/vertical                     | less than 5mg/15mg            |         |
| Bias compensation method                               | thread and weight             |         |
| Bias force, rim/centre (uncalibrated, set at max)      | 200mg/200mg                   |         |
| Downforce calibration error, 1g/2g                     | uncalibrated                  |         |
| Cue drift, 8mm ascent/descent                          | none, 0.6 secs/3.0 secs       |         |
| Arm resonances   | very good                     |         |
| Subjective sound quality                               | very good                     |         |
| Lead capacitance/damping method                        | 85pF/none                     |         |
| Estimated typical purchase price                       | £197                          |         |

\*First sample tilted 2 deg from vertical, second sample fine

### GENERAL DATA

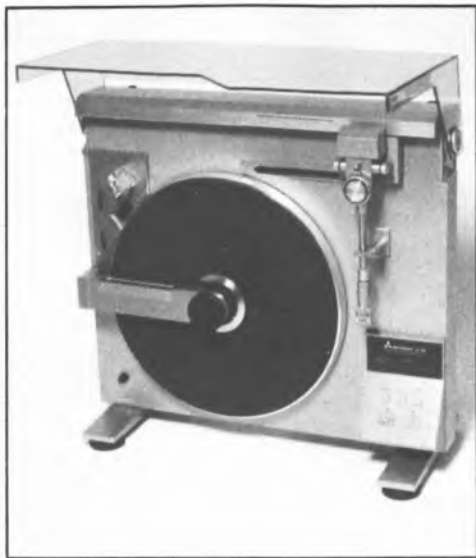
|   |  |         |
|---|--|---------|
| Approximate effective mass inc screws, excl cartridge | 5.5g                                   | Tonearm |
| Type/mass of headshell                                | special detachable arm/N/A             |         |
| Geometric accuracy                                    | 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                    | less than 15mg/less than 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                      | £157                                   |         |



Structural arm resonances, audio band

# Mitsubishi LT-5V

Mitsubishi Electric UK Ltd., Otterspool Way, Watford, Herts. WD2 8LD.  
Tel (0923) 40566



## Features and design

This vertically presented turntable created quite a stir when it was first released, and continues to fascinate, having a particular advantage for those who do not have a wide enough shelf or cabinet on which to place a conventional machine. A competitor has now been released by Sharp, which has the ability to play both sides of a record without turning it over, but in doing so sacrifices both platter and mat which the *LT5V* does not. Theoretically at least, the Mitsubishi should benefit from their retention.

An Audio Technica *AT12E* cartridge is fitted to the unit, offering fair compatibility, though it should be appreciated nonetheless that this is a cheap model. Belt driven via a DC motor with fine variable speed control, speed reference was provided by a mains frequency illuminated strobe, but some motor noise was audible if the deck was sited near the listener position. The parallel tracking arm runs along the upper section of the deck and is protected by a light plastic half cover. This swings upwards to allow fitting of the disc, which is clamped under a light action locking arm, hinged horizontally. A universal detachable headshell is fitted, giving a total arm effective mass of approximately 15g, suited to lower compliance cartridges.

The gravity hanging design of the tonearm complicated measurements and a lacquer test record had to be used for rumble measurement,

since the more accurate bridge was unsuitable. Automated in many respects, the *5V* offers push-button power cueing, plus traverse and lift/lower. Disc size is automatically detected and programmed for speed and arm entry position, but it must be said that little has been done to incorporate either acoustic or vibration isolation from the environment. In addition to its freestanding mode, the unit is also available in a larger cabinet which includes a stereo receiver.

## Lab results

Taking rumble first, and remembering that the test lacquer has more intrinsic noise than the usual measurements, the spectrum analysis showed a 100Hz breakthrough at just 70dB down; however the other products were better than 80dB down, and a good rumble figure of better than -72dB DIN B weighted was recorded. The combined wow and flutter reading was also fine when DIN weighted, but on its own the linear wow was on the high side at 0.3%; the vertical orientation of the test disc may have been a complicating factor here. The drive showed good torque, and the 1.7kg platter attained a stable speed in a moderate 3.5 seconds.

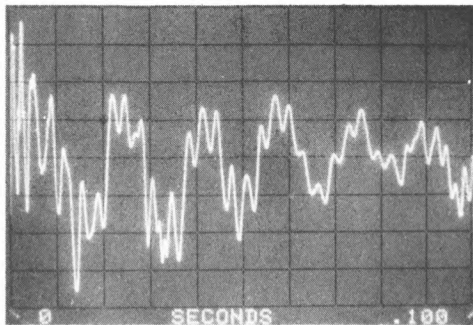
The platter disc damping was just sufficient to allow X10 scaling for the impulse response, although numerous spurious frequencies may be seen in a rather uncontrolled form. Fortunately, while the level of acoustic breakthrough was unexceptional, it was fairly evenly distributed, and will in any case be modified by close wall mounting. The vibration breakthrough was clearly below average, and the heavy gravity-balanced arm proved somewhat susceptible to footfall shock - a rigid shelf mounting is recommended. In general the arm performance was satisfactory, though the downforce weight was a rather loose fit, and on resonance behaviour the response was dominated by a severe flexure at a low 140Hz with a 20dB jump in level. At higher frequencies the arm was more or less decoupled from the cartridge, and hence beyond its influence.

## Sound quality

While in high fidelity terms the sound quality was no better than might be expected, showing a muddled bass, a lack of midrange depth and detail, as well as a 'dulled' treble, at least this deck did not exhibit unpleasant harshness or coloration in the mid register. The sound in fact was just average for the type of deck, and in context the supplied cartridge was a fair choice.

## Conclusion

If chosen this model should be bought on the basis of its unique format and convenient automation. The sound is acceptable, and improves a little with a firm foundation free of vibration and shock. But it would win no hi-fi awards, and on balance is best suited to the near music centre role in its combination receiver format.



Disc impulse transmission, magnified X10.

## GENERAL DATA

Integrated Turntable

### Motor Section

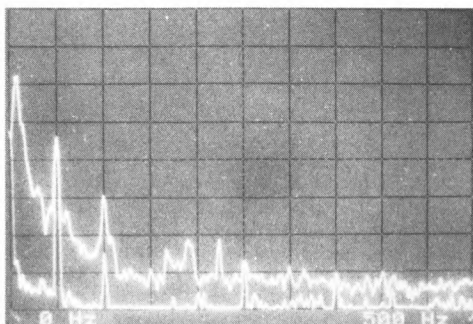
Type..... parallel tracking, belt drive, automatic  
 Platter mass/damping..... 1.7kg/good  
 Finish and engineering..... very good/good  
 Type of mains lead/connecting leads... 2 core/phonos + earth  
 Speed options..... variable 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2)..... 0.07%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... 0.3%/0.06%  
 Absolute speed error..... +0.1%  
 Speed drift 1 hour/load variation..... <0.1%/<0.1%  
 Start up time to audible stabilisation..... 3.5secs  
 Rumble: DIN B wtd L/R av (see spectrum) better than -72dB

### Arm Section

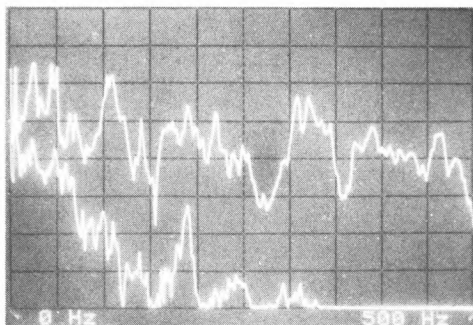
Approximate effective mass inc screws, excl cartridge..... 15g  
 Type/mass of headshell..... universal detachable/7g  
 Geometric accuracy..... very good  
 Adjustments provided..... overhang  
 Finish and engineering..... good/fairly good  
 Ease of assembly/setting up/use..... very good/very good  
 Friction: typical lateral/vertical..... less than 30mg/less than 30mg  
 Bias compensation method..... non required  
 Downforce calibration error: 1g/2g..... -0.15g/-0.1g  
 Cue drift/8mm ascent/descent..... negligible/3secs/3secs  
 Arm resonances..... poor  
 Lead capacitance/damping method..... 200pF/none

### System as a whole

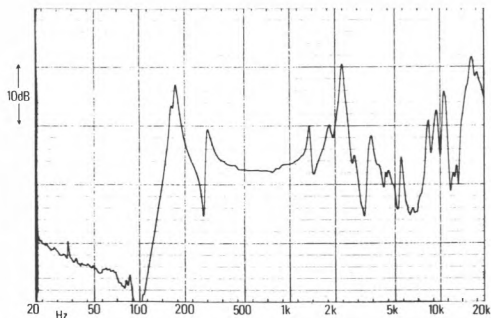
Size clearance for lid rear  
 466mm(w) x 200mm(d) x 430mm(h)/6cm height  
 Ease of use..... very good  
 Typical acoustic breakthrough and resonances..... fairly good  
 Subjective sound quality of complete system..... average -  
 Hum level/acoustic feedback..... good/average  
 Vibration sensitivity/shock resistance..... below average/average  
 Estimated typical purchase price..... £199



Rumble via lacquer disc (0-500Hz line): above, electrical; below, total.



Breakthrough (0-500Hz line): above, acoustic; below, vibration.



Structural arm resonances, audio range.

# Optonica RP7100

Sharp Electronics Ltd., Sharp House, Thorp Road, Manchester M10 9BE. Tel 061-205 2333



## Features and design

This elaborate turntable is an advanced development of the 5100 previously reviewed in *Choice*. Its major operating feature comprises a sensor for the detection of gaps between music tracks, which Sharp call *APLD* or 'automatic program locate device'. By entering the total number of spaces preceding a chosen track, the arm will automatically skip that number and set down as desired. Personally I am not certain how useful this feature is in practice, since it is achieved at considerable cost to the pocket as well as the performance of the deck. The problem lies in the fact that Sharp have chosen to build the sensor into a second arm alongside and coupled to the vertical bearing section of the existing arm. In consequence dynamic balance is very poor, with an extreme sensitivity to levelling and shock (an out-of-level position is in fact required for correct biasing), while the secondary arm also adds a serious resonance to the arm structure at 50Hz.

The deck is also unusual in employing a recessed area in the plinth allowing the use of an acoustically superior lid – a single sheet of plate glass, which requires virtually no rear clearance for elevation. A quartz-locked direct drive motor is used to power an alloy 1.4 kg platter fitted with a sensibly flat mat. Carrying a universal detachable headshell weighing 8g, the effective mass works out at 16g in the vertical plane due to the contribution of the sensor outrigger. So compatible cartridge compliances would range from 8–12cu, with downforces of less than 2g inadvisable due to the dynamic instability of the arm. Low capacitance leads are fitted which could aid

the electrical matching of some cartridges.

Vibration isolation has clearly not been given much thought in this design, as the rather stiff feet, which lack in this instance essential adjustment for levelling, offer plinth suspension resonances in the region of 12–18Hz.

## Lab results

The motor section demonstrated good dynamic characteristics, with low overshoot and very good speed accuracy assured by the quartz lock. Rumble levels were satisfactory though some mains-related components were evident on the spectrum, notably at 100Hz (–65dB), and 200Hz (–70dB); pole related harmonics were absent. The platter disc impulse was unpromising, requiring X1 scaling and demonstrating several mild resonances of long duration. Likewise neither the acoustic or vibration energy rejections held much hope for an exceptional sound quality, as both were significantly below average for the price.

The arm geometry was questionable with the sensor restricting cartridge location; in any case the arm was positioned rather low on the platter. Bearing play was evident, though with good friction levels, and the bias compensation proved inadequate, producing an equivalent to 0.3g on a 1.5g setting; this will have to be set by trial and error upon purchase. Dominated by the 50Hz sensor mode, the multiple arm resonances betray a lack of rigidity in several areas including the headshell junction, but the energy trend was nevertheless fairly even.

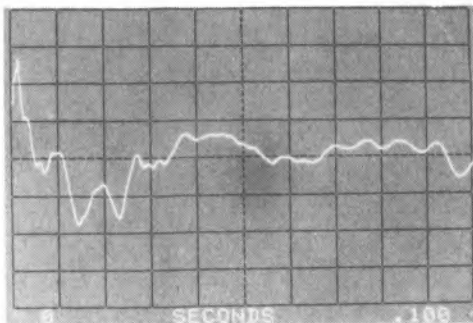


## Sound quality

Compared with the better examples in this group, the stereo was confused, particularly in terms of central focusing and lack of depth. Feedback could be a problem at higher gain settings, while the low frequency range sounded 'lumpy' and lacking in definition, though coloration in the mid and treble was quite low.

## Conclusion

Despite its track selection feature, or perhaps because of it, this turntable cannot be recommended on the basis of either its technical or subjective performance; in fact its less expensive brother the *RP5100* represents much better value for money.



Disc impulse transmission, standard X1.

## GENERAL DATA

Integrated Turntable

### Motor Section

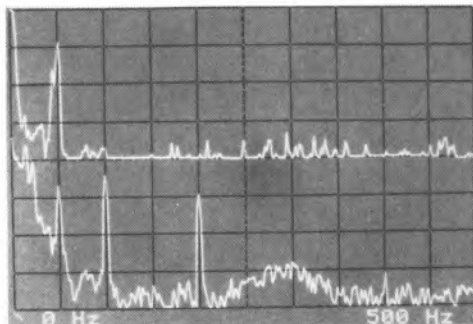
Type ..... quartz, direct drive, special track locator  
 Platter mass/damping ..... 1.4kg/very good  
 Finish and engineering ..... good/good  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... 0.06%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... 0.13%/0.06%  
 Absolute speed error ..... <0.01%  
 Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
 Start up time to audible stabilisation ..... approx 2.5secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... 77/68dB

### Arm Section

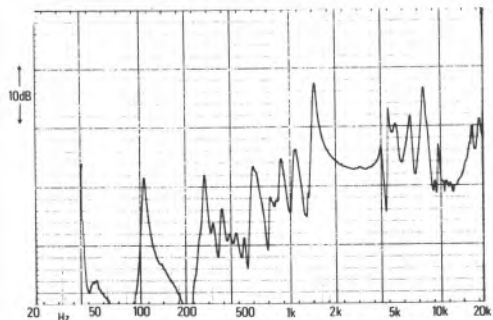
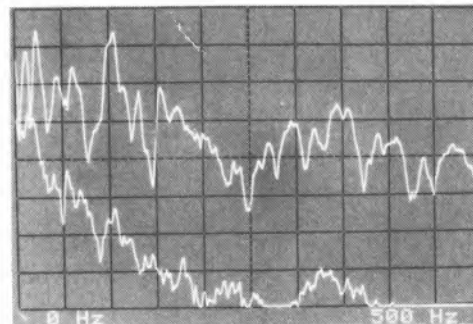
Approximate effective mass inc screws, excl cartridge ..... 16.0g  
 Type/mass of headshell ..... universal detachable/8g  
 Geometric accuracy ..... fair only  
 Adjustments provided ..... overhang (limited by apld), lateral angle  
 Finish and engineering ..... fairly good/only fair  
 Ease of assembly/setting up/use ..... good/good/very good  
 Friction, typical lateral/vertical ..... less than 20mg/less than 20mg  
 Bias compensation method ..... spring  
 Bias force: nm/centre (set to 1.5g elliptical) ..... 50mg/50mg  
 Downforce calibration error 1g/2g ..... +0.2g/<0.1g  
 Cue drift/8mm ascent/descent ..... negligible/0.5sec/1.5secs  
 Arm resonances ..... poor  
 Lead capacitance/damping method ..... 78pF/none

### System as a whole

Size/clearance for lid rear ..... 48.0(w) x 38.5(d) x 11.0(h)/0cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... fair  
 Subjective sound quality of complete system ..... below average  
 Hum level/acoustic feedback ..... good/poor  
 Vibration sensitivity/shock resistance ..... below average/poor  
 Estimated typical purchase price ..... £179



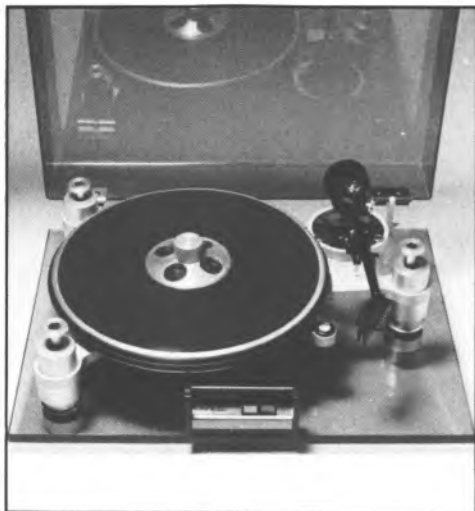
Rumble (0-500Hz lin): above, electrical only; below, total.



Structural arm resonances, audio range.

# Oracle

Absolute Sounds, 42 Parkside, London SW19.  
Tel 01-947 5047



A distinctive and costly subchassis turntable, designed and built in Canada, the Oracle has established itself as a 'superfi' product both here and across the Atlantic. Possessing a skeletal 'open' appearance, the unit is founded on a thick acrylic base plate to which the moulded lid and adjustable feet are fitted. The elegant laminated magnesium alloy subchassis is poised on three bell-shaped multi-turn coil springs concealed in piers, and a knob is fitted to each pier to allow tight control of belt/platter alignment and level. It has been carefully designed to provide near perfect chassis balance and mass distribution, so that by control of spring compliance to suit various arm masses the intended stable 3.5Hz vertical suspension resonance may be obtained. A total of nine colour-coded springs are provided, together with a table detailing the combinations required for almost every quality tonearm made. In addition, an adjustable dynamic balancer is present below the chassis, clamped to the substantial housing of the main bearing. Fortunately comprehensive instructions are provided for all the lengthy setting up procedures and alignments.

A number of other special features are incorporated, including a unique disc support system and damping arrangement. A carbon fibre reinforced mat of the slightly 'tacky' highly absorptive type is used, with a small

domed washer placed beneath it to slightly lift the record centre. A screw down record clamp, dished on its underside, bears down on the record at the periphery of the label, forcing it into contact with the mat, first at the edge and then with further clamp tightening progressively over the whole surface. The platter possesses a correct engineering profile, and has rim damping in the form of a dense neoprene sponge wave-trap fitted to its outer perimeter.

Belt driven, a high quality Papst DC motor is used, switchable by a front mounted electronic control between 33 $\frac{1}{3}$  and 45 rpm. The power supply is arranged as a separate box, equipped with a mains flying lead for the attachment of a UK plug.

## Lab results

Largely retested for this edition, the rumble showed a considerable improvement, with a large reduction in the 100Hz component. Total wow and flutter also improved to 0.05% – but linear wow was still a trifle high and speed slowing under load rather worrying, at close to 0.5%. Officially 'good to very good' on vibration isolation and acoustic breakthrough, the isolation was nonetheless imperfect with poorer rejection than before at 30Hz, 60Hz, 130Hz and 170Hz, the last also seen on the acoustic graph. Disc impulse damping remained very good, though showing a low-frequency ring, estimated to be around 60Hz again.

## Sound quality

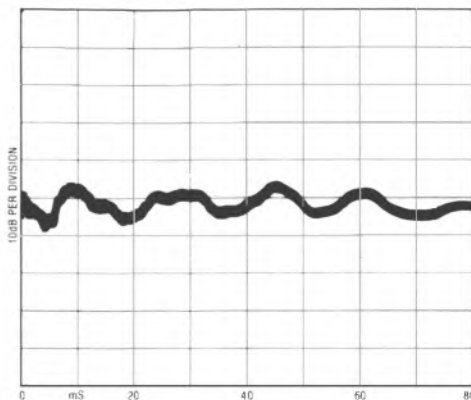
The subjective effect of the disc termination was to lend a rather 'dry' and well-damped character to the sound, with a somewhat 'distant' mid and treble. Transients were reproduced very clearly, with good instrumental differentiation especially on complex choral material. Depth and stereo focus were both very good. The bass was 'dry', almost 'lean' in character. Tried with the Sumiko arm, the effect tended to a 'softened richness', which even the liveliness of the Koetsu failed to dispel, but which was nonetheless very pleasant. The *Ittok* is probably not an ideal match but it did provide greater 'liveliness' and 'attack', and when used with the Koetsu Wood, resulted in a fine, albeit costly, turntable, totalling around £1300.

## Conclusion

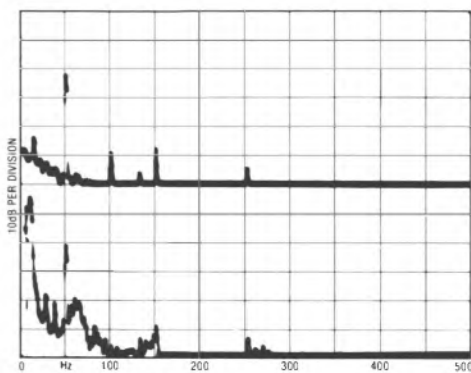
This superbly presented and finished design

represented a frustrating combination of strengths and weaknesses. Those favouring the former loved it, while those aware of its shortcomings were disappointed.

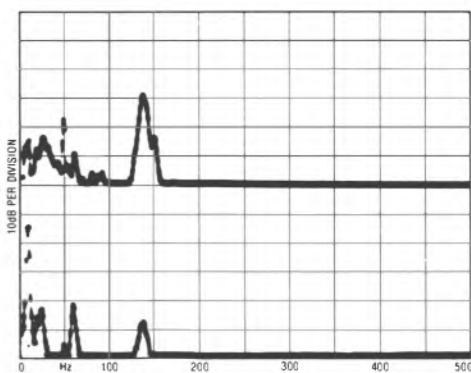
At this very high price, failure to keep perfect subjective pitch, plus the stiff rotational chassis vibrational mode and the residual vibration breakthrough all took their toll and these affects precluded recommendation. Nonetheless the Oracle can produce very good sounds with ancillaries of appropriate quality, particularly on less pitch-demanding classical programme, as here the transient load requirements are generally less frequent and arduous.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



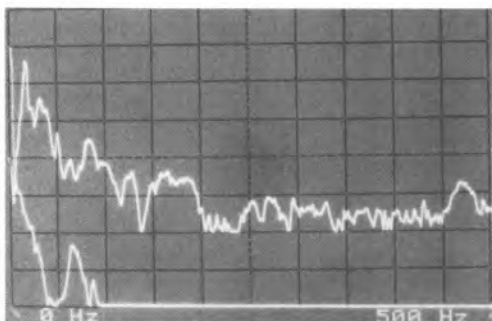
Breakthrough, acoustic (above) and vibration (below)

**GENERAL DATA**

Motor unit

- Type . . . . . manual, belt-drive, synchronous motor, subchassis
- Platter mass/damping . . . . . 2.3kg/excellent
- Finish and engineering . . . . . excellent/excellent
- Type of mains/connecting leads . . . . . 2-core, line transformer
- Speed options . . . . . 33/45 rpm
- Wow and flutter (DIN peak wtd, sigma 2) . . . . . 0.055%
- Wow and flutter (LIN peak wtd 0.2-5Hz/6-300Hz) . . . . . 0.13%/0.05%
- Absolute speed error . . . . . + 0.45%
- Speed drift, 1 hour/load variation . . . . . 0.7%/ - 0.45%
- Start-up time to audible stabilisation . . . . . 4.8 secs
- Rumble, DIN B wtd L/R average (see spectrum) . . . . . - 8.0dB
- Size/clearance for lid rear . . . . . 4 B(w) x 37(d) x 16(h)/8cm
- 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 . . . . . good + /fairly good

Estimated typical purchase price . . . . . £747



Breakthrough as modified (see text): above, acoustic; below, vibration.

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Pioneer PL120

Pioneer High Fidelity (GB) Ltd, 1-6 Field Way, Greenford, Middlesex UB6 8UN  
Tel 01-575 5757



A very modestly priced, rack-system orientated turntable the *PL120* was supplied with a fitted moving magnet cartridge which we suspect would not be readily discarded.

A sort of 'rubber' decoupled sub-chassis is provided to help combat feedback, the modest aluminium platter being belt driven by a small synchronous motor mounted on the plinth component. Two fixed speeds are provided while the arm is fitted with auto-return and stop. The headshell is detachable with the use of a special screwdriver, the arm possessing a moderate estimated 11g effective mass. The usual calibrated rotating-scale counterweight is present together with a spring-orientated anti-skating compensator. Not unexpectedly (considering the price) the arm bearings showed some slack, although the main platter bearing was well executed.

## Lab report

Fairly well engineered, the *PL120*'s finish was considered to be very good. The disc impulse result was quite respectable, showing good damping, and the 0.75kg platter attained speed in a rapid 1.5 seconds. Speed was accurate but some slowing under load occurred. The rumble figure was somewhat unbalanced between left and right channels but was most satisfactory considering the price.

Arm geometry was quite good and the arm proved easy to set up and use. Vertical friction was very low and the lateral result satisfactory in view of the downforce likely to be used. Bias compensation was well judged and in the cor-

rect ratio while downforce was acceptably accurate and the cueing worked well.

Rated average on arm resonances, the *120*'s chart shows the first break occurring at 500Hz, though good control was exhibited thereafter. Charted for frequency response, the cartridge showed a pleasantly uniform response free of treble peaks and from 30Hz to 20kHz  $\pm 1.5$ dB limits were met. Separation bettered 20dB throughout, satisfactory at the price, and the cartridge tracked most things competently at a 2g downforce.

For the whole unit, acoustic isolation was better than anticipated, as was vibration rejection. Shock resistance was good while overall acoustic feedback rated as average.

## Sound quality

While it was clear that this was no great subjective performer, the *PL120* did well enough on most things to score quite respectably at the price. The frequency response sounded unbalanced with some mid hardness and an emphasised treble but the bass was not as poor as for many other similar models. Stereo staging was lacking real depth but nonetheless gave a fairly spacious effect.

## Conclusion

Considering the generally good lab performance, honest well-engineered construction, useful facilities and included cartridge, the *PL120* must be well worth considering at £60 even if it misses the top category for unqualified recommendation.

**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

Type . . . . . semi-automatic, belt drive  
 Platter mass/damping . . . . . 0.75kg/good  
 Finish and engineering . . . . . excellent/very good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . less than 0.06%/0.04%

Absolute speed error . . . . . + 0.15%  
 Speed drift, 1 hour/load variation . . . . . synchronous/ - 0.4%  
 Start-up time to audible stabilisation . . . . . 1.5 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . - 73dB

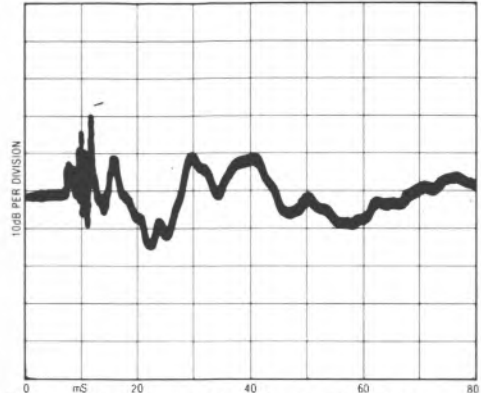
**Arm Section**

Approximate effective mass, inc screws, excl cartridgeest. 11g  
 Type/mass of headshell . . . . . special detachable/8g  
 Geometric accuracy . . . . . good  
 Adjustments provided . . . . . overhang/offset  
 Finish and engineering . . . . . very good/good  
 Ease of assembly/setting-up/use . . . . . very good/very good/very good

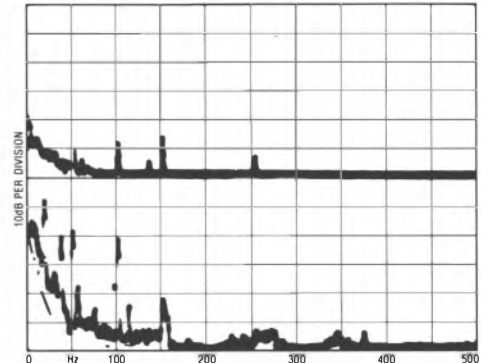
Friction, typical lateral/vertical . . . . . 50mg/5mg  
 Bias compensation method . . . . . spring  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . 170mg/250mg  
 Downforce calibration error, 1g/2g . . . . . + 0.1g/ + 0.1g  
 Cue drift, 8mm ascent/descent . . . . . none, 0.6 secs/1.3 secs  
 Arm resonances . . . . . average  
 Subjective sound quality . . . . . average -  
 Lead capacitance/damping method . . . . . 170pF/counterweight decoupling

**System as a whole**

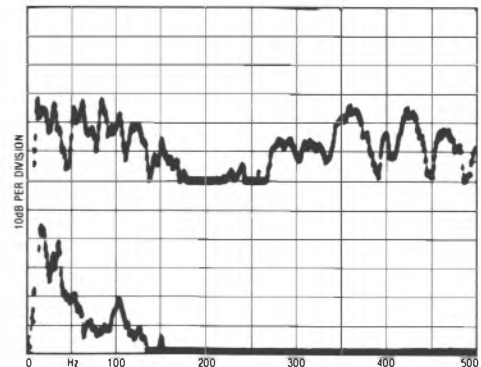
Size/clearance for lid rear . . . . . 42(w) x 36.5(d) x 11(h)/4cm  
 Ease of use . . . . . very good  
 Typical acoustic breakthrough and resonances . . . . . average  
 Subjective sound quality of complete system . . . . . below average  
 Hum level/acoustic feedback . . . . . very good/average  
 Vibration sensitivity/shock resistance . . . . . average/good  
 Estimated typical purchase price . . . . . £60



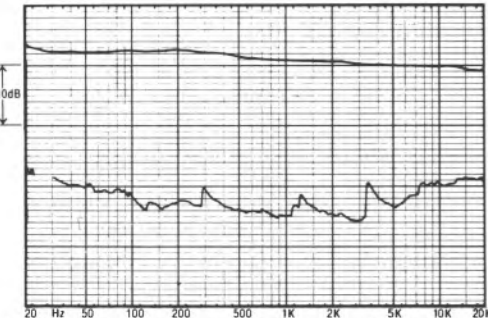
Disc impulse transmission showing damping



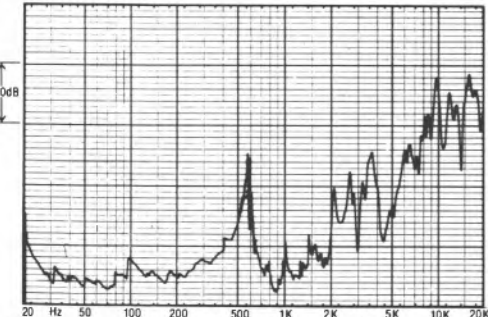
Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)



Frequency response and separation, cartridge



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Pioneer PL7

Pioneer High Fidelity (GB) Ltd, 1-6 Field Way, Greenford, Middlesex UB6 8UN  
Tel 01-575 5757



At no less than twice the price of the visually similar *PL120*, the *PL7* is distinguished by its fully-automatic player mechanism, its quartz-locked direct drive motor and the standard installation of a moving coil cartridge. The latter is in fact a modest affair, type *3MC* with a user-detachable stylus and with a shank-mount spherical tip tracking at the usual 2g down-force.

A very low-mass type, the *3MC* cartridge weighed 3.1g, which in conjunction with the moderate arm mass provides good stylus compatibility and a sensibly low subsonic resonance of around 10Hz.

## Lab report

The 1kg cast-alloy platter was fitted with a sensible mat offering good initial impulse damping, though a low frequency aftershock was less well damped, assumed to be rocking on the main bearing compliance. Wow and flutter was excellent, and start-up rapid, the speed proving highly accurate with no overshoot and zero slowing under load. Rumble was satisfactory at 74/69dB DIN B weighted, but poorer than specified; as Pioneer usually meet or exceed their specifications it was assumed to be a marginal sample fault.

At 11.5g effective mass including hardware, the arm's geometric accuracy was very good, though the supplied cartridge was itself aligned 1 deg in error on our chosen inner groove radius. The arm was easy to set up and use. Friction was held to low levels, though mild play was evident in the arm bearings, and bias

compensation was fine, the cue mechanism working well with sensible ascent and descent rates. Similar to the *PL120*, the arm resonance behaviour was classed as average with a fairly serious break and energy step at 500Hz. Lead capacitance was fairly high at 170pF.

Acoustic breakthrough resistance was classed as above average in performance with fairly good feedback resistance. Vibration rejection was barely average, though the footfall shock was well handled.

The cartridge frequency response showed a falling output from 100Hz to 2kHz, above which point it rose to a 3dB peak at 12kHz before falling away again. Separation averaged a modest 23dB, the 12kHz peak again noticed here.

## Sound quality

The sound was considered fairly poor with a sizzly, emphasised and sibilant treble, while the mid demonstrated a 'loud' forward quality with a sort of false echo about it. Stereo depth was poorly developed and detail was lacking throughout the range.

## Conclusion

Surprisingly the *PL7* was outperformed by the cheaper *PL120* on almost all parameters, and despite the inclusion of a moving-coil cartridge the '7 has not, we feel, done well enough to merit serious consideration. The purchaser would need to replace the existing cartridge with a competent alternative — on the face of it, an uneconomic step to take.

**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

Type..... fully auto, quartz direct-drive, subchassis  
 Platter mass/damping..... 1.0kg/above average  
 Finish and engineering..... excellent/good  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... 0.06%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)  
 less than 0.06%/0.06%

Absolute speed error..... none  
 Speed drift, 1 hour/load variation..... none/none  
 Start-up time to audible stabilisation..... 1.6 sec  
 Rumble, DIN B wtd L/R average (see Spectrum)..... - 74/ - 69dB

**Arm Section**

Approximate effective mass, inc screws, excl cartridge... 11.5g  
 Type/mass of headshell..... special detachable/8.5g  
 Geometric accuracy..... very good  
 Adjustments provided..... overhang/offset  
 Finish and engineering..... very good/good  
 Ease of assembly/setting-up/use..... very good/excellent

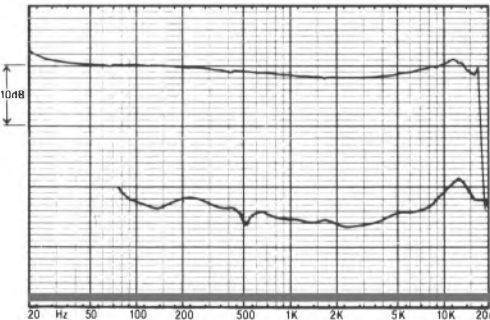
Friction, typical lateral/vertical..... 25mg/less than 5mg

Bias compensation method..... spring  
 Bias force, rim/centre (set to 1.5g elliptical)..... 150mg/200mg  
 Downforce calibration error, 1g/2g..... none/0.05g  
 Cue drift, 8mm ascent/descent..... none, 0.6 secs/1.4 secs  
 Arm resonances..... average  
 Subjective sound quality..... average -  
 Lead capacitance/damping method..... 170pF/counterweight decoupling

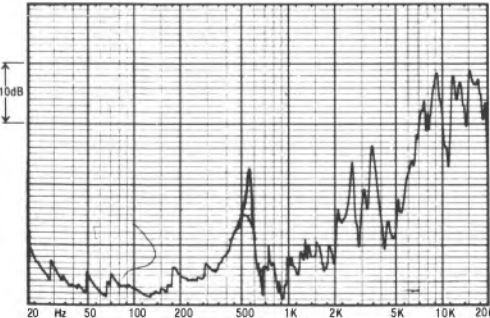
**System as a whole**

Size/clearance for lid rear..... 42(w) x 36(d) x 10.5(h)/3cm  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... above average

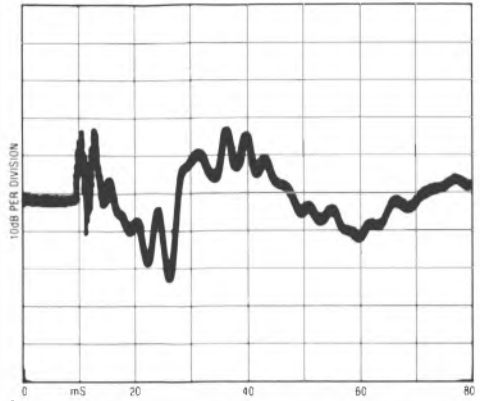
Subjective sound quality of complete system..... poor  
 Hum level/acoustic feedback..... very good/fairly good  
 Vibration sensitivity/shock resistance..... average/good  
 Estimated typical purchase price..... £120



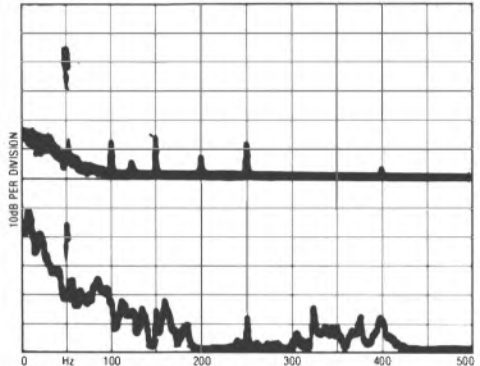
Frequency response and separation, cartridge



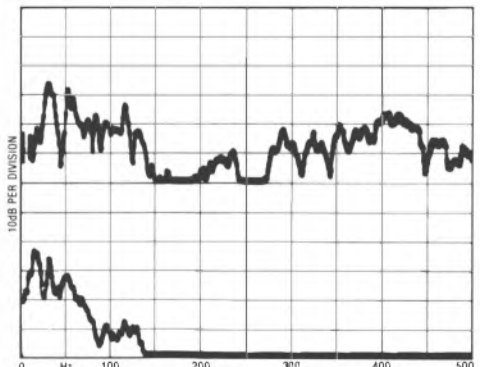
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Pioneer PL88F

Pioneer High Fidelity (GB) Ltd, 1-6 Field Way, Greenford, Middlesex UB6 8UN  
Tel 01-575 5757



A remarkable product, the *PL88F* hardly looks like a turntable at all. Its very construction in fact made life difficult for us in the lab, since much of the machine remains inaccessible to the reach or the use of certain of the measuring instruments!

A costly creation in a low profile steel cabinet, the *88F* is provided with an amplifier-style touch button control panel of surprising complexity. The arm is under complete power servo control, the fitted, fixed cartridge being a high-output moving-coil called the *PN41MC*, with an elliptical diamond-tipped stylus tracking at 2g. Distinguished by an inbuilt photoelectric cells and a lamp, the cartridge actually doubles as the programme track sensor for the arm automation, and is controlled by a central microprocessor — tracks may be programmed in order of choice. To load a record the appropriate button is pressed to open the front panel and cause the playing mechanism to slide forward in a 'ghostly' manner. Manual play is also possible in this 'load' position, a further button bringing the arm into view. Alternatively, after the record is in position, the whole may be closed up again (a rather slow procedure) and the deck left to its own automatic devices. Powered by a quartz-locked direct-drive motor, the deck's two speeds are manually or automatically selected and no fine variation is possible.

As with the *PL7*, the cartridge in the *88F* was also briefly assessed as part of the entire package.

## Lab report

Considering the ingenuity involved in the production of this player, it was considered to be well engineered and finished. The modest platter weighed some 0.9kg and did not offer much disc damping, some low-frequency wobble being present after the initial impulse.

Wow and flutter in all measurement forms was excellent with a clean overshoot-free motor torque and superb speed stability. Start-up was rapid and DIN weighted rumble excellent, and to spec. Despite this, however, some mild 100, 200 and 300Hz rumble components were present, as revealed by the spectrogram.

The arm proved difficult to analyse as it was hard to physically get at it. Judged by the general behaviour of the unit as a whole, the arm was considered to be well adjusted and of reasonable quality. Obviously very easy to use and set up, the cue mechanism was nicely judged for rate. The resonance behaviour was established by the graph taken using the attached cartridge, the result suggesting a rather spiky, resonant character with a serious break at 350Hz. Charted frequency response for the cartridge showed an isolated 3.5dB peak at 11kHz, and a modest stereo separation around 20-25dB. The 30Hz to 6kHz range was however quite uniform.

Due to its enclosed nature, the *PL88F*'s acoustic isolation was quite good, and the vibration rejection was not so bad either. Shock immunity was above average while feedback resistance was reasonably good, partly due to the relatively heavy construction.

## Sound quality

Auditioned as a complete unit with the platter both 'out' and retracted, the sound was undoubtedly the best of Pioneers tested this year. The mid was fairly transparent with clean transients and some stereo depth, and the bass was acceptably even, if lacking in real detail. The treble tended to a touch of brashness and fizziness, however.

## Conclusion

The *PL88F* is a fairly satisfactory deck in terms of its sound quality; representing a triumph of ingenuity, it will, I suspect be bought for its appearance and operating facilities rather than sonic performance.



**GENERAL DATA**

Integrated turntable (inc. cartridge)

**Motor Section**

Type..... programme search, front-load, quartz direct-drive  
 Platter mass/damping..... 0.9kg/average  
 Finish and engineering..... very good/very good  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... less than 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) .. 0.06%/0.04%  
 Absolute speed error..... none  
 Speed drift, 1 hour/load variation..... none/none  
 Start-up time to audible stabilisation..... 1.3 secs  
 Rumble, DIN B wtd L/R average (see spectrum)..... - 78dB

**Arm Section**

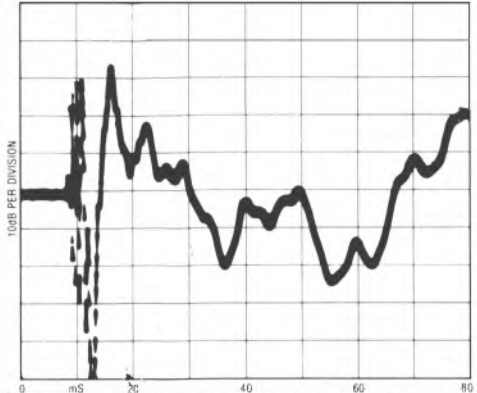
Approximate effective mass, inc screws, excl cartridge... N/A  
 Type/mass of headshell..... integrated  
 Geometric accuracy..... very good  
 Adjustments provided..... none  
 Finish and engineering..... very good/good  
 Ease of assembly/setting-up/use..... excellent/excellent/excellent

Friction, typical lateral/vertical..... -/-  
 Bias compensation method..... -/-  
 Bias force, rim/centre (set to 1.5g elliptical)..... -/-  
 Downforce calibration error, 1g/2g..... -/-  
 Cue drift, 8mm ascent/descent..... none, 1.1 secs/1.2 secs  
 Arm resonances..... \*average  
 Subjective sound quality..... \*average  
 Lead capacitance/damping method..... -/none

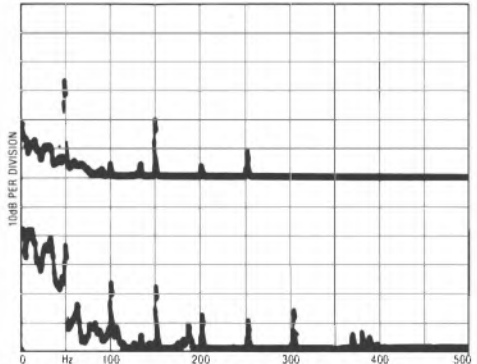
**System as a whole**

Size/clearance for lid rear..... 42(w) x 33.5(d) x 10cm(h)/none  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... good  
 Subjective sound quality of complete system..... average  
 Hum level/acoustic feedback..... very good/average  
 Vibration sensitivity/shock resistance..... average/average+  
 Estimated typical purchase price..... £300  
 \* with fitted cartridge

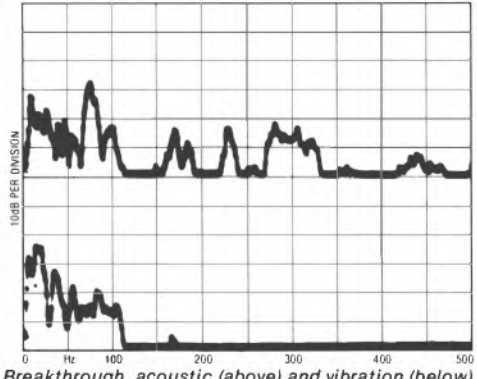
Note: tests carried out on 110V advance sample



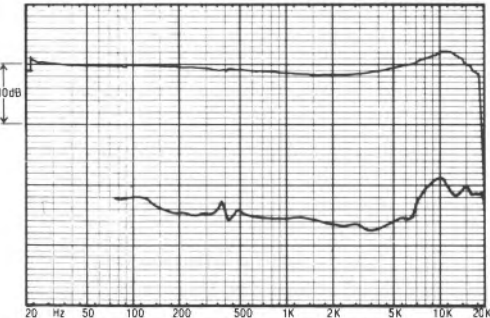
Disc impulse transmission showing damping



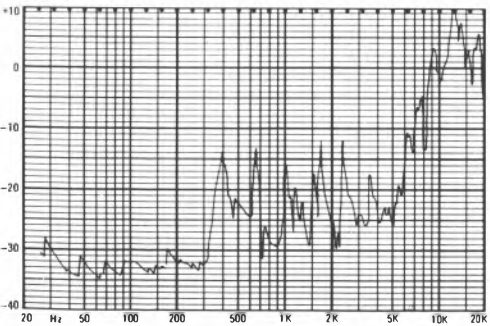
Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)



Frequency response and separation, cartridge



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

## Pink Triangle

Pink Triangle Products, 1 Cossington Court, Alder Road, Sidcup, Kent.  
Tel 01-302 1257



From the outside, the name and distinctive logo may seem all that is remarkable about this turntable, which has been designed in the UK along classic lines, using a sprung subchassis and belt drive. More detailed examination however reveals many unique features; for example, the platter is solid matt finished acrylic, supplying the record support and termination itself. A semi-glass black finish is used for the top deck, replacing the earlier tinted glass mirrors, and while the latter were removable the newer alloy plates are fixed. Fine speed control adjustment is available by the use of a screwdriver inserted in the small holes in the deck plate adjacent to the speed change switch, the drive being electronic via a small DC motor.

The subchassis is very light, but is an exceedingly rigid and well damped plate — an asymmetric section of honeycomb-cored aircraft flooring material.

The main bearing has been inverted and comprises an inherently self stabilising single point design. The inverted cup now has a ruby bearing surface as standard. An ingenious system of three small-diameter, but fairly long, coil-springs allows the chassis to hang freely in near isolation, with the vertical mode controlled by spring stiffness, and the lateral and torsional modes assisted by gravity as

well — a good feature.

Arm mounting is by means of a 'U' shaped section alloy extrusion, which is firmly bolted to four studs set in the subchassis. Adequate provision for lead dressing has been made, and the unit came fitted with an *Ittok*, which suited it well.

One point to bear in mind here is that the relatively low total suspended mass and high spring compliance results in slightly altered states of level with different record weights. The *Ittok* is little affected by this, but if using a Syrinx, for example, which is sensitive to absolute levelling, it could prove disastrous. However, the deck is easily levelled via concealed external nuts in the plinth sides.

### Lab results

State of the art rumble figures were achieved, the spectrum analysis revealing nothing of significance. The drive was remarkably stable with very low wow, very good flutter and fine weighted wow and flutter. As no dynamic wow overshoot occurred, this helped to mitigate the fairly low torque which resulted in a significant 0.5% slowing under standard loading. With a moderate 1.7kg platter mass, the flywheel effect was lower than in competing models.

The expanded X10 scaling proved possible for the disc impulse measurement, and the

result was very good, with balanced impulse decay control over a wide frequency range. This performance carried through to the vibration and acoustic isolation results, which were exemplary, and aural testing with a live cartridge showed that this platform was singularly inert overall in terms of resonances, yet the subchassis freedom also resulted in quite good 'footfall' shock resistance.

### Sound quality

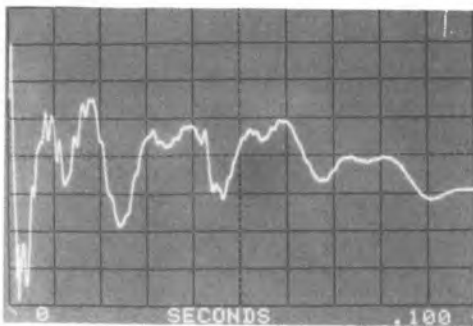
For this issue the Triangle was tried with both the *Ittok* and *Orion* tonearms and qualities of low coloration tonal neutrality as well as a pleasing musical balance were immediately apparent. The bass register was well above average showing an open and articulate quality — tuneful and with good weight and solidity. The sound was alive yet somehow unforced. Disc/platter contact seemed particularly good, with a well focused treble, the whole delivering stable, clear stereo images. With rock-orientated material we heard a mild lack of pitch stability which slightly detracted from the timing and tempo of the music, although this negative effect depended on the listener's sensitivity as well as on the programme type.

### Conclusion

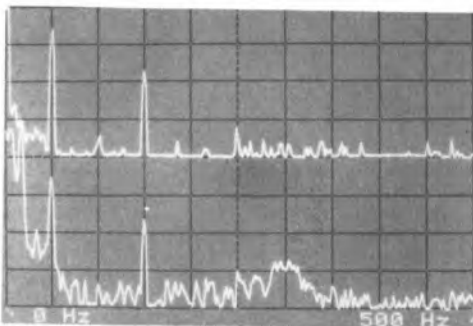
Completely retested for this issue, the performance was virtually identical to that obtained previously and accordingly the original test results still stand. Notably, the pitch slowing under load is unaltered, a factor we were now aware of under audition, and a second sample showed no significant improvement. To conclude, this unit has been improved as regards some physical details, and maintains a high performance with respect to stereo depth, tonal balance and coloration levels. Only the individual purchaser can judge the importance of the pitch stability by personal audition, and with this mild reservation, the recommendation is continued.

### GENERAL DATA

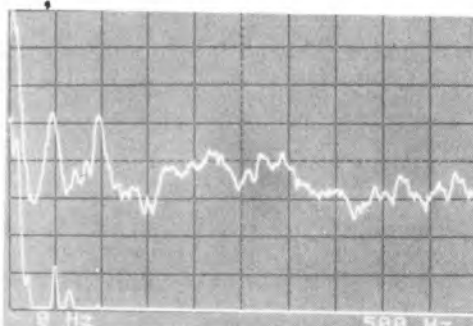
|  | Motor Unit                      |
|--|---------------------------------|
| Type .....   | belt drive                      |
| Platter mass/damping .....                           | 1.7 kg/very good                |
| Finish and engineering .....                         | very good/very good             |
| Type of mains lead/connecting leads .....            | 3 core/—                        |
| Speed options .....                                  | 33/45rpm (internally variable)  |
| Wow and flutter (DIN peak wtd sigma 2) .....         | 0.06%                           |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... | < 0.06%/0.07%                   |
| Absolute speed error .....                           | adjustable, +1%                 |
| Speed drift 1 hour/load variation .....              | +0.2%/-0.5%                     |
| Start up time to audible stabilisation .....         | 3secs                           |
| Rumble: DIN B wtd L/R av (see spectrum) .....        | 77/78dB                         |
| Size/clearance for lid rear .....                    | 45.5(w) x 38.5(d) x 15.2(h)/6cm |
| Ease of use .....                                    | good                            |
| Typical acoustic breakthrough and resonances .....   | excellent                       |
| Subjective sound quality of complete system .....    | very good+                      |
| Hum level/acoustic feedback .....                    | very good/excellent             |
| Vibration sensitivity/shock resistance .....         | excellent/good                  |
| Estimated typical purchase price .....               | £398                            |



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Rumble (0-500Hz lin): above, acoustic; below, vibration.

# RECOMMENDED

## Rega Planar 3

Rega Research Ltd, Swaines Industrial Estate, Ashington Road, Rochford, Essex  
Tel (0702) 333071



For several issues now, the Rega has been omitted at the maker's request on the grounds of a manufacturing shortfall in comparison with demand. However as Rega now dominate the lower priced audiophile end of the market in the UK, it was thought politic to purchase a deck and review it on our readers' behalf.

A simple design, it comprises a solid chip-board plinth covered in tough matt black laminate. Three fairly stiff stepped rubber feet provide a stable tripod foundation while the high quality lid is directly hinged to the chassis plinth with neither springs nor isolation. A plain main bearing with a thrust ball is used, and tolerances were close here, with no detectable play. Belt-driven via a rubber cord, the inner platter hub is a reinforced plastic moulding, the uppermost projection forming the tapered centre spindle and the outer platter boss. The platter is made of thick plate glass (reduced in thickness for the *Planar 21*), and surmounted by a thick felt mat. In a simple and ingenious gravity suspension, a second drive belt is looped to support the slow speed synchronous drive motor and suppress vibration coupling to the platter.

The arm is the traditional Rega unit made to their specification by Lustre in Japan, with improved bearings, a side entry cable fixing, and a stainless steel arm tube. Fitted with a universal detachable headshell, the arm has magnetically actuated bias compensation plus a rotating-scale calibrated counterweight, with some controlled decoupling from the arm tube. The lateral balance outrigger also has a damped stem. Effective mass is estimated at 16g, suited to lower compliance cartridges,

and in our (brand new) sample, some play was evident in the arm bearings.

Rega recommend that the deck should be placed on a light shelf, wall mounted, rather than a 'coffee table' or floor cabinet; this we found to be good advice.

### Lab report

The platter was clearly well founded as the minimal low frequency ringing on the disc impulse response shows. The initial transient was poorly damped, however, a characteristic of thick felt mats.

Almost no metal work was present in the unit and this meant very little humfield screening was provided. In fact, hum levels were poorer than average and the choice of cartridge will need some care. Weighted wow and flutter was satisfactory but linear wow was on the high side at 0.21%, this measured without the mat as the felt is of slightly variable thickness. Speed was fairly accurate, but slowed a significant 0.4% under load with some overshoot after recovery due to motor suspension tension rocking. Start-up was average for a belt drive at 4.5 seconds.

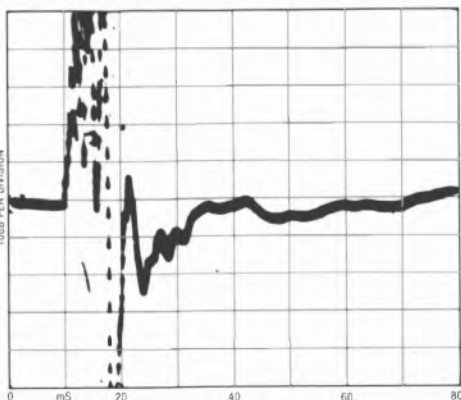
Rumble levels were just satisfactory for the price averaging -71dB DIN. Spectrum analysis showed a considerable content of mains-related vibrations such as 100 and 200Hz, with 'pole harmonic' components around 200-300Hz. The bearing alone measured better than -78dB with the motor off, however. Acoustic breakthrough was about average and the lid was found to be influential here, and results were better when was entirely removed. The plot is shown expanded by 10dB for lid up and down, the latter being preferred. Vibration isolation was also poorer than average.

The arm was well finished with very good geometry. It was easy to set up and use and demonstrated low bearing friction. Bias compensation was set to sensible levels and the cue worked well. Downforce calibration proved satisfactory. Charted for arm resonances, the design demonstrated surprisingly good control of the first headshell socket flexure at 230Hz; comparatively clean in the 300 to 3kHz range, the energy trend was rather broken up thereafter.

### Sound quality

Belying traditional assumed relationships between a number of technical parameters and sound quality, the Rega proves that a well-

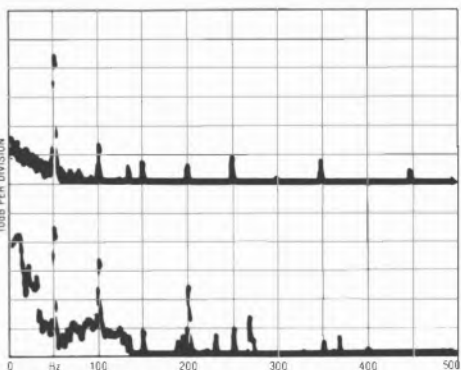
developed, subjectively-assessed balance of performance counts for more than technical excellence with regards to any one parameter. On the debit side the Rega did suffer from a modicum of programme wow, particularly on rock programme, but this was not considered serious at this price level; a mild loss of stereo depth was also noted, together with an accompanying impairment of low bass definition and evenness. Conversely it sounded 'musical' in a balanced and coherent manner. Upper bass definition was actually quite good, the midrange slightly 'warm' but well focused and the treble lively as well as transparent without the 'smear' and 'splash' evident with some cheaper turntables. Presentation of detail was considered well above average, little inferior to super-fi models in this respect.



Disc impulse transmission showing damping

## Conclusions

I have mild reservations concerning certain aspects of this model's lab performance but in truth the results are reasonable enough at the price, and I suspect that the cheaper *Planar 2* is equally good value. If you are very pitch-sensitive the Rega might pose problems — if not, the overall sound quality is such that it gains a warm recommendation. A good addition should confirm your decision either way.



Rumble, electrical (above) and total (below)

## GENERAL DATA

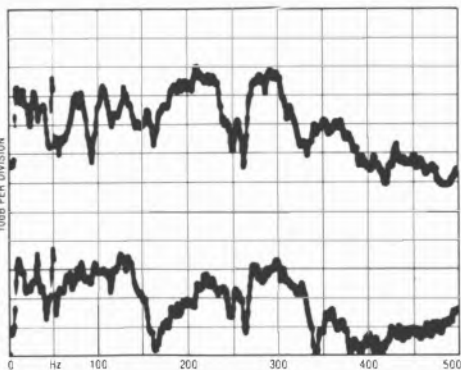
Integrated turntable

### Motor Section

Type ..... manual, belt-drive  
 Platter mass/damping ..... 2.2kg/good  
 Finish and engineering ..... very good/very good  
 Type of mains/connecting leads ..... 2-core/phonos and earth  
 Speed options ..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) ..... 0.09%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) \*0.21%/0.45%  
 Absolute speed error ..... + 0.4%  
 Speed drift, 1 hour/load variation ..... synchronous/ - 0.4%  
 Start-up time to audible stabilisation ..... 4.5 secs  
 Rumble, DIN B wtd L/R average (see spectrum) ..... - 72/ - 70dB

### Arm Section

Approximate effective mass, inc screws, excl cartridge ..... 16g  
 Type/mass of headshell ..... universal detachable/8.0g  
 Geometric accuracy ..... very good  
 Adjustments provided ..... overhang/lateral angle  
 Finish and engineering ..... excellent/very good  
 Ease of assembly/setting-up/use ..... very good/very good/very good  
 Friction, typical lateral/vertical ..... less than 25mg/15mg  
 Bias compensation method ..... internal magnet  
 Bias force, rim/centre (set to 1.5g elliptical) ..... 200mg/210mg  
 Downforce calibration error, 1g/2g ..... - 0.1g/ - 0.07g  
 Cue drift, 8mm ascent/descent ..... negligible 0.5secs/1.5secs  
 Arm resonances ..... average +  
 Subjective sound quality ..... average +  
 Lead capacitance/damping method ..... 70pF/counterweight decoupling



Breakthrough, lid up (above) and down (below)

## System as a whole

Size/clearance for lid rear ..... 45(w) x 36(d) x 12.3(h)/7cm  
 Ease of use ..... fairly good  
 Typical acoustic breakthrough and resonances ..... average  
 Subjective sound quality of complete system ..... good  
 Hum level/acoustic feedback ..... average - /fairly good  
 Vibration sensitivity/shock resistance ..... average - /good  
 Estimated typical purchase price ..... £148  
 \*worsened by unevenness in thick felt mat

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques

# Revox B795

FWO Bauch Ltd., Theobald Street, Borehamwood, Herts. WD6 4RZ.  
Tel 01-953 0091



## Features and design

This is the latest Revox turntable, and has almost supplanted their earlier more costly model, offering a very similar performance and only lacking the latter's digital speed readout and fine variable speed facility. A major objective in its design was to achieve a high resistance to shock, and this has been realised. Conversely, the rigidity and resonance characteristics, particularly in the important area of the cartridge support, have been ignored. In consequence the only 'ground' reference for the cartridge is a light 3g skeleton plastic framework. This vestigial arm is mounted within a parallel tracking gantry which is fool-proof in operation and swings over the record for 'play'. A microswitch detects any movement of the gantry, and instantly lifts the cartridge clear of the disc before any damage is done through clumsiness; as the gantry is swung to its rest position, the stylus is automatically cleaned by a brush attached to the deck plate.

A 'Revox' cartridge is fitted, designated *MDR20* and made by AKG. Drawn from the latter's new range, it is a moving magnet type possessing a medium compliance and fitted with an elliptical diamond stylus. Although part of the system, it may with skill be removed, and a variety of alternative cartridges can be fitted using an optional mounting kit. Care must however be taken when removing the stylus not only to avoid straining the arm assembly, but also to avoid the tiny stylus holder flipping over in the fingers and destroying the cantilever (the perils of hi-fi reviewing!).

All the parallel tracking mechanics including its motor are incorporated in the gantry, with the

necessary cables etc, passing through the hollow pivot. The power traverse is essential, and an illuminated view of the cartridge proved ample for accurate visual cueing. An excellent direct drive motor is fitted, offering two speeds to a quartz-locked reference. As the deck plate rests on damped coil-springs, it is isolated from the influence of both plinth and lid. The latter is specially angled, and does not require rear clearance when lifted.

## Lab results

The design of this model caused us some laboratory problems, and in particular our usual rumble measurement and spectrogram were impossible. An acetate lacquer whose threshold was around -73dB DIN was used instead of the coupler.

A quite substantial 2.5kg platter was fitted, though the disc damping was only fair due to a minimal contact hard rubber mat, with two concentric rings for support (like the Duals). X1 scaling was required for the impulse response, which showed little damping plus a large and extended initial ring. We understand that Revox are now fitting an improved mat with greater disc contact area, though we have not had the opportunity to evaluate this.

Using the lacquer, the quality of the rumble performance indicated an intrinsic figure of -77dB DIN B weighted or better, and the wow and flutter characteristics of the motor were exemplary, proving free of any overshoot. If they so wished, Revox could make studio machines with this motor. An effective mass of 3g was estimated for the tiny arm, the total figure including cartridge being a little over 7g, therefore

providing a stable high subsonic resonance. The arm worked well physically and offered good trackability.

A resonance graph was taken with the supplied cartridge, and it is thus not directly comparable with the others in the report. However it did not demonstrate a very clean performance, with sharp resonances as low as 110Hz as well as at 240 and 700Hz. Above 100Hz the unit's isolation was pretty good, but deteriorated at low frequencies; by 50Hz it was quite unexceptional for both transmission modes.

### Sound quality

Compared with the best in its price class, the Revox offered nearer mainstream than audiophile fidelity. The cartridge is not amongst our favourites, and lent a 'bitty' rather emphasised 'sharpness' to the upper treble. The sound was satisfactory overall but lacked stereo depth, while detail on subtle musical sections was also subdued. The bass spectrum was unexceptional, and in objective terms the unit did not really stand up to the acknowledged quality of other components in the Revox range.

### Conclusion

In a severe shock environment this player might appeal to a committed Revox owner, and although we were hopeful after a preliminary look at the B795 in the last issue, the high standards set by others this time round mitigate against it, particularly as a package with the supplied cartridge. With a carefully chosen alternative cartridge, the combination of features and sound quality may well be appealing.

### GENERAL DATA

Integrated Turntable

#### Motor Section

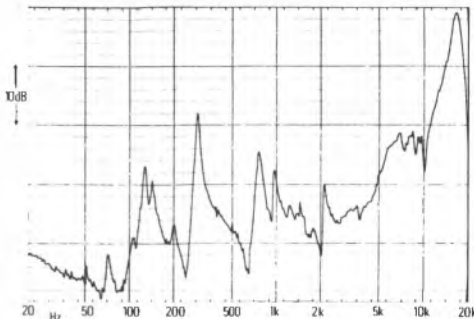
Type ..... quartz, direct drive, automatic, parallel tracking  
 Platter mass/damping ..... 2.5kg/fairly good  
 Finish and engineering ..... very good/good  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... 33/45rpm non variable  
 Wow and flutter (DIN peak w/d sigma 2) ..... <0.05%  
 Wow and flutter (LIN peak w/d 0.2-6Hz/6-300Hz) ..... <0.01%/<0.05%  
 Absolute speed error ..... <0.01%  
 Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
 Start up time to audible stabilisation ..... approx 1sec  
 Rumble: DIN B w/d L/R av (see spectrum) ..... -77dB

#### Arm Section

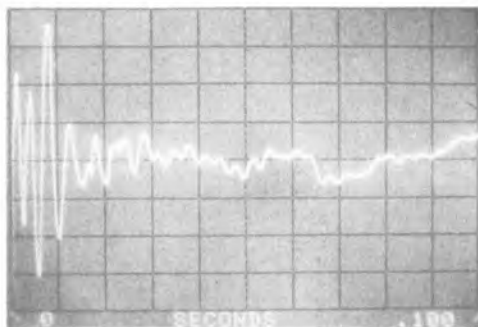
Approximate effective mass inc screws, excl cartridge ..... 3.0g  
 Type/mass of headshell ..... non detachable/N/A  
 Geometric accuracy ..... very good  
 Adjustments provided ..... no user adjustment  
 Finish and engineering ..... very good/fairly good  
 Ease of assembly/setting up/use ..... excellent/excellent  
 Friction: typical lateral/vertical ..... N/A / N/A  
 Bias compensation method ..... non required  
 Downforce calibration error: 1g/2g ..... preset/preset  
 Cue drift/8mm ascent/descent ..... negligible/0.5sec/1.5secs  
 Lead capacitance/damping method ..... N/A/none

#### System as a whole

Size/clearance for lid rear ..... 45.0(w) x 39.5(d) x 14.5(h)/0cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... above average  
 Subjective sound quality of complete system ..... fairly good  
 Hum level/acoustic feedback ..... very good/good  
 Vibration sensitivity/shock resistance ..... above average/very good  
 Estimated typical purchase price ..... £339



Arm resonances via PM20DR.



Disc impulse transmission, standard X1.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

# Revox B791

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



This turntable represents a development of the earlier *B795* previously covered in *HFC*; certain refinements have been added but basically the two reviews can be read in conjunction.

I was never quite happy with the choice of AKG/Revox cartridges that the company used to fit to their models, and noted that this new deck came with a Shure *M97* equivalent — an *HFC* Best Buy from an earlier 'Cartridges' issue. The *B791* sports an improved mat offering a flat disc contact and the digital readout of speed has returned, together with the push buttons for setting incremental variation in pitch.

The arm is a foolproof, servo-controlled assembly concealed beneath a cover, the whole forming a parallel tracking gantry which is swivelled over the record surface area once the disc has been placed on the platter. The arm is of very low mass, well suited to the high-compliance cartridge fitted, the latter carrying the Shure stabiliser which further aids sub-sonic resonance damping and improves shock immunity. Unfortunately by virtue of the fully powered but non-automatic arm operation, several measurement parameters were difficult to establish.

## Lab report

Internal inspection revealed the usual high Revox standard of engineering and construction. The platter with the new mat weighed 2.6kg and was a strong and accurately

machined alloy casting. Very little main bearing play was evident, though a minor low frequency rocking mode was detectable on the disc impulse response. Interestingly, the termination was not as favourable as might have been expected, since a delayed reflection of the leading impulse reappears about 30m sec later. In all respects wow and flutter was exemplary, and the powerful motor attained speed in 2.2 seconds with no overshoot or other undesirable characteristics. The rumble bridge could not be used for measurement, but checking with a test lacquer suggested that a better than 75dB result DIN B weighted was appropriate.

Acoustic breakthrough and vibration isolation results were good as while shock resistance was classed as very good, and a fine immunity to acoustic feedback was demonstrated. The arm appeared to perform well, judged by the fine tracking performance of the installed cartridge, but one weakness in conventional arm terms concerned the non-rigid nature of the arm pivots as well as the potentially resonant nature of its support; even more important were the group of counter balance springs — long coil types located near the cartridge. A resonance sweep taken with this arm on the earlier *B795* suggested that a fair number of serious resonances were present. For reference purposes a brief frequency sweep and separation curve was taken for the newer cartridge. From 30Hz to 5kHz the fre-



quency response met  $\pm 1$ dB limits, with a slight 1dB loss at higher frequencies. Separation was quite good at 30dB mid band and still measured 20dB, 10kHz; a smooth 'warm' sound quality was predicted from these results.

### Sound quality

As an ensemble the 791 is most definitely a 'rich' sounding turntable with some mid-range 'thickening' and 'dominance'. Bass reproduction was well above average with promising depth and articulation and while the stereo images were quite well focussed, the treble lacked some detail, and depth effects were moderate. Overall the sound felt a little 'compressed' in terms of perceived dynamic range but on the other hand pitch stability was extremely good.

### Conclusion

This latest Revox turntable gave a good account of itself and would not disgrace a complete Revox system. In comparative terms the value for money is only moderate, which bars recommendation — an audiophile would do better with a separate component turntable, and yet would lose the fine shock immunity, excellent motor drive and automated damage-proof tonearm/cartridge provided by this model.

#### GENERAL DATA Integrated turntable (inc. cartridge)

##### Motor Section

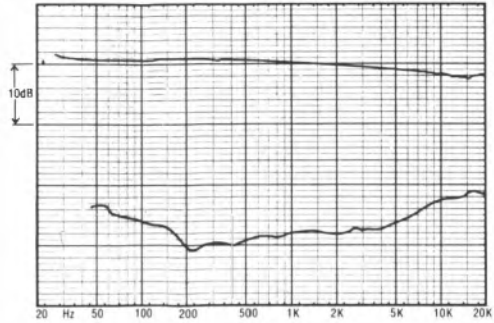
Type ..... powered arm, quartz direct-drive  
 Platter mass/damping ..... 2.6kg/average +  
 Finish and engineering ..... excellent/good  
 Type of mains/connecting leads ..... 2-core/phonos and earth  
 Speed options ..... variable, 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) ..... less than 0.05%  
 Wow and flutter (LIN peak wtd 6-300Hz) ..... less than 0.06%/0.05%  
 Absolute speed error ..... none  
 Speed drift, 1 hour/load variation ..... quartz-locked/none  
 Start-up time to audible stabilisation ..... 2.2 sec  
 Rumble, DIN B wtd L/R average (see spectrum) ..... better than -75dB

##### Arm Section

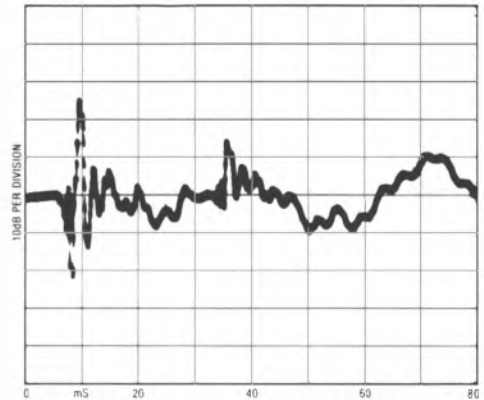
Approximate effective mass, inc screws, excl cartridge ..... 3.0g  
 Type/mass of headshell ..... integrated  
 Geometric accuracy ..... excellent  
 Adjustments provided ..... none  
 Finish and engineering ..... very good/very good  
 Ease of assembly/setting-up/use ..... excellent/excellent/excellent  
 Friction, typical lateral/vertical ..... —/—  
 Bias compensation method ..... not required  
 Bias force, rim/centre (set to 1.5g elliptical) ..... N/A  
 Downforce calibration error, 1g/2g ..... —  
 Cue drift, 8mm ascent/descent ..... none, 0.2 secs/1.2 secs  
 Arm resonances ..... —  
 Subjective sound quality ..... —  
 Lead capacitance/damping method ..... —/none

##### System as a whole

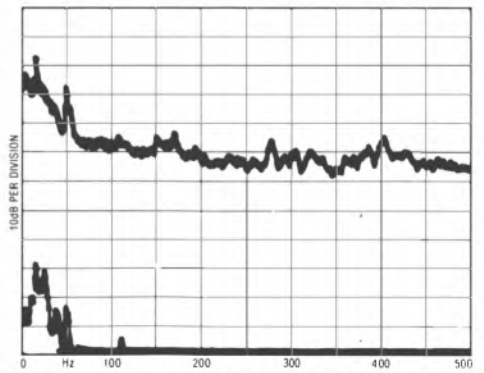
Size/clearance for lid rear ..... 45(w) x 40(d) x 14cm(h)/none  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... good  
 Subjective sound quality of complete system ..... good  
 Hum level/acoustic feedback ..... very good/good  
 Vibration sensitivity/shock resistance ..... good/very good  
 Estimated typical purchase price ..... £420  
 \*limited by test lacquer used for measurement



Frequency response and separation, cartridge



Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Sansui SR222 MkIV

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



The popular *SR222* model, long withdrawn, has been reintroduced in a revised *Mk IV* form at the bequest of the UK marketing division of Sansui. Visually the unit resembles its predecessor in several respects, though it has also been considerably updated, the improvements concerning the platter, now a much heavier casting; the mat, now a flat good contact type; a thicker less resonant lid, and finally a more solid plinth. The question to be answered is whether this will be sufficient to succeed in view of today's vastly more competitive turntable market.

A non-subchassis design, the platter is driven from a large four pole synchronous motor, using a flat rubber belt, and two speeds are available via two pulley diameters. In fact the speed change was not yet finalised on the review sample, and in the absence of an 'actuator', the belt was simply shifted by hand via an access hole in the platter.

While the arm now has a light new-style plastic headshell, the effective mass is actually greater than before.

## Lab report

Overall appearance and finish were very good for the price level. The platter was almost four times heavier than before at a substantial 2.5kg and while the initial disc impulse was well controlled, it was followed by a platter rocking mode at approximately 30Hz, which was less favourable.

Wow and flutter were both good, but the motor ran a significant -1.5% slow, though further slowing under load was minimal at 0.2%. Start up was extremely rapid at just under one second. DIN B weighted rumble just scraped inside the nominal 70dB hi-fi limit, analysis revealing motor vibration breakthrough at 25Hz, 100, 200 and 300Hz — just low enough to get a decent DIN-weighted reading.

Vibration isolation was about average, while acoustic breakthrough was considered poorer than average if fairly evenly distributed. Feedback margins were below average and shock immunity just satisfactory.

The arm just falls in the 'heavy' category, despite the light 5g headshell. Some bearing rattle was noticed though the arm was well fitted and geometric accuracy fine. In the lateral plane, friction was on the high side at 75mg but the vertical figure was very good. The spring type bias compensator gave values on the low side particularly at the rim, but in practice one can simply increase the setting by 30% or so. Downforce calibration was acceptably accurate and cueing well adjusted for rate and drift. Charted for arm resonances, a major break occurred at 200Hz, followed by a reasonably uniform energy characteristic at higher frequencies.

## Sound quality

Rated below average on audition the 222

sounded somewhat muddled. Stereo depth was just satisfactory but the treble showed some 'grainy' effects with mild slurring of sibilants and the bass had a degree of 'boominess' detracting from bass detail and definition. Overall, the tonal balance was fairly neutral.

### Conclusion

While the subjective report looks unpromising, it does not take account of the well below average price for this product. This, together with certain other plus points, makes it a possible recommendation. Worth considering. (Note: a later sample showed better bearing adjustment and mechanical rumble better than - 74dB)

### GENERAL DATA

Integrated turntable

#### Motor Section

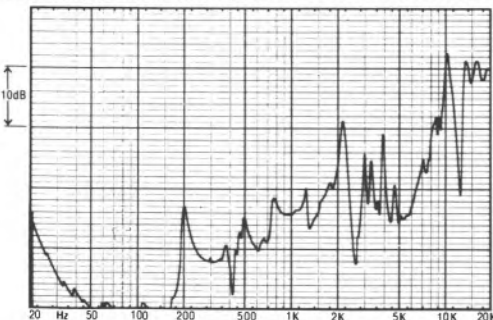
Type ..... manual, belt-drive, synchronous motor  
 Platter mass/damping ..... 2.5kg/fairly good  
 Finish and engineering ..... good + /good +  
 Type of mains/connecting leads ..... 2-core/phonos  
 Speed options ..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) ..... 0.06%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... 0.13%/0.05%  
 Absolute speed error ..... - 1.5%  
 Speed drift, 1 hour/load variation ..... synchronous/ - 0.2%  
 Start-up time to audible stabilisation ..... 0.85 secs  
 Rumble, DIN B wtd L/R average (see spectrum) ..... - 71dB

#### Arm Section

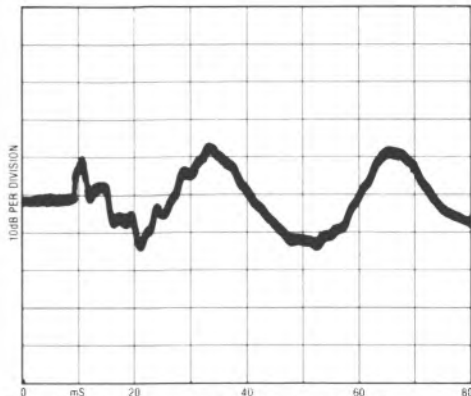
Approximate effective mass, inc screws, excl cartridge ..... 15g  
 Type/mass of headshell ..... special detachable/5g  
 Geometric accuracy ..... very good  
 Adjustments provided ..... offset angle, overhang  
 Finish and engineering ..... very good/good  
 Ease of assembly/setting-up/use ..... good/good/good  
 Friction, typical lateral/vertical ..... 75mg/10mg  
 Bias compensation method ..... spring  
 Bias force, rim/centre (set to 1.5g elliptical) ..... 125mg/175mg  
 Downforce calibration error, 1g/2g ..... - 0.05g/0.1g  
 Cue drift, 8mm ascent/descent ..... none, 0.7 secs/1.4 secs  
 Arm resonances ..... average -  
 Subjective sound quality ..... average -  
 Lead capacitance/damping method ..... 85pF/partial counterweight decoupling

#### System as a whole

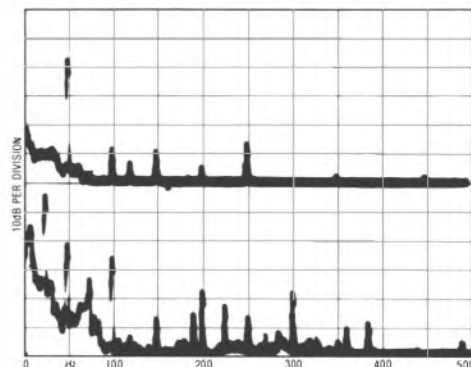
Size/clearance for lid rear ..... 49(w) x 40(d) x 13.5(h)/7cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... average -  
 Subjective sound quality of complete system ..... average -  
 Hum level/acoustic feedback ..... good/average  
 Vibration sensitivity/shock resistance ..... average/average  
 Estimated typical purchase price ..... £85



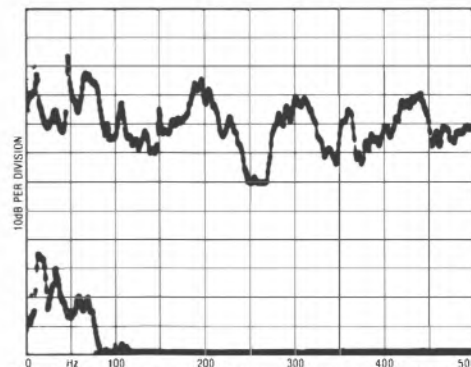
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Sansui XRQ7

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



Widely promoted at present, the XRQ7 comprises an imposing integrated design with a new motor called 'synchomotor.' Here a second rotor system within the motor balances and neutralises some of the vibrational components, the motor itself consisting of a quartz locked, two speed direct drive. This is a good looking product, with a medium-weight lid and a finely-veneered high-gloss plinth.

Sansui have permanently attached a hard-surfaced mat to the cast alloy platter, which actually weighs less than the one fitted to the '222. A solid plinth design, the XRQ7 appears to have little provision for vibration or acoustic isolation. Microprocessor-controlled, it sports an automated tonearm, the lead-in position programmed via the record speed/size selector. The arm has detachable 'wands' (two are supplied) and contrary to visual expectations in fact was found to be of high mass. Some arm pivot play was noted. In addition the platter could be rocked on its main bearing.

## Lab report

The platter with solid mat in combination weighed 2.1kg. Examining the disc impulse responses, the initial transient had been well trapped, but was followed by a low frequency platter rocking at about 30Hz. However wow and flutter, together or separately assessed, were excellent. The motor attained speed rapidly and once locked to the quartz reference showed high torque with no overshoot.

Despite the 'silent synchomotor' design, the rumble readings although undoubtedly good were nonetheless not as spectacular as might be expected, at -75dB. Narrow-band spectrum analysis revealed the existence of several spurious components in the motor drive, at 100, 200, 300 and 400Hz, these predominantly of mains frequency origin.

Acoustic breakthrough response was also disappointing; rather below average up to several hundred Hertz. Vibration rejection turned out to be no better, so in combination these two results inevitably led to a below average result for acoustic feedback in a live system. Shock resistance was also below average, partly due to the high mass arm.

Estimated via resonance measurement, the arm mass worked out at a surprising 21g, and only suited to low compliance cartridges. Quite well engineered, it was also excellently finished, and the geometry was considered very good, with adjustment provided for tilt, overhang, offset angle and height. Friction was very low but the bias compensation showed poor linearity, the rim value far too low at the 1.5g setting. Downforce calibration was fine and the cue was satisfactory. Arm lead capacitance was very low but the arm resonance behaviour was rather poorer than average, with serious breaks evident at 200Hz, 550Hz, 900Hz and 3kHz.

## Sound quality

Noticeably bright with a 'splasy' treble, the sound, while lively enough, lacked real depth in terms of the stereo image. Low bass was attenuated, while the upper bass was lumpy and poorly differentiated. It sounded rather 'loud' and 'forward' with a significant defocusing of central images especially in the midrange but pitch and timing were however rather good.

## Conclusion

This turntable has little to offer at this price level as regards sound quality. The arm is both heavy and of mediocre subjective performance, while the motor system is poorly isolated from the environment: in our view serious consideration is just not possible here.

## GENERAL DATA

Integrated turntable

### Motor Section

Type . . . . . fully-auto, quartz direct-drive  
 Platter mass/damping . . . . . 2.15kg/average  
 Finish and engineering . . . . . very good/good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . less than 0.04%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . 0.05%/0.04%  
 Absolute speed error . . . . . none  
 Speed drift, 1 hour/load variation . . . . . none  
 Start-up time to audible stabilisation . . . . . 1.8 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . - 75dB

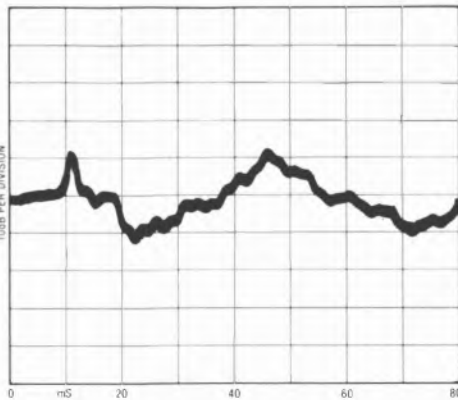
### Arm Section

Approximate effective mass, inc screws, excl cartridge . . . . . 21g  
 Type/mass of headshell . . . . . special detachable carrier  
 Geometric accuracy . . . . . very good  
 Adjustments provided . . . . . tilt/overhang/offset/height  
 Finish and engineering . . . . . excellent/very good  
 Ease of assembly/setting-up/use . . . . . very good/very good/very good

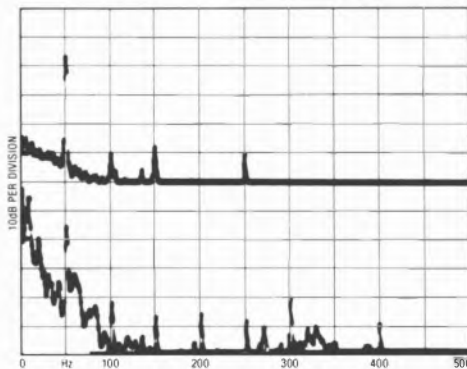
Friction, typical lateral/vertical . . . . . 10mg/5mg  
 Bias compensation method . . . . . internal spring  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . 70mg/170mg  
 Downforce calibration error, 1g/2g . . . . . none/- 0.05g  
 Cue drift, 8mm ascent/descent . . . . . 1.7 secs/1.3 secs  
 Arm resonances . . . . . below average  
 Subjective sound quality . . . . . below average  
 Lead capacitance/damping method . . . . . 75pF/counterweight decoupling

### System as a whole

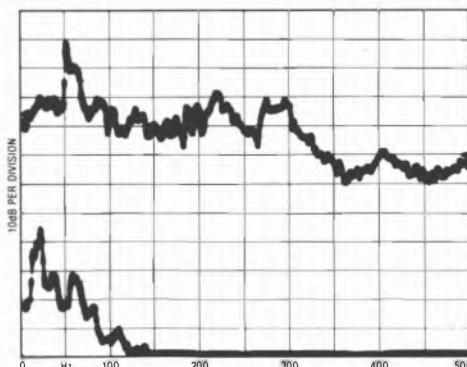
Size/clearance for lid rear . . . . . 49(w) x 42(d) x 18(h)/7cm  
 Ease of use . . . . . very good  
 Typical acoustic breakthrough and resonances . . . . . below average  
 Subjective sound quality of complete system . . . . . below average  
 Hum level/acoustic feedback . . . . . very good/average -  
 Vibration sensitivity/shock resistance . . . . . average - /average -  
 Estimated typical purchase price . . . . . £270



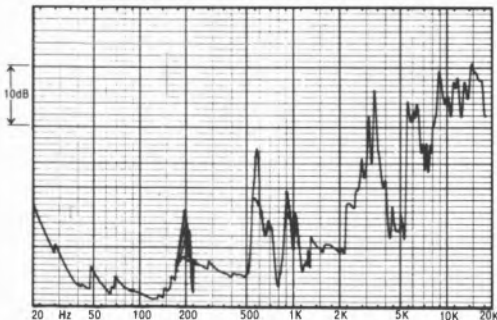
Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# SME 3009 Series III(SB)

SME Ltd., Steyning, Sussex BN4 3GY.  
Tel (0903) 814321



## Features and design

This review covers the two models in the SME *Series III* range, with the cheaper *S* sharing many of the fundamental components of its more expensive brother, including a virtually indistinguishable performance. In addition to all the basic adjustments, the top price version has a rack and pinion adjustment for geometric overhang, and fine screw adjustment for both bias and downforce; the silicone fluid damper assembly, an optional extra on the *S*, is fitted as standard.

The main parts are constructed of carbon fibre reinforced mouldings, the arm using the traditional SME bearing combination of a horizontal plane ball race and knife edges in the vertical plane; the vertical bearing axis runs through the stylus tip to maximise downforce stability and reduce warp wow.

Although a friction-fit interchangeable arm carrier has been incorporated, the design objective was undoubtedly that of low mass. Viscous damping has been included (*S* optional) to help control the high Q subsonic resonances of certain moving magnet cartridges which possess excessive compliances. A low 5.0g effective mass has been achieved by using a damped thin wall nitride-surface-hardened titanium arm tube, with a vestigial reinforced plastic cartridge platform/shell. Unfortunately this headshell is so small that some of the longer bodied cartridges produce a very tight fit; in addition, very little support is provided ahead of the fixing screws. These are made of plastic to reduce mass, but consequently cannot be done up tightly - the reverse of the thinking behind the Mission, Syrinx, and Linn etc designs, which

stress tight cartridge fixing. SME do however provide some bituminous mastic to help couple the cartridge to the headshell.

Improvements have been made to the cartridge wiring tags, which were previously rather too stiff and easily broken off the wires during fitting. An increased mass option has recently been made available to give better matching with lower compliance cartridges, comprising accessory mass loading plates for the headshell which can be added as required: two are in fact supplied, weighing 4.4 and 2.2g. The augmented effective mass including steel fixing screws works out at 12g, and the combination is suitable for cartridges down to 8cu. At the other extreme, and in conjunction with mild damping (we believe that SME's damping recommendations are excessive), models up to 60cu can be accommodated without the ballast weights.

## Lab results

Demonstrating excellent geometric accuracy, a full range of adjustments was provided, including tilt, which is awkwardly set by a friction lock on the headshell and requires much trial and error. Bearing friction was excellently low, and on our sample measured below 10mg in both planes. As in previous issues we found the bias settings were excessive by about 50%, but this can easily be compensated, while downforce also tended to be several percent on the low side. The cue descent was too slow at 4 seconds for a 8mm drop: one second is ample and minimises record damage when cueing on music tracks.

We found that when damping was applied as recommended, stereo image stability suffered

due to excess forces being applied to the stylus on mid low frequency record warps in the 0.5 to 4Hz range; minimum damping thinned by 30% of diluent stabilised the most severe resonance combinations successfully. In fact many cartridges worked well without damping.

The resonance characteristics in the audio range were fairly well damped but very complex, with a flexure associated with the counterweight at 88 Hz, a shell/tube mode at 220 Hz, and further effects at higher frequencies. On this sample some 'noise' was present on the graph, suggesting play in the assembly, which is suspected to be in the counterweight mechanics. A second graph taken with 6g of ballast showed an even more complex result, superficially demonstrating more resonance damping, in energy terms the trend is in fact less favourable, with a 15dB discontinuity.

### Sound quality

This arm was characterised by a 'soft' balance, with a subjectively subdued treble. Coloration was comparatively low and the overall sound pleasantly relaxed. Stereo imaging was to a good standard and the bass register reasonably detailed and extended. Low compliance moving-coils gave quite good results with the ballast, although some loss of transient precision and focus was evident when compared with the top class higher mass competition. The arm was at its best when used with more compliant cartridges that made less demands in terms of rigidity.

### Conclusion

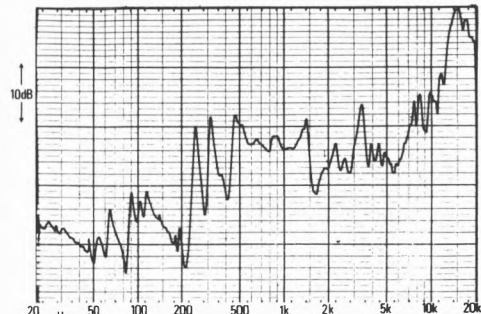
Despite the higher effective mass option, this finely made and exceedingly versatile arm is not really suited to top moving-coil cartridges possessing lowish compliances. However, it remains one of the best low mass tonearms at its price, and may be aligned to a high state of precision; the optional capacitance loading is a further advantage, though the lead-out cables are still rather stiff for subchassis turntables, but can easily be changed.

### SME 3009 IIISB

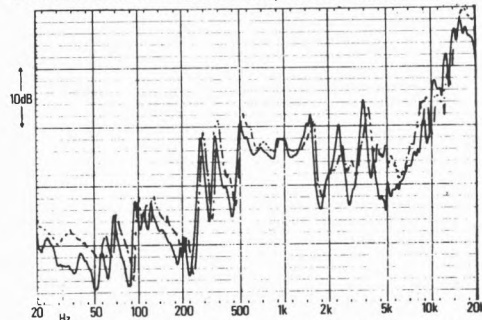
The IIISB is a new addition to the existing SME Series III arms, also reviewed in this book. SME have increased their versatility and geometric performance by the simple expedient of adding some accessories to a new version of the carrier arm CA1. These include the established mastic mounting compound, to be placed between cartridge back and arm; a properly-fitting type '3818' ballast weight which approximately doubles the effective mass to 10g inclusive of screws, plus a return to aluminium mounting hardware. Carbon fibre reinforced nylon screws are also provided as standard, the final accessory being a revised

### GENERAL DATA

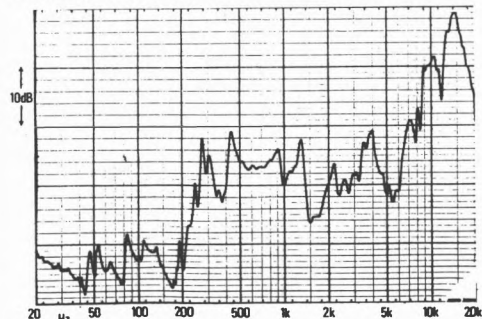
|   |  |         |
|---|--|---------|
| Approximate effective mass inc screws, excl cartridge | ..... 5.0g   | Tonearm |
| Type/mass of headshell                                | ..... plug in arm tube/N/A                               |         |
| Geometric accuracy                                    | ..... excellent  |         |
| Adjustments provided                                  | ..... overhang, tilt, arm height                         |         |
| Finish and engineering                                | ..... excellent/very good                                |         |
| Ease of assembly/setting up/use                       | ..... good/good/very good                                |         |
| Friction: typical lateral/vertical                    | ..... less than 10mg/less than 10mg                      |         |
| Bias compensation method                              | ..... suspended weight (pulley)                          |         |
| Bias force: rim/centre (set to 1.5g elliptical)       | ..... 275mg/275mg  |         |
| Downforce calibration error: 1g/2g                    | ..... -0.12g/-0.18g                                      |         |
| Cue drift/8mm ascent/descent                          | ..... negligible/0.6sec/4.0secs                          |         |
| Arm resonances  | ..... good   |         |
| Subjective sound quality                              | ..... good +   |         |
| Lead capacitance/damping method                       | ..... optional to 300pF/variable fluid damping (not 'S') |         |
| Estimated typical purchase price                      | ..... £120 (£90 'S')                                     |         |



Structural arm resonances, audio band



Arm resonances: solid, cartridge tight; dotted, cartridge loose.

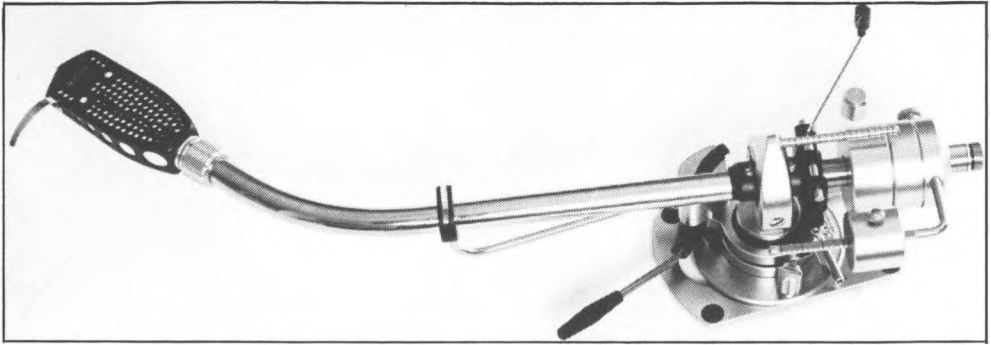


Arm resonances with headshell mass loading.

continued on page 167

# SME 3009R

SME Ltd, Steyning, Sussex BN4 3GY  
Tel (0903) 814321



With demand continuing for the earlier *3009 II Improved* arm series, SME have released a further version of the *3009* with a detachable headshell, this aimed at the lower compliance moving-coil cartridge users. Readers may recall that the original 'improvement' to the *3009*, undertaken about a decade ago concerned a mass reduction to achieve compatibility with the high compliance cartridges then in vogue. These developments finally culminated in the release of their low mass *Series III*.

Retracing their steps, SME have given the 'R' a reinforced headshell design of thicker aluminium, further revised to provide a better seating for the cartridge; it is now also fitted with a double locking pin to increase the rigidity of fixing to the arm tube. Currently, the latter is made from stainless steel rather than the original aluminium, and the first series *3009* counterweight assembly has been reintroduced, with a firmer mounting between weights and rear section, plus locking arrangements for the main and slider components. These changes have resulted in a

doubling of price to the £190 level.

Inclusive of hardware, the estimated effective mass is 12g, suited to low-to-medium compliance cartridges in the 8-16cu range. Adjustments include vertical tilt (the slip action fixing here is none too tight) plus height and overhang, the latter via the famous SME base slider incorporated in the pillar.

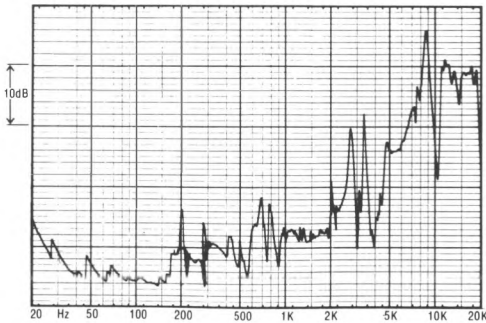
## Lab report

The arm was excellently finished and built — comparable with the best in the world in this respect. The instructions were exemplary.

Arm geometry was judged to be excellent and is now optimised for 30cm LP records with a sensible two-point protractor to aid alignment. Friction was satisfactorily small while bias compensation values were close to that required if marginally low. Downforce was also precise, but cue descent slow, at 6.5 seconds.

Arm lead capacitance was high at 285 pF, this deliberately to match certain moving-magnet cartridges. A small ceramic capacitor lurks within the superb gold plated shells of the phono plugs on each cable, and snipping the leads and excising this possibly doubtful component provides a cable capacitance reduction to 75pF. A characteristic of SME cables is their relatively high stiffness which can cause difficulties when installing in sub-chassis turntables with compliant suspension; 'loop' lead dressing is often required to extract a good performance from the assembly.

Charted for resonances, the result was classed as above average, essentially on grounds of a uniform energy trend. Breaks were well damped (partly due to the rather non-rigid construction), and the headshell modes at 100 and 300Hz were well disguised and broken up as were the beam modes at



Structural arm resonances, audio band



600-900HZ. Ringing was evident at around 3kHz, with another severe effect at 9kHz.

### Sound quality

Addedition in a Lux PD300, sound quality was rated as lying in the 'average' group. The tonal balance was fairly open, but the sound lacked precision and stereo focus was felt to be impaired throughout the frequency range. Stereo depth was compressed and the bass register, while fairly even, was found to be lacking in 'slam' and 'attack'. Some upper-mid hardness was also observed, particularly with moving-coil cartridges.

### Conclusions

I regret to have to conclude this review without any recommendation for the 3009R. I am certain that SME have the necessary engineering

skill to produce a front-rank medium-size tonearm at a realistic price, but personally I feel that revamping a long-discontinued product has not provided a viable answer in this case.

### GENERAL DATA

|  |                                     |         |
|--|-------------------------------------|---------|
| Approximate effective mass, inc screws, excl cartridge | 12.0g                               | Tonearm |
| Type/mass of headshell                                 | detachable (two locating pins)/3.5g |         |
| Geometric accuracy                                     | very good                           |         |
| Adjustments provided                                   | tilt/overhang/height                |         |
| Finish and engineering                                 | excellent/very good                 |         |
| Ease of assembly/setting-up/use                        | good/very good/very good            |         |
| Friction, typical lateral/vertical                     | 30mg/less than 5mg                  |         |
| Bias compensation method                               | thread and weight                   |         |
| Bias force, rim/centre (set to 1.5g elliptical)        | 150mg/150mg                         |         |
| Downforce calibration error, 1g/2g                     | none/none                           |         |
| Cue drift, 8mm ascent/descent                          | none, 0.8 secs/1.6 secs             |         |
| Arm resonances   | average +                           |         |
| Subjective sound quality                               | average                             |         |
| Lead capacitance/damping method                        | 35pF/counterweight decoupling       |         |
| Estimated typical purchase price                       | £190                                |         |

### SME 3009 III SB *continued*

two point alignment protractor to go with the new geometry, the latter a small revision to offset angle. This is necessary since the SME carrier has single hole fixings, and only overhang can be adjusted, this via the pillar base slide. The headshell has been slightly enlarged and strengthened to give more space for the deeper cartridges and a broader base for mounting. Our sample came in a handsome all-black finish.

### Lab report

For comparative purposes, the arm was re-tested with the ballast weight, this condition suitable for low to medium compliance cartridges, particularly moving coil types. On most mechanical and measured parameters the performance was very good. Bias compensation appears to have been reduced to more realistic levels compared with previous samples, but the cue descent rate remains a trifle slow.

The complexity of the arm resonance plot reflects the pivot design and the large number of attached mechanical components. The trend was considered favourable with reasonable control of breakup modes, though some of these were rather low in frequency, for example 90Hz and 200Hz (ballast version).

### Sound quality

Placed in the 'good' category, the latest Series III was felt to offer an improved performance with moving coil cartridges as the bass felt more extended, with better detail and articulation. The heaviest possible counterweight helps matters here. The mid had the usual, slightly bland, 'rich' characteristic of the III, and the treble did not sound as clear or well localised as some more recent tonearms, although admittedly the latter are usually much

more expensive. A mild loss of stereo depth and immediacy was also observed.

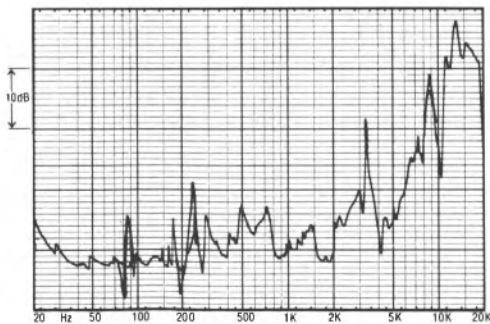
### Conclusion

On grounds of its respectable sound quality and high versatility with excellent finish and construction, not to mention the fine written instructions, the III continues to qualify for recommendation in its latest SB form.

### GENERAL DATA

|  |                         |         |
|--|-------------------------|---------|
| Approximate effective mass, inc screws, excl cartridge | 5 (* 10)g               | Tonearm |
| Type/mass of headshell                                 | detachable carrier      |         |
| Geometric accuracy                                     | excellent               |         |
| Adjustments provided                                   | tilt/overhang/height    |         |
| Finish and engineering                                 | excellent/very good     |         |
| Ease of assembly/setting-up/use                        | good/good/good          |         |
| Friction, typical lateral/vertical                     | 5mg/less than 5mg       |         |
| Bias compensation method                               | thread and weight       |         |
| Bias force, rim/centre (set to 1.5g elliptical)        | 150mg/150mg             |         |
| Downforce calibration error, 1g/2g                     | - 0.05g/none            |         |
| Cue drift, 8mm ascent/descent                          | none, 0.9 secs/3.9 secs |         |
| Arm resonances   | good                    |         |
| Subjective sound quality                               | good                    |         |
| Lead capacitance/damping method                        | 280 (* 75)pF/none       |         |
| Estimated typical purchase price                       | £90                     |         |

\*See text



Structural arm resonances, audio band

# Sony PSX600

Sony (UK) Ltd, Staines House, 158-162 High Street, Staines, Middlesex  
Tel Staines 61600



## Features and design

The only new model available in time for this issue, the *PSX600* can be regarded as a downmarket version of the unusually elaborate and costly *PSB80*, which we examined in the last edition. This was the first model to incorporate the much publicised 'Biotracer' electronically controlled tonearm, and the new '600' incorporates a version of this arm design, though in this case the player costs less than £200.

Sony have demonstrated occasional intermittent strength in turntable design, and the new *PSX600* has quite a lot going for it. The *Biotracer* facilitates automatic operation, including record size detection via a fixed optical turret, and power traverse is provided and controlled by DC force motors built into the arm and under servo-control. These also apply downforce and biasing, and a measure of electronic damping of the arm/cartridge subsonic resonance is automatically provided.

A substantial plinth is fitted with viscous core vibration-absorbing feet, though the lid is a shade resonant, and as usual is joined directly to the plinth, which is no help so far as acoustic isolation is concerned. A Sony quartz-locked direct drive motor is fitted, possessing sufficient torque for instant start cueing; speeds are fixed at 33 and 45rpm.

The 1.6kg platter is equipped with a sensibly flat rubber mat, and by employing a special Sony detachable headshell of reduced weight, a total effective mass of 11g has been achieved. This is nominally suitable for medium compliance

cartridges of 12–25cu, but the inbuilt damping permits a more extended 10–35cu range.

As measured, however, the damping level was high, which resulted in a visible and hence significant stylus deflection of medium compliance cartridges when tracking a 'swinger' or similar warp. Theoretically this could impair the stereo image stability, due to the exaggerated low frequency modulation of the mean cartridge generator geometry (the absence of damping for a serious arm/cartridge resonance naturally results in a similar modulation). As with all engineering problems in audio, the answer lies in an optimum balance rather than an extreme solution to a particular problem.

## Lab results

While Sony claim –78dB DIN rumble, our measurement could not better –74dB. We did not suspect that the excellent motor was at fault, but rather that noise generated in the arm servo electronics was responsible, as a similar effect had been recorded earlier with the *PSB80*. Nonetheless the rumble spectrogram illustrated was more than satisfactory, and turned out to be that of the arm alone, surprisingly the graph taken with the platter rotating was no different! State of the art speed accuracy was demonstrated, with excellent wow and flutter results and a rapid 0.8 second start up; no dynamic wow effects were present.

The arm was generally well engineered and showed good alignment, but bearing play was nonetheless present. It was difficult to measure because of the inbuilt electronics, but bearing friction was low, the bias compensator quite accurate, and the downforce calibration particularly so.

When running the audio response curve, the subsonic resonance of our test cartridge showed a well-controlled response, the peak reduced to +4.5dB, 12.5Hz (from +9.5dB, 11Hz undamped). A reduction to +6dB would have been sufficient, but the supplied degree of damping did endow the turntable with exceptional impact shock resistance. Possessing a fairly even trend, the resonance curve above 20Hz was dissected by flexural modes from a low 120Hz upwards. X10 scaling was just possible for the disc impulse, showing good mid and treble damping, but also platter rocking at 30Hz. Acoustic breakthrough was also quite good and the vibration resistance better than expected.

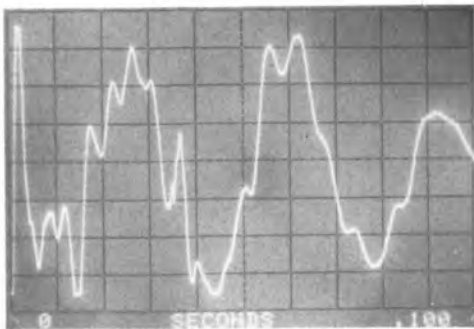
## Sound quality

The sound quality was appropriate for the type and price, demonstrating good low frequency

feedback immunity, though the bass was 'light' in character with 'softened' definition. In tonal balance the treble range was 'dulled', and some loss of image depth was also noted in the midrange, but overall the stereo performance was quite respectable.

### Conclusion

Easily bettered in sound quality by a manually operated 'audiophile' unit, the *PSX600* nonetheless has certain features which on balance qualify it for a reserved recommendation. It is a fairly neutral sounding, well made product with exceptional shock resistance, which could prove important to some purchasers. In addition it 'handles' well, with excellent automatics giving quiet and smooth operation.



Disc impulse transmission, magnified X10.

### GENERAL DATA

Integrated Turntable

#### Motor Section

Type ..... quartz, direct drive, fully automatic  
 Platter mass/damping ..... 1.6kg/good  
 Finish and engineering ..... very good/very good  
 Type of mains lead/connecting leads ... 2 core/phonos + earth  
 Speed options ..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... <0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) <0.1%/<0.06%  
 Absolute speed error ..... <0.01%  
 Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
 Start up time to audible stabilisation ..... approx 0.8sec  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -73/74dB

#### Arm Section

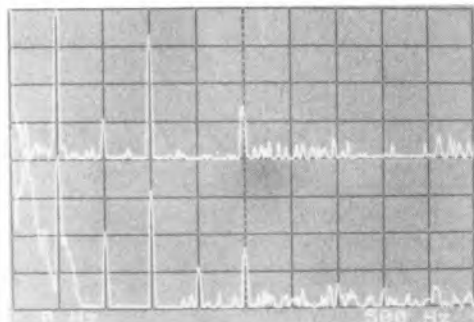
Approximate effective mass incl screws, excl cartridge ..... 11g  
 Type/mass of headshell incl screws ..... special detachable/6g  
 Geometric accuracy ..... very good (see text)  
 Adjustments provided ..... overhang, lateral angle  
 Finish and engineering ..... very good/good  
 Ease of assembly/setting up/use ..... very good/very good/very good  
 Friction: typical lateral/vertical ..... less than 20mg/less than 20mg  
 Bias compensation method ..... electronic  
 Bias force: rim/centre (set to 1.5g elliptical) ..... 160mg/190mg  
 Downforce calibration error: 1g/2g ..... +0.04g/±0.00g  
 Cue drift/8mm ascent/descent ..... negligible/0.5sec/0.5sec  
 Arm resonances ..... fairly good  
 Subjective sound quality ..... above average  
 Lead capacitance/damping method ..... 100pF/electronic servo damping

#### System as a whole

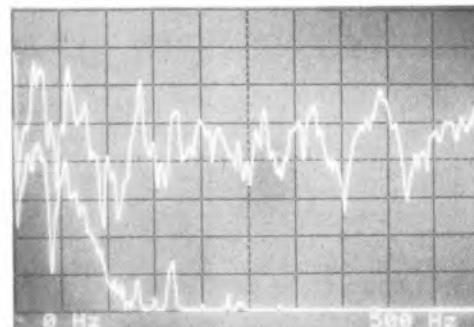
Size/clearance for lid rear ..... 43 0(w) x 37 5(d) x 12 5(h)/4 5cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... good  
 Subjective sound quality of complete system ..... above average  
 Hum level/acoustic feedback ..... good/good  
 Vibration sensitivity/shock resistance

fairly good/exceptionally good

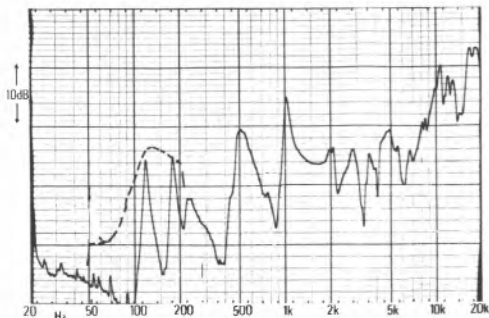
Estimated typical purchase price ..... £180



'Rumble' (0-500Hz lin): above electrical alone; below, electrical plus arm (see text).



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Arm resonances and damping.

# Sony PSX800

Sony (UK) Ltd, Staines House, 158-162 High Street, Staines, Middlesex  
Tel Staines 61600



Another model in the Sony 'Biotracer' series, the 800 is distinguished by its use of a linear or parallel tracking arm as opposed to the normal radial types. Possessing a full 'Biotracer' configuration, the short arm is traversed by a linear motor on a damped roller carriage. Downforce is applied by another linear motor, the arm having been previously automatically calibrated to zero balance. Under full microprocessor and servo control, the arm motion is touch-button operated for power cueing and traverse, being electronically damped at low frequencies.

The platter is equipped with sensor holes and in conjunction with a built-in lamp these provide detection of record size, and hence appropriate speeds and cue starts. A quartz-locked direct-drive, the motor is Sony's own brushless slotless type, claimed to produce smooth pulse-free power plus a rapid start.

All controls are placed on the exposed front edge of the plinth and are accessible when the small lid is closed.

## Lab report

Both finish and engineering were excellent. Weighing 1.7kg, the modest platter attained full speed in a rapid 1.5 seconds and the sensible mat afforded good disc impulse damping, as the photo confirms. All the speed characteristics were at the threshold of measurement, and to an excellent standard. Motor dynamics were exemplary with zero

overshoot and high torque. The rumble measurement was good but marginally failed to meet spec; spectral analysis, particularly clear when the electrical components were subtracted, showed components at 200, 300 and 400Hz, these believed to be generated in the arm and not the motor itself. However the levels concerned were largely insignificant.

The small lid and the massive dense construction helped to produce a good result for acoustic isolation and the vibration resistance was not so bad either considering this is not a sub-chassis design.

In the medium mass category at 12g, the arm was more versatile than one might expect due to the electronic damping. Geometric accuracy was understandably excellent and it was also very easy to set up and use. However the electronic downforce was found to err on the plus side by a constant 0.3g. Cueing was fine.

Charted for resonances, the arm was characterised by a severe mode at 350Hz with an erratic energy trend thereafter — definitely below average here.

## Sound quality

The unit fared well as regards shock and feedback immunity and scored average for subjective quality. Wow was conspicuously absent, with very stable tempo and pitch on demanding programme. Bass was above average, with fair attack and and a relatively even

rendition. However the midrange could sound colored with defocused central images, while the treble was somewhat splashy and ragged. Stereo depth effects were also less obvious with this model.

### Conclusion

In some respects the *PSX800* was quite a good turntable, with the present arm probably its weakest link. In truth however the performance was little better than that of the less costly *PSX600*, and at a price approaching £400, the '800's subjective standard just does not warrant recommendation here.

### GENERAL DATA

Integrated turntable

#### Motor Section

Type . . . . . fully-auto, quartz direct-drive, Linear 'Biotracer'  
 Platter mass/damping . . . . . 1.7kg/good  
 Finish and engineering . . . . . excellent/very good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . less than 0.04%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . less than 0.05%/0.05%

Absolute speed error . . . . . none  
 Speed drift, 1 hour/load variation . . . . . none  
 Start-up time to audible stabilisation . . . . . 1.5 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . -76dB

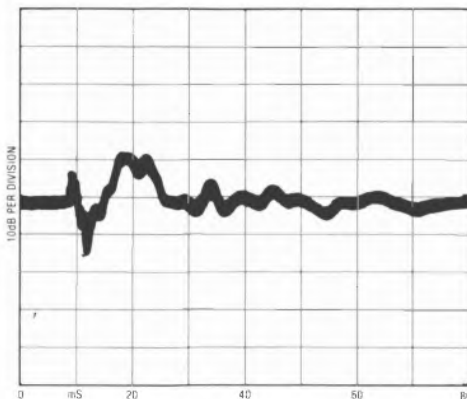
#### Arm Section

Approximate effective mass, inc screws, excl cartridge . . 12.6g  
 Type/mass of headshell . . . . . detachable/8.0g  
 Geometric accuracy . . . . . excellent  
 Adjustments provided . . . . . overhang  
 Finish and engineering . . . . . very good/good  
 Ease of assembly/setting-up/use . . . . . very good/very good/excellent

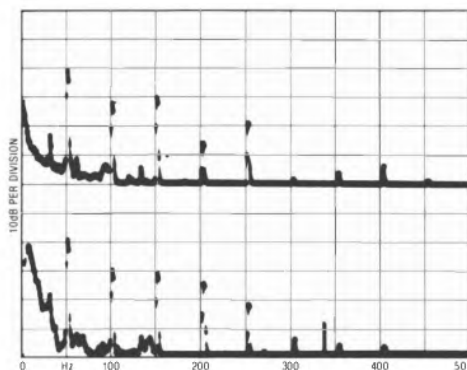
Friction, typical lateral/vertical . . . . . /—  
 Bias compensation method . . . . . N/A  
 Bias force, rim/centre (set to 1.5g elliptical) . . . . . N/A  
 Downforce calibration error, 1g/2g . . . . . + 0.3g/ + 0.3g  
 Cue drift, 8mm ascent/descent . . . . . none, 1.2 secs/1.5 secs  
 Arm resonances . . . . . below average  
 Subjective sound quality . . . . . average  
 Lead capacitance/damping method . . . . . /electronic

#### System as a whole

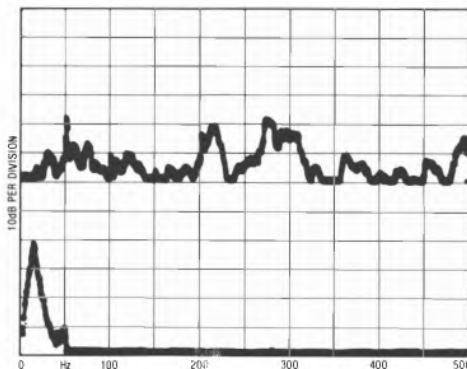
Size/clearance for lid rear . . . . . 43(w) x 44(d) x 12cm(h)/none  
 Ease of use . . . . . excellent  
 Typical acoustic breakthrough and resonances . . . . . good +  
 Subjective sound quality of complete system . . . . . average  
 Hum level/acoustic feedback . . . . . good/good  
 Vibration sensitivity/shock resistance . . . . . above average/good  
 Estimated typical purchase price . . . . . £375



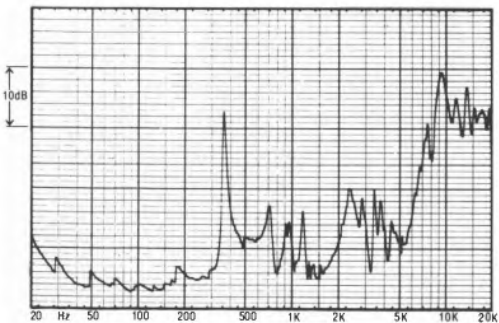
Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)



Frequency response and separation, cartridge

Charts above characterise general turntable behaviour. See text for commentary on these results, see *Technical Introduction* for explanation of test techniques

# STD 305S(M)

Strathclyde Transcription Developments, Midton Road, Howwood, Renfrewshire PA9 1AQ.  
Tel (05057) 5151



## Features and design

The 305M was the first and more costly version of this motor unit to be released some years ago now, comprising a two-speed belt drive with a four-spring subchassis. It exhibited a high standard of plinth construction and finish commensurate with its price range, but STD also found it possible to produce a less expensive version by economising on externals yet retaining the essential mechanics. This is designated the 305S, and uses a heavy, moulded black plinth.

Rather light in construction, the subchassis is heavily damped by bituminous cladding. Levelling and adjustment requires the removal of the bottom cover as well as the setting of the four spring tensions to produce a clean, 'free' movement. The lid is of heavy gauge and non-resonant plastic, mounted on friction hinges.

## Lab results

Weighing 2.0kg, the flat alloy platter is fitted with a felt mat that provides reasonable disc support. Two disc impulse responses were tried and are presented for comparative purposes, one with the mat as supplied and the other with the *Audio Ref* mat substituted; note that the latter did not affect the low frequencies, the disturbance here being due to platter rocking. At 0.07%, combined wow and flutter was very good, as were the rumble results although the spectrum analysis did reveal some spurious components around -80dB. Speed error and torque were both good, and both acoustic and vibration isolation were fine; in this instance the acoustic results were taken with the lid shut, using an *Audio Ref* mat.

## Sound quality

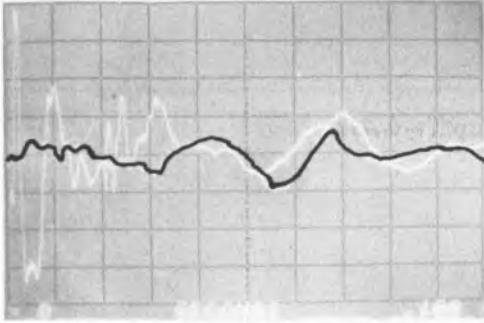
In its price class the S was undoubtedly capable of a high sound quality. The benefits of negligible motor imperfections, good resistance to feedback, and the isolated nature of the disc platform were reflected in the precision of the stereo staging, good detail and depth rendition, an extended and fairly even bass, and a general lack of 'muddle' which is an unfortunate feature of the majority of plinth plus feet turntables.

## Conclusion

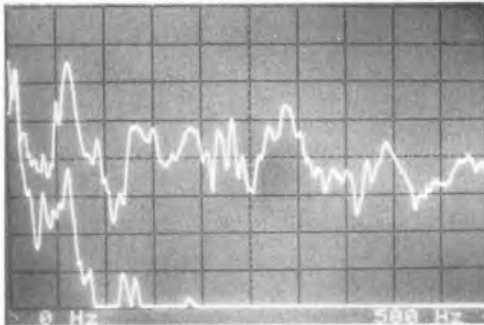
While the M remains worth considering, the S can be confidently recommended as providing good value for money. The shock resistance achieved by some foam damping in the springs, is a little better than for other competing subchassis models, and this might be a particular factor in its favour under certain circumstances.

## GENERAL DATA

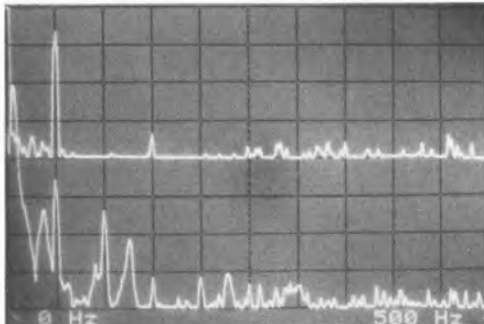
|  |                                   |
|--|-----------------------------------|
| Type   | Motor Unit                        |
| Platter mass/damping                           | belt drive                        |
| Finish and engineering                         | 2kg/good                          |
| Type of mains lead/connecting leads            | good/good                         |
| Speed options                                  | 2 core/-                          |
| Wow and flutter (DIN peak wtd sigma 2)         | 33/45rpm                          |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | 0.07%                             |
| Absolute speed error                           | 0.11% / < 0.06%                   |
| Speed drift 1 hour/load variation              | -0.25%                            |
| Start up time to audible stabilisation         | -0.35%                            |
| Rumble: DIN B wtd L/R av (see spectrum)        | 3.5secs                           |
| Size/clearance for lid rear                    | -75/-76dB                         |
| Ease of use                                    | 47.5(w) x 36.5(d) x 15.5(h)/5.5cm |
| Typical acoustic breakthrough and resonances   | fairly good                       |
| Subjective sound quality of complete system    | very good                         |
| Hum level/acoustic feedback                    | very good/very good               |
| Vibration sensitivity/shock resistance         | very good/fairly good             |
| Estimated typical purchase price               | £170                              |



Disc impulse: black Audio Ref mat; white, STD felt mat (X10).



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

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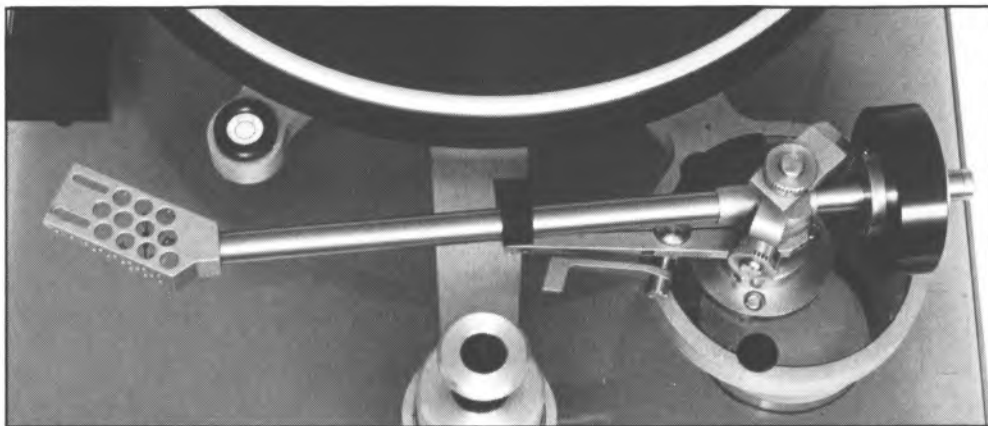
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# Sumiko MDC800 'The Arm'

Absolute Sounds, 42 Parkside, London SW19.  
Tel 01-947 5047



The legendary Breuer, a Swiss made exotic tonearm, was apparently only available in limited numbers for a short while. As a result the US agent commissioned an American made arm loosely based on the Swiss model.

Entitled by Sumiko *The Arm*, it is about three times the price of an *Ittok*, but the two have some features in common, since the *Ittok* also shares some of its design thinking with the Breuer. The similarities include the use of a rigid one-piece headshell firmly fixed to a large diameter pipe, plus a pre-loaded strong gimbal bearing assembly, a decoupled counterweight, spring operated downforce (and biasing) for optimum dynamic balance, and a three point pillar locking arrangement.

However, the *Ittok* uses six screws for the main tube joint, the Sumiko a thermally bonded interface, and while the decoupled *Ittok* counterweight demonstrates a pretty tight fit, that on the Sumiko is almost too loose for comfort, and incorporates a lead shot filling for energy absorption. The *Ittok* controls are calibrated *à la* Japanese, but not so the Sumiko (*à la* Breuer), which also demonstrated a rather low level of bias correction, the designer's philosophy favouring minimal correction.

*The Arm's* alloy tube has foam damping, and when physically handled appears to be a remarkably inert and strong structure. The headshell, a Breuer-like thin-wall multi-perforated component, is milled from a solid block to ensure the strongest link between itself and the main tube. The complete structure is finished in a high quality satin black.

A 13g effective mass was determined, similar to the *Ittok* and suited to cartridges in the 8-16cu range, particularly high performance moving-coils. The bias range was inadequate, as supplied only suiting a 0-1g cartridge downforce. Resetting the hairspring achieved an effective range of up to 1.8g. The maximum 'balanced' downforce available was just 1.35g, so we produced the higher figures necessary for *Asak* and *Koetsu* cartridges by forward-setting the main counterweight. It must be said that our sample was an ex-demonstration model drawn from very early production, and the problems we encountered will hopefully be untypical in normal production.

## Lab results

An elaborate alignment jig in which the arm sits was provided to help cartridge fitting, and the geometric accuracy was certainly very good, despite the lack of vertical tilted adjustment (sacrificed in the interests of rigidity). The bias was at least in the right ratio as well as frictionless in operation, while bearing friction was also low, though a trace of play in the horizontal plane was detected on our sample. Cue descent was to slow at 4.5 seconds — one second is sufficient.

A singular lack of high Q resonances was evident from the audio range graph, and the main flexure in the region of 500-600Hz confirms the high rigidity; the energy trend was barely interrupted. Good damping was evident throughout.

For this edition we tested a later production tonearm with a tighter counterweight assem-



bly. Resonance behaviour was more energetic than before, with a noticeable mode at 3.3kHz. The energy trend now also showed a distinct step at 500Hz, with a less favourable appraisal in the light of this. Bias compensation was also improved.

### Sound quality

As in previous auditions, the sound was smooth and relaxed. Bass definition, always good, was marginally improved with this production sample, and it demonstrated fine depth, neutrality and tunefulness. Slight stereo defocusing and mild coloration were both noted in the upper midrange, but by comparison with most other examples the sound quality was very good.

### Conclusion

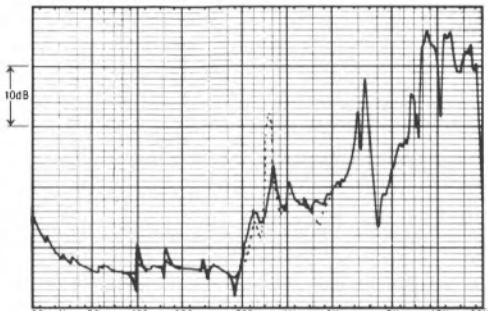
The MDC800 once stood alone at this exalted quality standard and in that context the very high price did not seem so important. However since our original review, this arm has been joined by others of somewhat comparable quality, but at more realistic prices — so while the '800 was never 'competitive', it is even less so now. I cannot argue with the performance, but feel that it is really too expensive at around the £800 level.

### GENERAL DATA

Tonearm

#### Arm Section

|  |                                       |
|--|---------------------------------------|
| Approximate effective mass, inc screws, excl cartridge . . .   | 13g                                   |
| Type/mass of headshell . . . . .                               | non-detachable                        |
| Geometric accuracy . . . . .                                   | excellent                             |
| Adjustments provided . . . . .                                 | overhang/offset/height                |
| Finish and engineering . . . . .                               | very good/very good                   |
| Ease of assembly/setting-up/use . . . . .                      | very good/fair/good                   |
| Friction, typical lateral/vertical . . . . .                   | less than 5mg/less than 5mg           |
| Bias compensation method . . . . .                             | internal coil spring                  |
| Bias force at centre, when at 150g at rim (uncalibrated) . . . | 190mg                                 |
| Downforce calibration error, 1g/2g . . . . .                   | uncalibrated                          |
| Cue drift, 8mm ascent/descent . . . . .                        | none, 0.6 secs/1.9 secs               |
| Arm resonances . . . . .                                       | good +                                |
| Subjective sound quality . . . . .                             | very good                             |
| Lead capacitance/damping method . . . . .                      | 75pF/partial counterweight decoupling |
| Estimated typical purchase price . . . . .                     | £795                                  |



Structural arm resonances, audio band

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A relatively inexpensive integrated turntable, the *SLQ20* comes complete with a plug-in cartridge. This is the *P24*, from the 'linear tracking' range, also supplied with the *SL5* player. A modest moving-magnet type, it offers good trackability at a low 1.25g downforce, and with a standardised weight of 6g these cartridges may in fact be easily interchanged (like camera lenses) without worrying about such things as alignment, calibration and downforce. A shanked mounted spherical stylus is fitted, user detachable.

The tonearm is of the conventional radial-tracking type, but with a headshell socket only accepting 'plug-in' types.

A surprising level of features is included — for example, an auto-turn arm mechanism and a two-speed quartz-locked direct-drive motor. Some steps have been taken to reduce acoustic and vibration feed-through effects, although this fairly lightly built unit would not properly qualify as an isolated sub-chassis design.

An illuminated stroboscope is included but is quite redundant as the speeds are precisely accurate and fixed by the quartz oscillator reference.

## Lab report

The platter and mat weighed an average 1.2kg and provided satisfactory damping of the initial disc impulse, but significant post-transient ringing was revealed. Well finished

and engineered, the drive delivered textbook wow and flutter results, with very low levels of linear wow. Speed accuracy was predictably superb, while the motor delivered a high torque free of overshoot or dynamic wow effects. Start-up was rapid while rumble was outstanding at  $-80\text{dB}$ , this being essentially the measurement threshold. Even spectrum analysis could not elucidate any spurious motor effects.

At mid frequencies the unit behaved well with respect to acoustic breakthrough although its performance as regards vibration isolation was only average. It was rated below average on both shock and overall acoustic feedback.

Considered of good constructional quality, and alignment the tonearm demonstrated good geometry and adjustment, and was particularly easy to set up and use. Friction was low but the bias compensation levels were inaccurate with the mechanism failing to engage at all settings below 1g. Downforce calibration and cueing were fine. The arm resonance behaviour was established using the supplied cartridge and indicated an unpromising performance. The energy trend was uneven with a serious group of resonances centred on 600Hz, and a mild torsional mode can be seen at 200Hz (see *SL5* review for cartridge response).

## Sound quality

With the supplied cartridge which at this price

level quite frankly is unlikely to be replaced, the sound quality was fairly poor. Bass was lacking as well as poorly defined; the mid was hard and forward with the treble edgy and over-bright. Stereo focusing was reasonable but little depth was portrayed.

### Conclusion

Despite the inclusion of a superb motor drive, plus many other sensible and well-engineered details, the sound quality of this neat turntable does not seem to justify the trouble that has been taken in its design. We did not find it very pleasant to audition, and it cannot be recommended.

### GENERAL DATA

Integrated turntable (inc. cartridge)

#### Motor Section

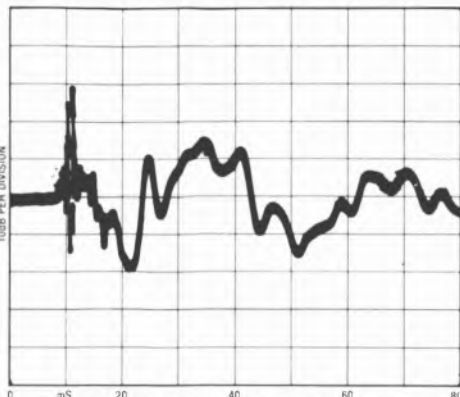
Type . . . . . semi-auto, quartz direct-drive, subchassis  
 Platter mass/damping . . . . . 1.2kg/average +  
 Finish and engineering . . . . . very good/good  
 Type of mains/connecting leads . . . . . 2-core/phonos and earth  
 Speed options . . . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . . . less than 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . . . less than 0.06%/0.04%  
 Absolute speed error . . . . . none  
 Speed drift, 1 hour/load variation . . . . . none  
 Start-up time to audible stabilisation . . . . . 1.0 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . . . -80dB

#### Arm Section

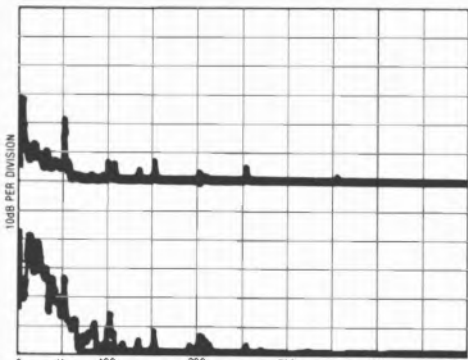
Approximate effective mass, inc screws, excl cartridge . . . . . N/A  
 Type/mass of headshell . . . . . Technics plug in/N/A  
 Geometric accuracy . . . . . very good  
 Adjustments provided . . . . . none  
 Finish and engineering . . . . . very good/very good  
 Ease of assembly/setting-up/use . . . . . very good/very good/very good  
 Friction, typical lateral/vertical . . . . . 25mg/5mg  
 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 . . . . . slight, 0.8 secs/0.8 secs  
 Arm resonances . . . . . average -  
 Subjective sound quality . . . . . average -  
 Lead capacitance/damping method . . . . . 125pF/counterweight decoupling

#### System as a whole

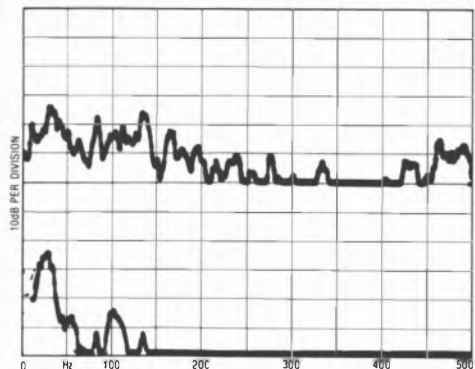
Size/clearance for lid rear . . . . . 43(w) x 37(d) x 10.5(h)/5cm  
 Ease of use . . . . . very good  
 Typical acoustic breakthrough and resonances . . . . . above average  
 Subjective sound quality of complete system . . . . . poor  
 Hum level/acoustic feedback . . . . . very good/average -  
 Vibration sensitivity/shock resistance . . . . . average/average -  
 Estimated typical purchase price . . . . . £109  
 \*no marking for 2g - estimated on scale position



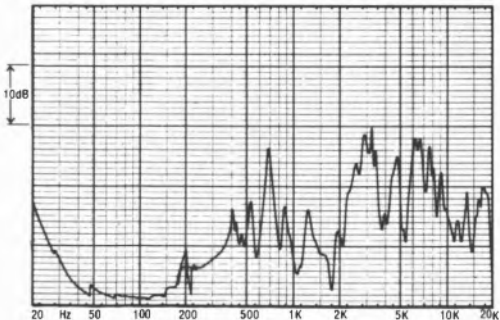
Disc impulse transmission showing damping



Rumble, total (see text)



Breakthrough, acoustic (above) and vibration (below)



Structural arm resonances, audio band

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

## Technics SL5

National Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB  
Tel Slough 34522



Presumably hoping to build on the great initial success of their earlier LP-jacket-sized turntables, the *SL5* looks rather like the recommended *SL7* but is priced more competitively at approximately £120. However this is explained upon closer inspection, as the '5 demonstrates a lighter plastic construction rather than the solid castings of the *SL7*.

This ultra-compact model again has a low mass linear tracking, servo controlled tonearm. In fact it presents an interesting contrast to the *SLQ20*, since in the latter, the money is spent on the motor, while the *SL5* concentrates on the tonearm and compact size. It is highly automated, with detection of record size, automatic speed selection and cue traverse plus repeat play options all provided. A Technics *P24* cartridge with a spherical tip is supplied. This could be upgraded if it was felt worthwhile, but as it is also common to the *SLQ20*, we subjected it to a brief analysis.

Running at the usual two fixed speeds, the motor is not quartz locked. Little isolation is provided from acoustic or vibration interference, apart from the fairly compliant rubber feet.

### Lab report

Taking the cartridge first, the 400Hz glitch shown in the response is not the fault of the cartridge per se; rather it is caused by a resonance in the *SL5* tonearm used for the measurement. Very flat from 30Hz to 8kHz, the

cartridge response unfortunately rose at higher frequencies to +5dB at 20kHz. Channel separation was however very good at over 30dB for much of the frequency range and trackability was also fine in the 1.3-1.6g downforce range.

The platter was rather light at 0.83kg mass, but offered fairly good impulse damping. Wow and flutter was very low and the speeds accurate despite the absence of quartz lock. Drift was low and the torque and overshoot were judged satisfactory. The rumble bridge could not be used here and via the less satisfactory test lacquer, the results was judged fine at better than 75dB. Spectrum analysis suggested very low levels of spurious motor harmonics and while vibration rejection was about average, the acoustic isolation was quite good if uneven.

Shock was fairly well handled which is normal for a linear tracker, and it also behaved well on the feedback test.

Well constructed and adjusted, the lid-mounted tonearm possessed very good geometry and a low effective mass of around 3g. The arm/cartridge subsonic resonance was well judged and an idea of its audio band resonance behaviour may be gleaned from the relevant curve for the *SL10*. However, the *P24* frequency response displays an arm resonance mode at 400Hz, as mentioned above.

## Sound quality

Rated below average, the SL5 did not succeed well in portraying stereo image depth. The bass was lumpy and colored lacking in tonal differentiation while the upper treble showed a mild fizzy quality, emphasising record distortions and noise. The midrange also lacked precision of focus as well as detail.

## Conclusion

The data presented above suggests that the saving which could be gained by buying a SL5 as opposed to the SL7 would be a false economy. The SL5 does not, we feel, sound good enough to recommend despite the moderate price tag and attractive features.

## GENERAL DATA

Integrated turntable (inc. cartridge)

### Motor Section

Type..... fully-auto, direct-drive, linear tracking  
 Platter mass/damping..... 0.83kg/above average  
 Finish and engineering..... very good/good  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... less than 0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... less than 0.06%/0.05%

Absolute speed error..... +0.1%  
 Speed drift, 1 hour/load variation..... 0.05%/—  
 Start-up time to audible stabilisation..... less than 1 sec  
 Rumble, DIN B wtd L/R average (see spectrum)..... better than -75 dB

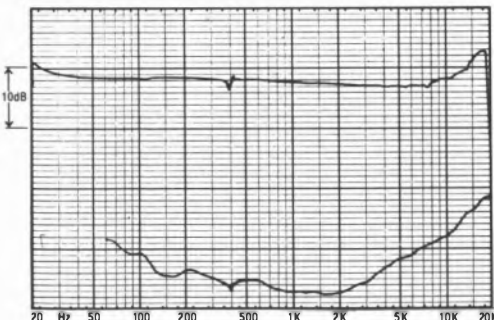
### Arm Section

Approximate effective mass, inc screws, excl cartridge... 3.0g  
 Type/mass of headshell..... integrated cartridge  
 Geometric accuracy..... excellent  
 Adjustments provided..... none  
 Finish and engineering..... very good/very good  
 Ease of assembly/setting-up/use..... very good/excellent/excellent

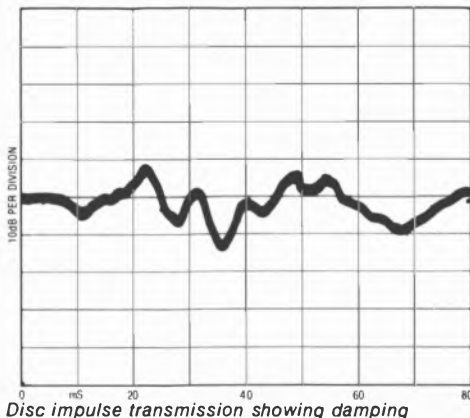
Friction, typical lateral/vertical..... —/—  
 Bias compensation method..... not required  
 Bias force, rim/centre (set to 1.5g elliptical)..... N/A  
 Downforce calibration error, 1g/2g..... none/—  
 Cue drift, 8mm ascent/descent..... none, 0.8 sec/1.1 secs  
 Arm resonances..... —  
 Subjective sound quality..... below average  
 Lead capacitance/damping method..... —/none

### System as a whole

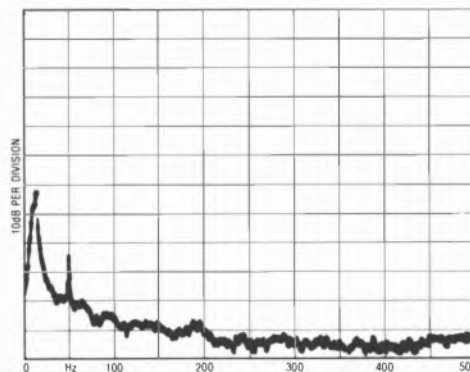
Size/clearance for lid rear..... 31.5(w) x 31.5(d) x 9(h)/0.5cm  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... good  
 Subjective sound quality of complete system..... average —  
 Hum level/acoustic feedback..... very good/good  
 Vibration sensitivity/shock resistance..... average/fairly good  
 Estimated typical purchase price..... £119



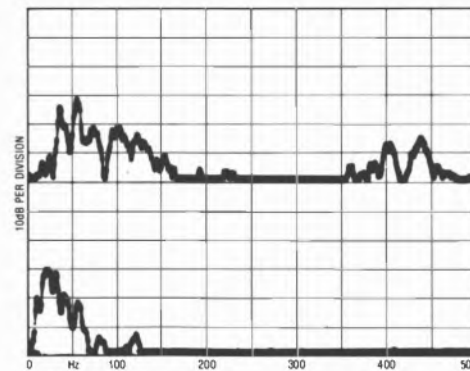
Frequency response and separation, cartridge



Disc impulse transmission showing damping



Rumble, total (see text)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# Technics SL7, SL10, SLDL1, SLQL1, SL15

National Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB  
Tel Slough 34522

RECOMMENDED



This range of Technics turntables has so many common factors in engineering and in component elements that it is logical to assess them as a group. The first model was the *SL10*, an extraordinarily compact and ingenious integrated player of superb external appearance. However, it proved hard to manufacture, and furthermore Technics underestimated demand for the product. Accordingly a year or so ago they introduced a companion model of virtually the same dimensions with an essentially comparable performance called the *SL7*. An improved micro-processor plus rationalised motor and control circuitry allowed a massive reduction in components as well as easier construction, resulting in a 30% price saving. Since then the *SL7* design has been widened and stretched physically to match normal component and rack dimensions, producing the *SLQL1* and the cheaper *SLDL1*. At the top end of the range, the *SL10* has been supplemented by the *SL15*, which has additional track selection facilities, allowing the choice of any track in any order via a numbered array of pushbuttons. The successful incorporation of this complex additional feature within the limited space of the *SL10* frame is something of an achievement.

The major component that all these models have in common is the basic tonearm from the *SL10*, a parallel tracking device built into a heavy set of precision castings. On the '10 and '15 the casting is continued to form the entire lid, while the other models have transparent front lid

sections, comprising plastics mouldings of a far heavier grade than usually fitted to turntables. A lid-mounted tonearm is admittedly sensitively located, but the exceptional rigidity and weight of the lids has proved to be beneficial for acoustic isolation and feedback immunity.

Cartridges of above average quality are fitted, and use a special fixing which gives a low effective mass total of 9g, ensuring good mechanical compatibility for the arm/cartridge subsonic resonance (10-12 Hz). Physically completely symmetrical, the tonearm is based on a precision optical angle sensor which detects errors from the tangent in the arm as it tracks, holding any error to  $\pm 0.1$  of a degree, which is many times better than for an offset fixed pivot arm. The arm has a reasonably rigid rectangular metal tube beam, with quite strong bearings and miniature four-point gimbal ball races. A variable rate micro-motor energises the leadscrew drive, and manual cue traverse at two speeds are provided according to the pressure exerted on the pushbuttons. Spring loading for downforce gives good dynamic balance, and with the lack of bias requirement endows the arm with a higher shock resistance than conventional models.

All the turntables are fully automatic and fitted with protection devices, for example to cue up the arm instantly when the lid is moved or lifted. Small slots in the mat/platter allow the lid-mounted LED lamps to activate sensors underneath, detecting record size and setting speed/cueing position. Manual override is however

possible, for example for a 45rpm 12 inch disc, and a repeat play function is also provided.

All the models are powered by Technics direct drive motors - quartz-locked with two fixed speeds except in the case of the cheaper *SLDL1*, which has a mains stroboscope plus fine speed control via a thumbwheel on the front section of the plinth, instead of the quartz reference. The basic controls of all models may be operated with the lid shut, and no additional clearance need be provided at the rear to accommodate lid elevation. A common constructional feature is the heavy/inert baseplates of either mineral-loaded plastics mouldings or of cast metal, and the units are supported on four steel coil spring feet with rubber damping inserts.

### The cartridges

The cartridges fitted range from a special version of the *305MC* moving-coil model in the *SL10* (which has an integral and switchable moving-coil pre-amp and can thus accept moving magnet alternatives), to the good quality moving magnet fitted to the *'DL1*. A top quality moving magnet model is fitted to the *SL15*, being a version of the *Choice* recommended *EPC205 IIIIL*, while the *SL7* uses a *P202*, which also has many similarities to the *'205*, including the hollow boron cantilever, the low inductance generator giving wide electrical bandwidth and good tolerance of loading, plus a top quality naked elliptical diamond stylus. A slightly different version is fitted to the *SLQL1*, the cantilever carrying a shank-mounted elliptical tip (*EPS22ES*), which can be replaced by the *EPS-22ED* (*EPS 202ED*) stylus of the *SL7* if so desired at a later date.

A *P23E* model is used for the *SLDL1*, still employing the broad electrical bandwidth generator, and tracking at a 1.25kg downforce as all the models do quite comfortably. But here the output is a little higher than before, and the cantilever uses an aluminium micro-tube fitted with a shank-mounted elliptical tip.

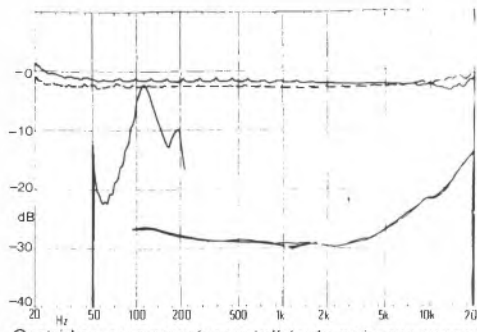
All the cartridge masses are identical, and hence are interchangeable without any necessary readjustment. In addition Ortofon have now built a compatible version of one of their own *30* series, though appropriate electrical loading should be applied here to give the best results.

### Lab results

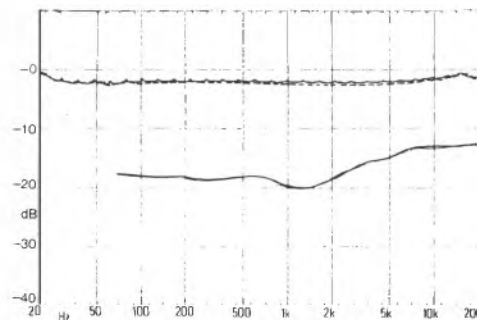
Not every unit in the range has been tested, but key models have been evaluated which are generally representative of the group as a whole.

#### **SLDL1**

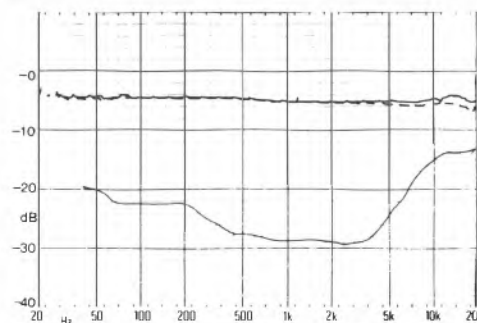
The *SLDL1* delivered an excellent mechanical performance with high torque, overshoot-free, with low drift and negligible wow or rumble. The arm performed well, judged largely by the fine stability and tracking performance of the supplied



Cartridge response/crosstalk/subsonic resonance raised (X decade): *P202ED* (on *SL7*).



Cartridge response/crosstalk: *P202* (on *QL1*)



Cartridge response/crosstalk: *P23E* (on *DL1*).

cartridge at a 1.25g downforce. (See *SL10* trace for the arm audio band resonance behaviour). The subsonic resonance was near ideal at +8dB, 10Hz, while acoustic and vibration isolation were both very good above 100Hz, though the latter showed some deterioration at lower frequencies. The disc impulse transmission photos could not be taken, but platter damping was quite good, and all the models were fitted with a sensibly flat rubber mat possessing satisfactory absorption properties.

*continued overleaf*

**GENERAL DATA**

Integrated Turntable

**Motor Section**

Type ..... direct drive, parallel tracking, automatic  
 Platter mass/damping ..... 1.4kg/good  
 Finish and engineering ..... very good/very good  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... <0.05%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... 0.1%/<0.06%  
 Absolute speed error ..... <0.1%  
 Speed drift 1 hour/load variation ..... <0.1%/<0.1%  
 Start up time to audible stabilisation ..... approx 1.6secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -77dB

**Arm Section**

Approximate effective mass, excl cartridge ..... approx 3g  
 Type/mass of headshell ..... plug in cartridge, special type /N/A  
 Geometric accuracy ..... excellent  
 Adjustments provided ..... downforce  
 Finish and engineering ..... both very good  
 Ease of assembly/setting up/use ..... excellent/excellent/excellent  
 Friction: typical lateral/vertical ..... N/A  
 Bias compensation method ..... not required  
 Bias force: rim/centre (set to 1.5g elliptical) ..... N/A  
 Downforce calibration error 1g/2g ..... N/A  
 Cue drift/8mm ascent/descent ..... negligible/0.5sec/1.0sec  
 Arm resonances ..... N/A (SEE SL10)  
 Subjective sound quality (complete unit) ..... good  
 Lead capacitance/damping method ..... N/A/none

**System as a whole**

Size/clearance for lid rear ..... 43.0(w) x 35.0(d) x 8.8(h)/0cm  
 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 ..... average +/-very good  
 Estimated typical purchase price ..... £180

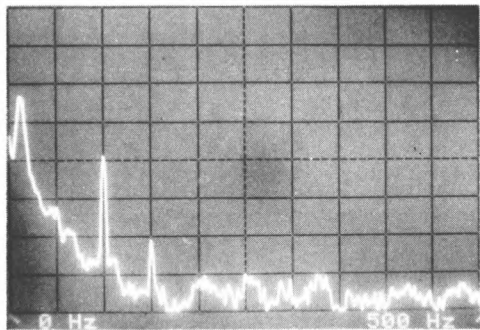
The good tracking properties of the cartridge have already been mentioned, and to this must be added an above average distortion performance as well as the good frequency response/separation characteristics printed here. The channel balance was very good, the response  $\pm 1\text{dB}$  20Hz-16kHz, and the separation, typically -28dB in the midband, still measured well at 10kHz.

**SLQL1**

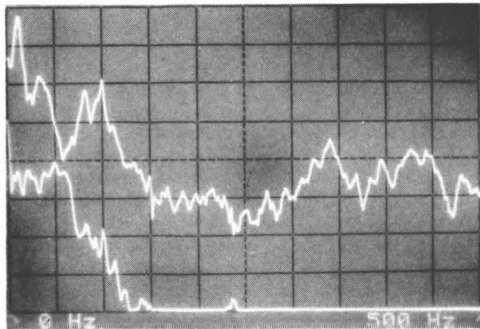
Very similar to the 'DL1, the QL1 showed the benefit of its quartz lock in higher speed accuracy. The sample of P202 cartridge supplied produced a very well balanced and uniform response, but gave disappointing midband separation of under 20dB. The results with a second sample as fitted to an SL7 can be seen from the appropriate curve, where a rather better result was obtained, but on this occasion the cartridge demonstrated poorer channel balance. It should be noted that the cartridges do appear to have an element of sample variability, though this is by no means confined to Technics' models.

**SL7**

All these turntables had to be measured for rumble using a lacquer acetate test disc, rather than the more sensitive rumble bridge employed where possible elsewhere. Nevertheless the indications were of a DIN B weighted figure better than -76dB, and I have no reason to doubt the spec of -78dB given for all models and applicable to the SL-7. The rumble spectrogram compares pure electrical breakthrough with the total rumble including disc charted below, and no pole switching harmonics can be seen - a tribute to the slotless full-wave current-controlled motor.



Total rumble via lacquer, SLDL1/SLQL1.



Breakthrough SLDL1/SLQL1: above, acoustic; below, vibration.

**GENERAL DATA**

Integrated Turntable

**Motor Section**

Type ..... direct drive, parallel tracking, automatic  
 Platter mass/damping ..... 1.35kg/good  
 Finish and engineering ..... very good/very good  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... 33/45rpm  
 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 ..... <0.01%  
 Speed drift 1 hour/load variation ..... <0.01%/<0.01%  
 Start up time to audible stabilisation ..... approx 1.3secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... better than -76dB

**Arm Section**

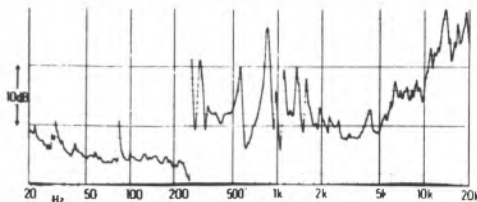
Approximate effective mass inc screws, excl cartridge ..... approx 3g  
 Type/mass of headshell ..... plug in cartridge/N/A  
 Geometric accuracy ..... excellent  
 Adjustments provided ..... downforce  
 Finish and engineering ..... very good/very good  
 Ease of assembly/setting up/use ..... very good/excellent  
 Cue drift/8mm ascent/descent ..... negligible/1.0sec/1.0sec  
 Arm resonances ..... see SL10  
 Subjective sound quality ..... good  
 Damping method ..... none

**System as a whole**

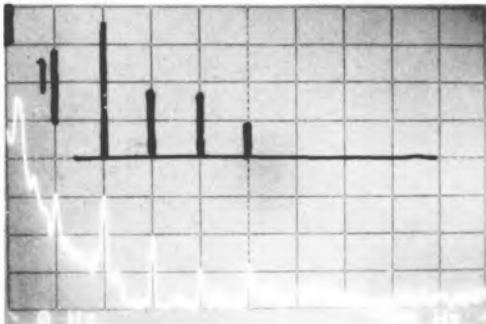
Size/clearance for lid rear ..... 31.5(w) x 31.5(d) x 6.5(h)/0cm  
 Ease of use ..... excellent  
 Typical acoustic breakthrough and resonances ..... very good  
 Subjective sound quality of complete system ..... good  
 Hum level/acoustic feedback ..... very good/very good  
 Vibration sensitivity/shock resistance ..... average +/-very good  
 Estimated typical purchase price ..... £200



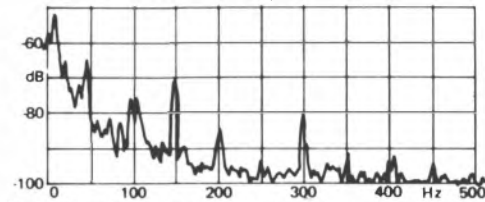
A +10dB resonance at an ideal 11Hz was recorded for the arm/P202 cartridge combination, but channel balance was slightly erratic: 1dB out at low frequencies, it was matched at 7kHz and then diverged above 10kHz to a maximum of 1dB, 15kHz, so the frequency balance of the two channels will be slightly different. Fine stereo separation was recorded - still 22dB, 10kHz, and approaching 30dB in the midband. The cartridge proving to be an excellent tracker with low distortion evident throughout the tests.



Structural arm resonances, audio band.



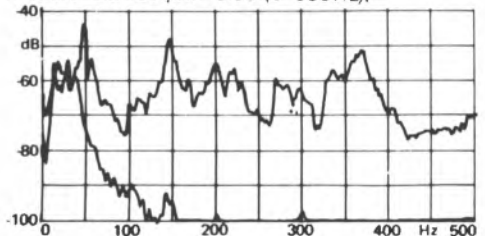
Rumble via lacquer disc (0-500Hz lin).



Rumble via lacquer disc (0-500Hz).



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

|   |  |
|---|--|
| <b>GENERAL DATA</b>                                   | integrated turntable                     |
| <b>Motor Section</b>                                  |  |
| 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   | 33, 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                                     |
| <b>Arm Section</b>                                    |  |
| 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/use                       | 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 ascen/descen                            | good/1.0sec/1.2secs                      |
| Arm resonances  | good                                     |
| Subjective sound quality                              | good                                     |
| Lead capacitance/damping method                       | N/A/none                                 |
| <b>System as a whole</b>                              |  |
| 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)               |

continued overleaf

## SL10

Overall the performance of the SL10 can be seen to be similar to the other models in the group, though one detail difference was noted, in that the power level and speed of the arm tracking servo-motor was higher than for the later turntables in the series. Very critical listening involving relatively quiet, clean programme such as solo piano showed a trace of arm-drive rumble, which proved undetectable with the SL7 arm and those of its companions, due to their slower and hence quieter arm motors.

However in other respects, the tests on this model provided the main data for the tonearm performance of the group as a whole. On arm resonances (measured with the 305MC cartridge and the lid partially dismantled) a flexure was present at 250Hz, probably in the rear assembly, with the first beam mode deferred until 590Hz, which is a relatively high frequency. Following a 'scrappy' region between 800Hz and 2kHz, it quickly settled down to a tidy performance up to 20kHz.

Similar results for acoustic and vibration isolation were achieved, and the 305MC cartridge proved to be a good performer, providing a  $\pm 0.3$ dB response from 40Hz to 11kHz, with 30dB separation between 100Hz and 10kHz. Trackability and distortion performances were both very good, though towards the frequency response extremes (20Hz and 20kHz), a 3dB lift occurred, and in this area the moving magnet alternatives are rather smoother.

### Sound quality

A 'generic' sound quality was exhibited by all these turntables, but there were differences between the models which are worth discussing.

As a group feedback levels were low and shock immunity good, while the bass registers were above average, though not quite as clear, firm or even as the manual subchassis models in similar price ranges. Stereo presentation, image stability and detail were all well above average, but on coloration grounds the models appeared

a trifle 'hard' and 'forward' in the midband, if not unduly so. The frequency balance gave an 'open' and 'lively' effect, with good clarity in the treble, and the overall impression was of a 'light' and 'lively' balance.

Of the less expensive models, the *SLDL1* was preferred, giving a more pleasant and relaxed performance than the *SLQL1*, which seemed a trifle 'edgy'. The *SL7* was better still, giving improved detail, and it was also found to sound better than the original *SL10*. Trial fitting of the 'luxury' cartridge option '205III' produced further depth, refinement and detail in the *SL7*.

### Conclusions

All models set high standards in terms of complete integrated players. The *SLDL1* offers fine value for money and may be confidently recommended. Little advantage would appear to be gained from the more costly *SLQL1*, which was still good but is less competitive.

Bar the remarkable *SL10* styling (in which respect I feel the *SL7* is inferior), the latter supercedes the '10 in all other respects, and is excellent value at nearly £100 less than the '10. The latter still remains a fine 'buy' in its own right, and if the styling is paramount and the auto track programming important, then the more costly *SL15* provides both, as well as the updated features of the '7 and Technics' best possible cartridge option. However, in strict hi-fi terms it cannot be said to offer such good value at around £400.



## Technics SP15/EPA500

National Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB  
Tel Slough 34522

This is a top class system made up from separately available components which are physically difficult to match with any others, and hence were used together to form an integral unit.

Owing a great deal to the popular professional *SP10 II*, the *SP15* has a less costly motor more applicable to domestic situations, but improvements in efficiency which provide a very similar rapid electronic start-stop performance. A quartz-lock direct drive motor is used, offering two speeds with very high torque and excellent dynamic characteristics. The substantial platter is fitted with a fairly hard rubber mat whose flat surface affords favourable disc support and damping. In the Technics tradition the engineering is to an exceptional standard with an accurately machined platter and a strong main bearing possessing low friction and undetectable play. Fine speed control is provided in the form of a synthesiser unit which allows pushbutton selection of 0.1% speed increments up or down, the amount monitored by a LED readout.

As a chassis the motor unit may be mounted in any strong panel, but for our tests we used the matching plinth and cover, which has a very substantial laminated wood base. Visually the plinth is split into two sections with a rosewood upper and a satin black lower portion. The whole assembly is heavy, and is supported on relatively compliant rubber feet which provide quite a low main suspension resonance at 6Hz or so. Due to the high foot damping and the attachment of the large lid to the plinth, the isolation will not match a good subchassis design, despite the lid being

of excellent quality and moulded in a low resonance grade of smoked plastic.

The *EPA500* is a versatile tonearm with a longer than usual stylus tip to pivot distance. Tracing errors are somewhat reduced, and the smaller offset angle consequently reduces bias compensation requirements. The extra length means that very few turntables can accommodate it, and furthermore it employs a very large pillar assembly to make space for the substantial mechanics which provide easily variable height adjustment via a strong helical gear assembly free of play.

A key feature of the design is the interchangeable top sections. The whole cartridge carrier complete with adjusted counterweight may be pre-balanced and rapidly swapped. A thumb-wheel lock firmly fixes the carriers into the precision gimbal bearing assembly, and the lead out wire connections are integral with the join. Increasing its versatility, three types of carrier are available to suit different types of cartridges. The 'H' is a low mass unit with a reinforced plastic headshell suited to high compliance models; the 'M' is somewhat beefed-up, but otherwise similar, and the 'L' is a substantial large diameter tube with a cast metal headshell, giving strength and effective mass suited to the finest low compliance moving-coil cartridges.

The integral seismic counterweights incorporate effective viscous damping for control of the arm/cartridge subsonic resonance. No down-force calibration is provided, so Technics supply

*continued overleaf*

an accurate electronic gauge. A convenient calibrated internal spring provides bias compensation, and the side entry cabling requires considerable below-deck clearance.

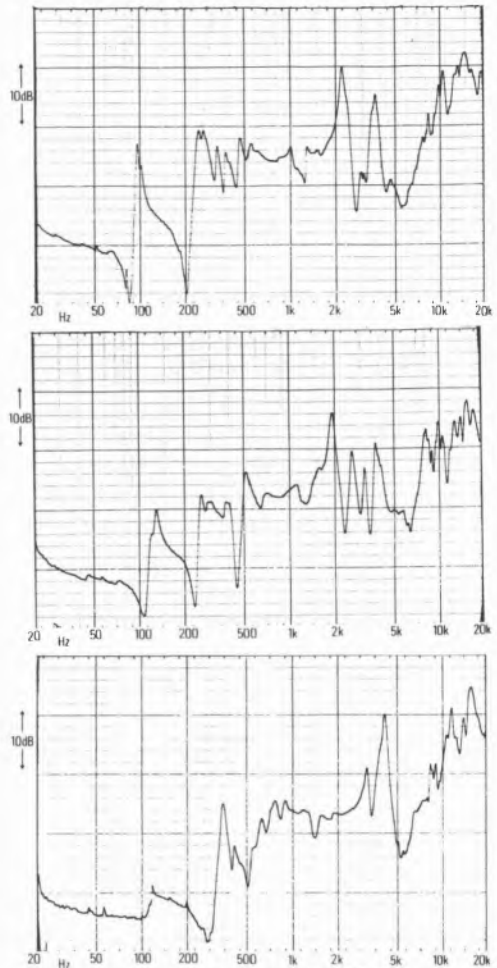
### Lab results

Not unexpectedly in terms of lab results the motor performance was exemplary. State of the art rumble figures were in no way compromised by the spectrum analysis reading down to  $-100\text{dB}$  relative to the test reference level, and no trace of mains-related rumble, motor-pole or bearing noise could be detected. The total rumble accurately mirrored the static electrical performance with the exception of the tiny contribution made by the rumble bridge itself, and wow and flutter was likewise below measurement thresholds, probably better than 0.035% DIN peak weighted. The motor can be expected to maintain this standard of performance for many years, as it has so few moving parts.

Start up time was very fast, approximately 0.3 second to  $33\frac{1}{3}\text{rpm}$  and proportionately more for the higher speeds, while electronic braking assured similarly rapid speed change and stop. Vibration isolation was in fact quite good, as indeed was the acoustic breakthrough, the latter showing an even, balanced character. Interestingly the breakthrough was poorer than for the 'miniature' Technics series, due to the larger lid area involved, so as a trial the lid was removed, providing the 10dB or so improvement shown by the dotted line. By implication, if used under high sound level conditions, the subjective quality should also be improved, and this was indeed found to be the case.

Shock resistance was also above average, due partly to the good dynamic balance of the arm, and also to the high mass of the system as a whole. A X10 scaling was possible for the disc impulse transmission response, which showed good control of the initial transient and progressive, even damping at all frequencies; there can be little point in substituting alternative mats in such as case.

While the bearing assembly was common to all three arm carriers, and hence they share the same recorded low friction levels, their other characteristics were distinctly different. Type *H* had an effective mass of 8g, suited to cartridges in the 15 to 30cu range, while *M* possessed a 10.5g mass for 12–25cu matching, and *L* a 14g effective mass suitable for 8–15cu cartridges (many moving-coils). Differences in construction resulted in a range of audio band resonances which are plotted separately, with *H* showing a first break at 90Hz. The cause was not immediately identified, but it was also present at 110Hz on the *M* version. The first flexure on *H* appeared at a fairly low 220Hz and was probably due to the headshell bonding to the tube; this was also a



Arm resonances: top, 'L'; middle, 'M'; bottom, 'H'.

feature of *M* at 230Hz. With *H* a strong step appeared in the energy trend above 230Hz, though the modes were well controlled at higher frequencies; in this respect however *M* was judged superior, with better damping and a more uniform trend.

Of the set the honours go to the *L* tube which avoided significant flexure until 310Hz and further up the range the damping was quite good, with a comparatively smooth energy trend and very few other resonances: a result certainly worthy of high quality moving-coil cartridges.

The arm mechanics worked very well, with biasing of the correct values and in the right ratio, and it also proved easy to use.

## Sound quality

Of the three tonearms *M* was best for low mass, medium compliance cartridges, and performed well with the *EPC 205 III*, for example. The sound was well balanced, demonstrating good stereo and low coloration levels. By comparison *H* was less well integrated and gave a more 'muddled' quality with a slightly reduced stereo depth impression. However the *L* tube was clearly superior overall, offering greater clarity, a firmer low frequency register, and a neutral and unexaggerated treble response.

The complete unit demonstrated a pleasant and secure standard of reproduction, which was not quite as coherent as, say, the complete Linn system, but which was very satisfying nonetheless. At the highest sound levels the stereo depth and clarity benefitted from removal of the heavy lid, while the 'vinyl sound' was comparatively clean, confirming the good disc support.

## Conclusion

In my view the *SP15* is certainly more than good enough for studio desk use. Its plinth system plus the matching *EPA500* tonearm results in a fine manually operated player, offering three speeds, cartridge matching versatility and interchangeability, and a synthesised variable speed. The unit promises a long and reliable life, and in context is certainly worth consideration, despite the fact that the overall sound could perhaps be matched by other less expensive systems.

## GENERAL DATA Integrated Turntable (available as separates)

### Motor Section

|  |                              |
|--|------------------------------|
| Type   | quartz, direct drive, manual |
| Platter mass/damping                           | 2.65kg/very good             |
| Finish and engineering                         | excellent/very good          |
| Type of mains lead/connecting leads            | 2 core/phones + earth        |
| Speed options                                  | 33/45/78rpm                  |
| Wow and flutter (DIN peak wtd sigma 2)         | <0.05%                       |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | <0.06%/<0.06%                |
| Absolute speed error                           | <0.01%                       |
| Speed drift 1 hour/load variation              | <0.01%/<0.01%                |
| Start up time to audible stabilisation         | approx 0.3sec                |
| Rumble: DIN B wtd L/R av (see spectrum)        | -78/-78dB                    |

### Arm Section

|   |                                   |
|---|-----------------------------------|
| Approximate effective mass inc screws, excl cartridge | 'H' 8.0g, 'M' 10.5g, 'L' 14.0g    |
| Type/mass of headshell                                | detachable arm tubes. 3 types/N/A |
| Geometric accuracy                                    | excellent                         |
| Adjustments provided                                  | overhang, lateral angle, height   |
| Finish and engineering                                | excellent/excellent               |
| Ease of assembly/setting up/use                       | excellent/very good/good          |
| Friction: typical lateral/vertical                    | 20mg/less than 10mg               |
| Bias compensation method                              | internal spring                   |
| Bias force: rim/centre (set to 1.5g elliptical)       | 150mg/190mg                       |
| Downforce calibration error: 1g/2g                    | negligible/negligible             |
| Cue drift/8mm ascent/descent                          | negligible/1.0secs/1.5secs        |
| Arm resonances  | see text                          |
| Subjective sound quality                              | see text                          |
| Lead capacitance/damping method                       | 85pF/seismic counterweight        |

### System as a whole

Size/clearance for lid rear ... 53.0(w) x 42.0(d) x 17.2(h)/7.5cm

Ease of use ... very good

Typical acoustic breakthrough and resonances ... very good

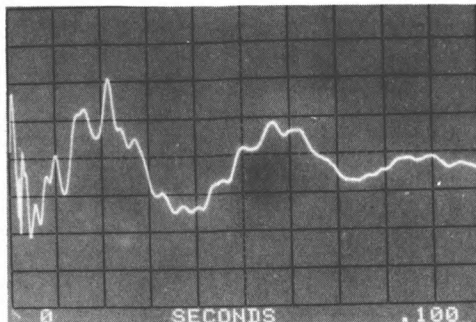
Subjective sound quality of complete system ... good ++

Hum level/acoustic feedback ... excellent/very good

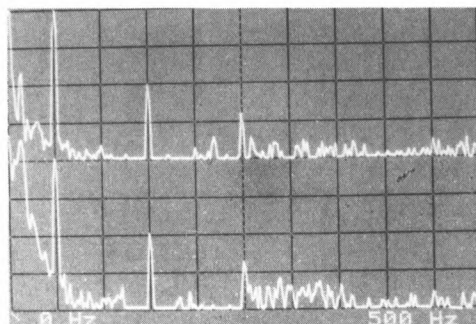
Vibration sensitivity/shock resistance ... good/good

Estimated typical purchase price ... £650 (motor) £315, arm £170

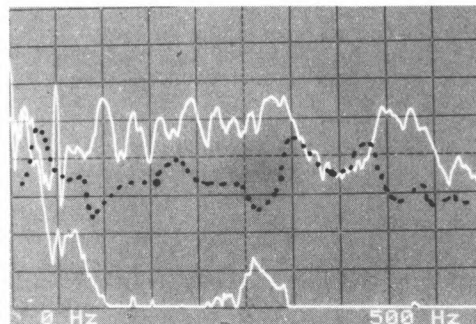
\*longer than usual arm



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

RECOMMENDED

## Thorens TD166 II

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF  
Tel Waltham Cross 716666



Originally popular a number of years ago the 166 has been revised and reintroduced after a long absence. On the face of it, this would appear to be quite a competitive product: for under £120 a good quality, well adjusted tonearm is provided, fitted to a true sub-chassis belt-drive deck.

The arm uses the Thorens detachable wand system offering a low effective mass in the region of 5-6g, and suited to medium to high compliance cartridges. Calibrated adjustment is provided for downforce and bias compensation while plinth mounted, shock-free cueing is built-in. Only manual operation is provided, and the plinth and hinged lid are rather resonant; in practice this is immaterial since the player components are isolated on the spring-suspended internal sub-chassis. A generous cast machined platter is fitted with a main bearing of satisfactory quality. Power is supplied by a slow-speed synchronous motor via a compliant belt. The old-style Thorens mat is used for this economy model, but it could easily be updated by a felt or other type.

### Lab report

While a promising 2.5kg platter is fitted, the disc impulse response was uninspiring with considerable post impulse ringing; a good mat would help matters here considerably. Finish and engineering were generally quite good and two speeds are provided with a good mechanical changeover. Weighted wow and flutter was

very good, though some mild pure wow was noted. The 166 ran 1.4% fast, which might just be noticed by a someone with absolute pitch acuity, but showing under load was negligible. Rumble was above average at -72dB, DIN weighted, and nothing untoward was evident from the spectrum analysis. As it should, the 166 rated as good on both acoustic and vibration isolation, while hum levels were moderate, feedback resistance well above average, and shock resistance fairly good.

The arm showed good geometry and was adjustable in all planes, which is unusual at this price level. As in the past, I found the Thorens system for cartridge fixing awkward but otherwise the arm was easy to set up and use. The bearings provided very low friction levels and bias compensation was in the right ratio if slightly low, while the cue operation was fine. Experiments with the arm resonances revealed a significant improvement in sound with the finger lift cropped to about one third its original length, or even removed altogether. Curtailing the lift meant that the 400Hz resonance then disappeared, and that at 500Hz was moderated.

### Sound quality

Used as supplied, the sound quality was rather special for the price. It portrayed dynamics well and demonstrated worthwhile stereo depth and space, proving to be quite detailed and articulate throughout the frequency range.

The bass was quite good with a surprisingly stable tempo and drive. Substitution of a better mat and altering the finger lift gave greater clarity and smoothness.

**Conclusion**

The 166 is unhesitatingly recommended. For the price it offers a good arm, a stable motor drive, good environmental isolation and a well balanced performance. The sound quality is well above the general competition, and furthermore the arm's low mass and high sensitivity allow the use of quite delicate higher compliance cartridges while still working well with medium compliance types.

**GENERAL DATA**

Integrated turntable

**Motor Section**

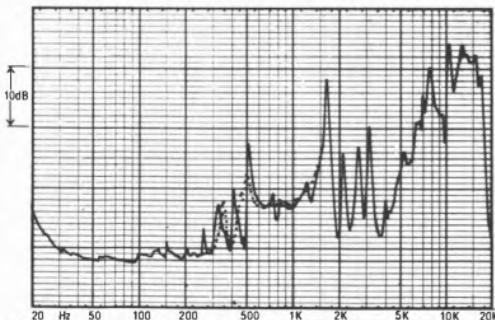
Type . . . manual, belt-drive, synchronous motor, subchassis  
 Platter mass/damping . . . 2.5kg/poor  
 Finish and engineering . . . good/good  
 Type of mains/connecting leads . . . 2-core/phonos and earth  
 Speed options . . . 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2) . . . 0.08%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . . 0.15%/0.06%  
 Absolute speed error . . . + 1.4%  
 Speed drift, 1 hour/load variation . . . synchronous/ - 0.18%  
 Start-up time to audible stabilisation . . . 3.5 secs  
 Rumble, DIN B wtd L/R average (see spectrum) . . . - 72dB

**Arm Section**

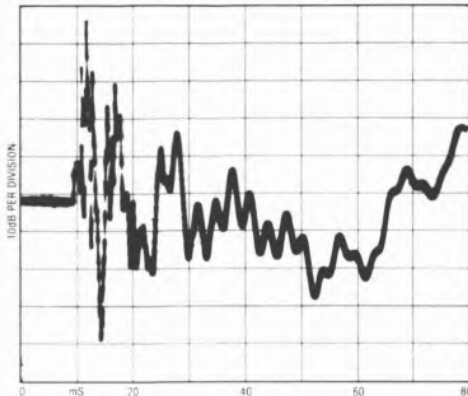
Approximate effective mass, inc screws, excl cartridge . . . 6.0g  
 Type/mass of headshell . . . detachable carrier  
 Geometric accuracy . . . very good  
 Adjustments provided . . . overhang/offset/height  
 Finish and engineering . . . good/good  
 Ease of assembly/setting-up/use . . . good/fair/very good  
 Friction, typical lateral/vertical . . . less than 5mg/10mg  
 Bias compensation method . . . pulley  
 Bias force, rim/centre (set to 1.5g elliptical) . . . 150mg/150mg  
 Downforce calibration error, 1g/2g . . . - 0.2g/none  
 Cue drift, 8mm ascent/descent . . . none, 0.8 secs/3.1 secs  
 Arm resonances . . . average +  
 Subjective sound quality . . . average +  
 Lead capacitance/damping method  
 240pF/counterweight decoupling

**System as a whole**

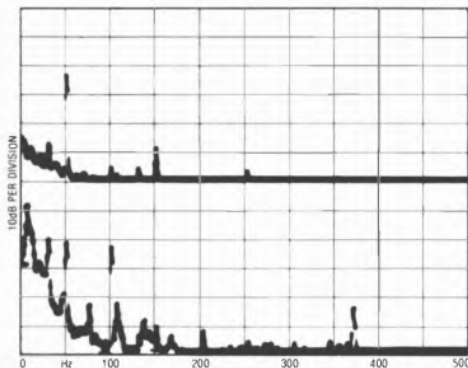
Size/clearance for lid rear . . . 43(w) x 35(d) x 15(h)/8.5cm  
 Ease of use . . . very good  
 Typical acoustic breakthrough and resonances . . . good  
 Subjective sound quality of complete system . . . good +  
 Hum level/acoustic feedback . . . very good/good  
 Vibration sensitivity/shock resistance . . . good + /fairly good  
 Estimated typical purchase price . . . £115  
 \*with fingerlift as supplied - see text



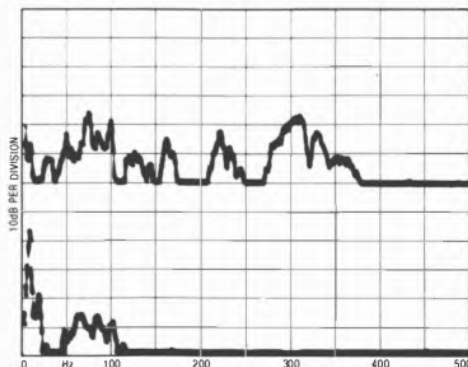
Structural arm resonances, audio band



Disc impulse transmission showing damping



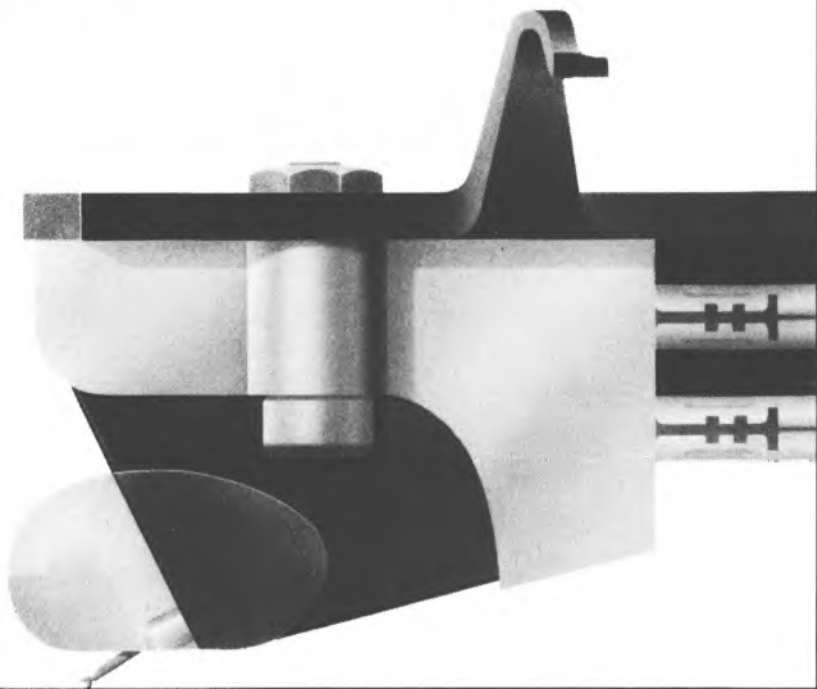
Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

# *Grace* F9E



## *Russ Andrews Turntable Accessories*

*Distributors for Grace and Supex*

*Edge Bank House, Skelsmeigh, Kendal, Cumbria, LA8 9AS*

*Tel. Selside (053 983) 247*



# Thorens TD160BC

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF  
Tel Waltham Cross 716666

RECOMMENDED



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.

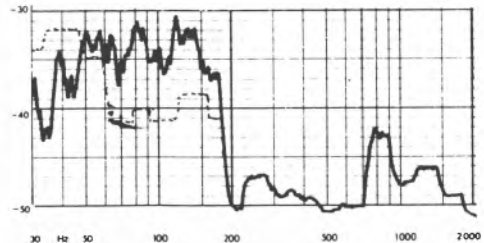
Rated as good for the standard Thorens version and as very good with the ATR style modifications, the subjective performance attracted very little criticism. The mat change resulted in a significant

improvement in midrange detail and stereo depth, similar to the *LP12* in terms of neutrality, low frequency depth, evenness and ambience.

In both forms, every good value is offered, and a strong recommendation holds.

## GENERAL DATA

|  |                             |
|--|-----------------------------|
| Type   | Motor Unit                  |
| Platter mass/damping                         | belt drive                  |
| Finish and engineering                       | 2.5kg/good                  |
| Type of mains leads                          | very good                   |
| Speed options/variable?                      | 2 core                      |
| Wow and flutter (DIN pk wtd $\sigma_2$ )     | 33 $\frac{1}{3}$ ; 45rpm/no |
| Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)     | 0.06%                       |
| Speed accuracy/drift/variation under load    | 0.11%/0.08%                 |
| Start up time to audible stabilisation       | +0.6%/none/-0.4%            |
| Rumble (av DIN B wtd L/R)                    | 3.5secs                     |
| Size/rear clearance for lid                  | 73/74dB                     |
| Typical acoustic breakthrough and resonances | 43(w) x 34(d) x 15(h)/9.5cm |
| Subjective sound quality of complete system  | very good                   |
| Hum level/Acoustic feedback                  | very good/very good         |
| Vibration of shock sensitivity               | very good                   |
| Ease of use                                  | straight forward            |
| Estimated typical purchase price             | £120                        |



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

RECOMMENDED

## Thorens TD147

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF  
Tel Waltham Cross 716666



In essence the *TD147* comprises a development of the upmarket *160S*, with a fitted Thorens tonearm based on the *TP16* detachable-carrier wand system, and allowing the inclusion of some semi-automatic facilities.

A substantial thick chipboard plinth is provided for the *147*, the review sample being mahogany veneered. A lever control is fitted for speed change, with another for remote arm cueing. Thorens have used a new motor for this model, a low voltage (16V) 16-pole synchronous type, and the accompanying miniature transformer is fitted into the supply cable to reduce cartridge hum induction.

The *147* is a full sub-chassis design, the inner chassis a reinforced light steel pressing suspended on three adjustable coil springs. The large zinc alloy platter is belt-driven at two fixed speeds and is fitted with a pulley clutch to improve start-up. The low mass arm has precision bearings with spring downforce and frictionless magnetic bias compensation.

### Lab report

Weighing 3.5kg, the accurately-machined platter came fitted with a reasonably flat mat affording fairly good disc damping. The unit was well engineered and finished, with a substantial and well-toleranced main bearing. All readings for wow and flutter were to a good standard, the speed accuracy being satisfactory and the slowing under load of moderate proportion. Rumble was quite excellent at 192

–80dB with the spectral analysis revealing very little spurious effects.

Acoustic isolation edged into the very good class while vibration energy was also well rejected. Shock resistance was satisfactory but feedback margins were up with the best. Hum levels were low and the unit was easy to use, unlike many sub-chassis types.

Arm bearings were commendably free of play yet provided low friction levels. The bias compensation worked well though the readings were somewhat on the low side. Downforce calibration was accurate at the higher settings, while the cue operated at a decent rate with no drift. The arm geometry was very good overall, though height adjustment was by means of clumsy spacers; Thorens could well improve on this. Arm lead capacitance was also rather high at 240pF, and would be unsuitable for certain cartridges when added to amplifier input capacitance.

The arm resonance graph suggested quite a good behaviour with the energy trend quite well maintained, the minor modification of the springy finger lift giving a further improvement.

### Sound quality

The sound was felt to present an improvement over the favourable level already established by the *166*, though not anything like as great an improvement as the 2:1 price increase might suggest. Characterised by a 'tuneful stability', the *147* gave good rendition of bass inform-

ation with considerable detail throughout the range. The arm could sound a trifle hard and brash at times, with fair depth but slightly vague stereo focus but the addition of a felt mat, deletion of the lift and packing the cartridge to an accurately set vertical tracking angle helped considerably, and almost took the sound into the uppermost category.

**Conclusion**

While clearly not as good value as the 166, the 147 is a fine-sounding integrated turntable of honest, well adjusted, conventional design, whose overall performance certainly warrants recommendation.

**GENERAL DATA**

Integrated turntable

**Motor Section**

Type... auto-stop, belt-drive, synchronous motor, subchassis  
 Platter mass/damping... 3.5kg/good  
 Finish and engineering... very good/very good  
 Type of mains/connecting leads

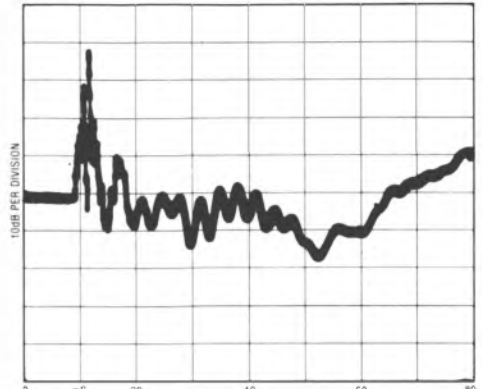
2-core, line transformer/phonos and earth  
 Speed options... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)... 0.08%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)... 0.12%/0.05%  
 Absolute speed error... + 0.8%  
 Speed drift, 1 hour/load variation... synchronous/ - 0.25%  
 Start-up time to audible stabilisation... 4.3 secs  
 Rumble, DIN B wtd L/R average (see spectrum)... - 80dB

**Arm Section**

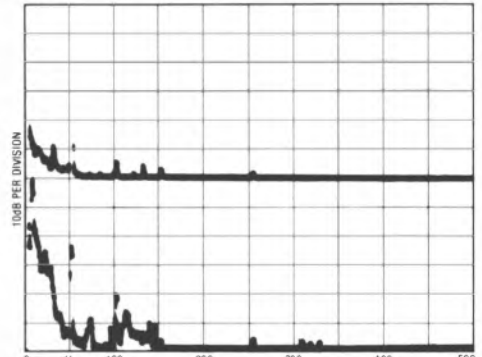
Approximate effective mass, inc screws, excl cartridge... 6.0g  
 Type/mass of headshell... detachable carrier  
 Geometric accuracy... very good  
 Adjustments provided... overhang/offset  
 Finish and engineering... very good/very good  
 Ease of assembly/setting-up/use... good/fair/very good  
 Friction, typical lateral/vertical... 25mg/25mg  
 Bias compensation method... magnetic  
 Bias force, rim/centre (set to 1.5g elliptical)... 150mg/150mg  
 Downforce calibration error, 1g/2g... + 0.2g/ + 0.05g  
 Cue drift, 8mm ascent/descent... negligible, 0.5 secs/0.9 secs  
 Arm resonances... average +  
 Subjective sound quality... average +  
 Lead capacitance/damping method... 240pF/none

**System as a whole**

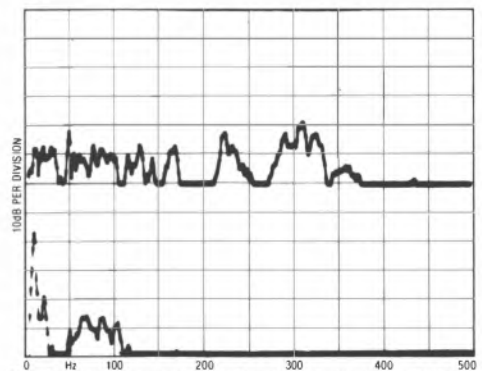
Size/clearance for lid rear... 44(w) x 36.5(d) x 17(h)/8.5cm  
 Ease of use... very good  
 Typical acoustic breakthrough and resonances... very good  
 Subjective sound quality of complete system... good + +  
 Hum level/acoustic feedback... very good/very good  
 Vibration sensitivity/shock resistance... good + /fairly good  
 Estimated typical purchase price... £240



Disc impulse transmission showing damping

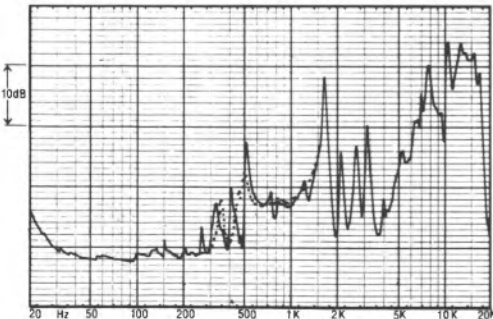


Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques



Structural arm resonances, audio band

# Thorens TD126 Mk IV

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF  
Tel Waltham Cross 716666



Supplied over the years in various forms, and as reviewed last year had undergone several changes, not the least of which has been the official factory incorporation of an *SME III* tonearm, fitted with both manual and power cueing plus a sensor for auto lift and switch-off at end of side (for the arm data, see the separate *SME* review.) However not all the changes have been necessarily for the better: for example, the main bearing shaft on the version tested last year was smaller than before, measuring just 6.5mm in diameter. The servo time constants on the servo-controlled motor had been altered but the dynamic wow was still present, estimated at  $\pm 0.3\%$ , spread over a rather long 3 seconds recovery time.

The full-size top deck plate forms the die-cast isolated chassis, mounted on coil springs, which are easily adjusted from below. The medium weight 2.6kg platter is belt driven at three adjustable speeds, with an illuminated stroboscope allowing speed reference to the main frequency. At last a mat with some degree of disc contact has been fitted, though this is of a rather hard synthetic rubber grade.

## Lab results (Mk III)

The rumble results were poorer than before, though still averaging a good -73dB DIN B. However a significant 100Hz content at -65dB unweighted is shown on the spectrogram, plus certain other components. Steady state wow and flutter was excellent, but on last year's sample transient load changes resulted in poorer wow, which was also noted during

start up. X10 scaling was possible for the disc impulse response, though the mat was not a star performer as the extended ringing shows. Although isolation and breakthrough were well above average, they were nonetheless not in the Walker class, for example.

## Sound quality

The 126 has now emerged in a revised form, and this *MkIV* was assessed for this edition. After many years' battle, Thorens have at last conceded defeat concerning their 'overshooting' DC servo motors and have here reverted to a synthesised mains oscillator plus original synchronous motor drive. As a result dynamic wow has disappeared while the drive is once again both stable and powerful. Other improvements concern the return to the larger main bearing and the all metal platter, but the other chassis details are unaltered as are the facilities offered.

Reauditioned, the unit gave a fine wow-free performance. The bass was comparatively even and extended, while good stereo depth and ambience were apparent. Very good feedback immunity was also established.

## Conclusion

The 126, reincarnated in synchronous drive

### GENERAL DATA

Motor Unit - integrated with SME III

#### Motor Section

|  |                                   |
|--|-----------------------------------|
| Type   | ..... belt drive                  |
| Platter mass/damping                           | ..... 2.5kg/good                  |
| Finish and engineering                         | ..... very good/very good         |
| Type of mains lead/connecting leads            | ..... 2 core/phonos + earth       |
| Speed options                                  | ..... 33/45/78rpm (variable)      |
| Wow and flutter (DIN peak wtd sigma 2)         | ..... <0.05%                      |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) | ..... <0.1%/<0.05%                |
| Absolute speed error                           | ..... +0.6% (requires adjustment) |
| Speed drift 1 hour/load variation              | ..... +0.25%/ -0.07%              |
| Start up time to audible stabilisation         | ..... 4.5secs                     |
| Rumble: DIN B wtd L/R av (see spectrum)        | ..... -72/-74dB                   |

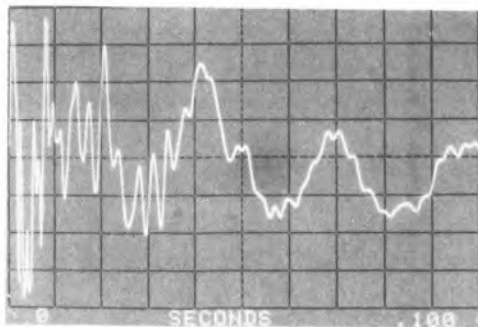
#### Arm Section

|  |   |                                 |
|--|---|---------------------------------|
| Approximate effective mass inc screws          | ..... excl cartridge                                  | ..... 5.0g                      |
| Type/mass of headshell                         | ..... plug in arm tube/N/A                            |                                 |
| Geometric accuracy                             | .....   | ..... excellent                 |
| Adjustments provided                           | ..... overhang, tilt, arm height                      |                                 |
| Finish and engineering                         | .....   | ..... excellent/very good       |
| Ease of assembly/setting up/use                | .....   | ..... good/good/very good       |
| Friction: typical lateral/vertical             | ..... less than 10mg/less than 10mg                   |                                 |
| Bias compensation method                       | .....   | ..... suspended weight (pulley) |
| Bias force: nm/centre (set to 1.5g elliptical) | .....   | ..... 275mg/275mg               |
| Downforce calibration error: 1g/2g             | .....   | ..... -0.12g/-0.18g             |
| Cue drift/8mm ascent/descent                   | ..... negligible/0.6sec/4.0secs                       |                                 |
| Arm resonances                                 | .....   | ..... good                      |
| Subjective sound quality                       | .....   | ..... good +                    |
| Lead capacitance/damping method                | ..... optional to 300pF/variable fluid damping option |                                 |

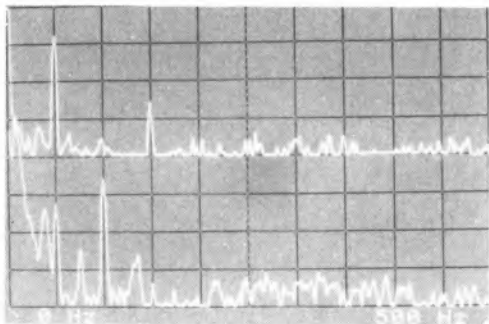
### System as a whole

|  |                                       |
|--|---------------------------------------|
| Size/clearance for lid rear                  | ..... 50.3(w) x 38.8(d) x 17.0(h)/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/very good             |
| Vibration sensitivity/shock resistance       | ..... good/very good                  |
| Estimated typical purchase price             | ..... £400                            |

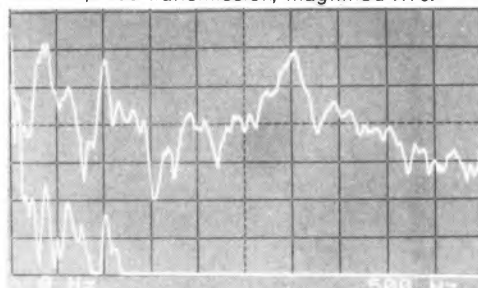
form, returns to the recommended listings as a versatile three-speed, full sub-chassis stalwart of respectably good sound quality. It is easy to set up and align, and should give a long trouble free life.



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

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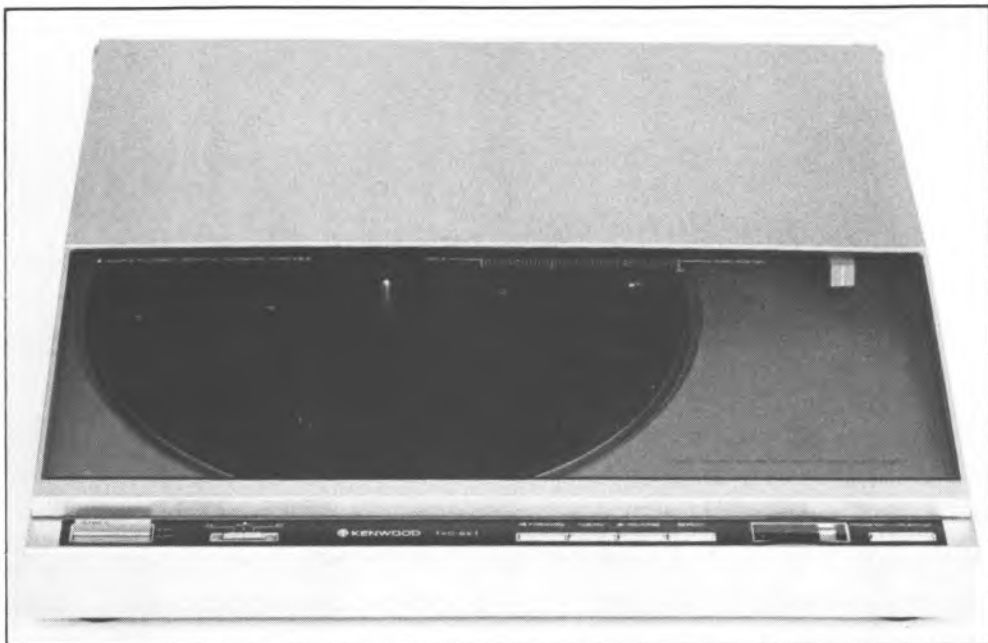


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# Trio KD9X

Harman UK (Audio) Ltd, Mill Street, Slough, Berks SL2 5DD  
Tel (0753) 76911



The KD9X belongs to the parallel- or linear-tracking group, having an automated servo-controlled tonearm with an integrated moving magnet cartridge — considered a fixture for the purposes of this review — the stylus fitted having a modest spherical tip tracking at a 2g downforce. An inbuilt photodetection system is used for track seeking, and a pushbutton controlled digital display shows the track number selected, as well as a letter code for certain operating modes — for example, 'E' means that the playing cycle has ended. The arm has power traverse and is not normally touched by hand at all.

A direct drive type, the player has two speeds, automatically or manually selected, and under quartz lock. The design has a solid plinth with little isolation from environmental interference.

Our first sample was an ex-demonstration one, and unfortunately on delivery it was found to have sustained some damage to the tonearm beam. This temporarily repaired, the rest of the turntable was found to operate satisfactorily and testing therefore proceeded, with the exception of the arm resonance graph of course.

## Lab report

The cartridge was briefly assessed with the aid of some tracking tests which it passed satisfactorily. A response/crosstalk graph showed that separation was smooth and reasonably good, the cartridge giving a fairly typical moving magnet response which would probably benefit from some extra capacitance loading — up to a total of 500pF. A slight suck-out was noted in the presence range but the subsequent treble rise was not excessive.

A rather lightweight 0.9kg platter was fitted, possessing poor damping properties judging by the impulse response — this was dominated by low frequency rocking. The engineering was judged 'average' but with a very good surface finish. Possessing accurate speed, the player also performed well on the wow and flutter test and started up rapidly. However, rumble figures of better than -70dB could not be obtained, partly due to the necessary use of a test record, and partly due to noise emanating from the servo motor on the arm carriage, which proceeded in a series of very small 'jerks'.

Acoustic breakthrough was judged about average as was the vibration rejection. Shock

resistance was fairly good, but feedback resistance was merely average.

Arm geometry was predictably excellent, and as far as could be judged, its various facilities and parameters were all satisfactory. Cue rates were sensible with negligible drift, but most measurements could not be undertaken due to the enclosed servo-controlled nature of the design.

### Sound quality

Assessed as a complete unit, the sound was frankly better than expected, and achieved an average rating. The cartridge/arm sound was not unpleasant with reasonable bass extension and definition, plus a smooth midrange. However, the treble showed some graininess with less detail than usual and on the whole the stereo image was rather lacking in depth as well as focus.

### Conclusion

The KD9X is clearly not a great turntable, but of its type, namely the lightweight automated liner tracking group — it is probably one of the best-sounding. However this is insufficient to secure a *Hi-Fi Choice* recommendation, although it might be worth considering if its styling and facilities appeal strongly.

#### GENERAL DATA

Integrated turntable (inc. cartridge)

#### Motor Section

Type..... quartz, direct-drive, linear tracking  
 Platter mass/damping..... 0.9kg/average —  
 Finish and engineering..... very good/average  
 Type of mains/connecting leads..... 2-core/phonos and earth  
 Speed options..... 33/45 rpm  
 Wow and flutter (DIN peak wtd, sigma 2)..... 0.07%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)

0.08%/less than 0.05%

Absolute speed error..... — 0.05%  
 Speed drift, 1 hour/load variation..... none  
 Start-up time to audible stabilisation..... 1.6 secs  
 Rumble, DIN B wtd L/R average (see spectrum)  
 better than —70dB

#### Arm Section

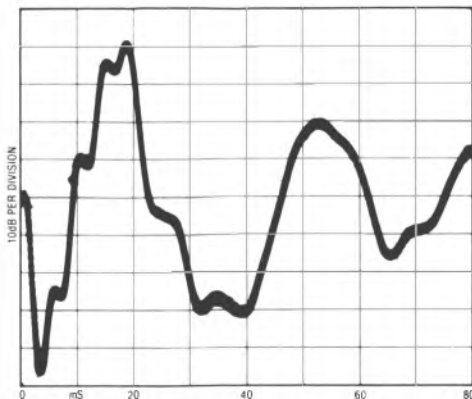
Approximate effective mass, inc screws, excl cartridge... N/A  
 Type/mass of headshell..... non-detachable  
 Geometric accuracy..... excellent  
 Adjustments provided..... none  
 Finish and engineering..... good/average  
 Ease of assembly/setting-up/use  
 very good/excellent/excellent

Friction, typical lateral/vertical  
 less than mg/less than mg

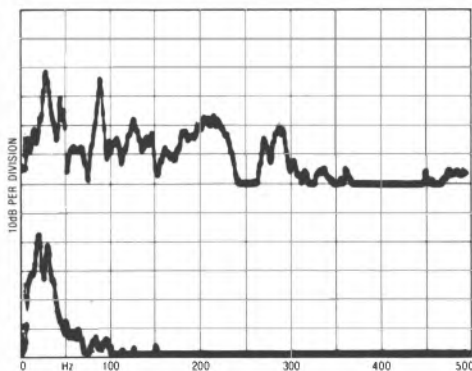
Bias compensation method..... not required  
 Bias force, rim/centre (set to 1.5g elliptical)..... N/A  
 Downforce calibration error, 1g/2g..... —/—  
 Cue drift, 8mm ascent/descent..... none, 1.8 secs/2.0 secs  
 Arm resonances..... N/A  
 Subjective sound quality..... N/A  
 Lead capacitance/damping method..... —/none

#### System as a whole

Size/clearance for lid rear..... 43.5(w) x 39(d) x 11cm(h)/none  
 Ease of use..... very good  
 Typical acoustic breakthrough and resonances..... average  
 Subjective sound quality of complete system..... average  
 Hum level/acoustic feedback..... very good/average  
 Vibration sensitivity/shock resistance..... average/fairly good  
 Estimated typical purchase price..... £249

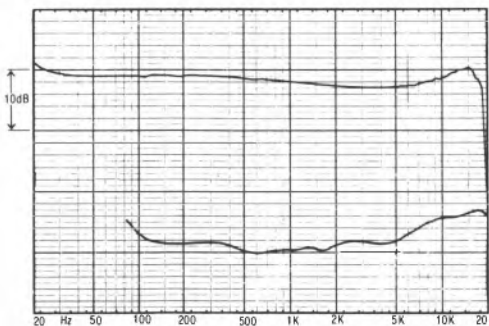


Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

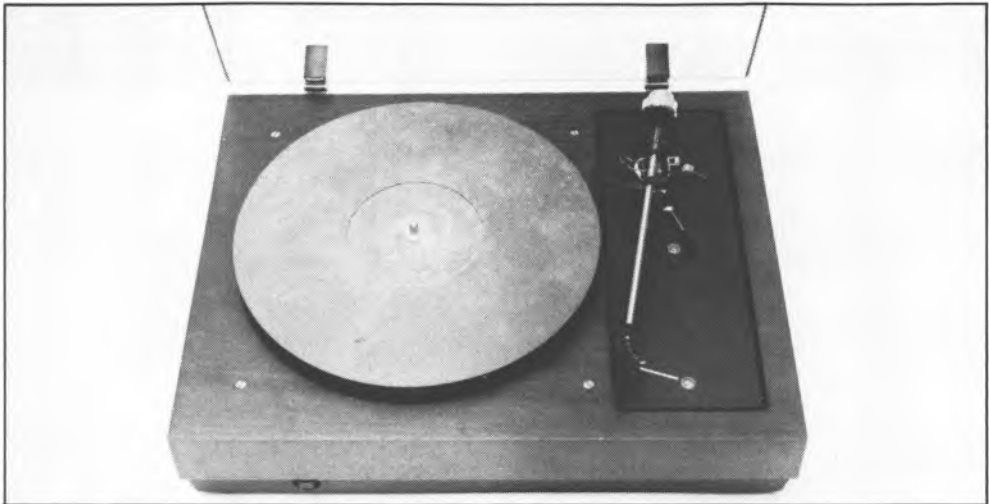


Frequency response and separation, cartridge

RECOMMENDED

# Walker CJ55

CW & J Walker Ltd., Brentwood, Red Lane, Frodsham, Warrington WA6 6RA.  
Tel (0928) 33326



For the last issue, a pre-production sample of the CJ55 arrived just in time to meet our deadline, but this year we were able to test a full production model. Designer Colin Walker is well known in the hi-fi industry, and with this turntable has at last brought the benefit of his two decades of product experience to bear on one of his own creations, rather than on behalf of others.

Stressing traditional design rather than pointless innovation, the unit uses an open hardwood frame for the subchassis, floating on four coil-springs whose setting is easily achieved from above. A full size rectangular arm board is incorporated. Belt driven from the usual synchronous motor, the double unit platter is different in being machined from a long established organic heavy engineering material called *Tufnol*, which provides an inert hard platform for the record; however additional mats can be used if so desired. The large 10mm main bearing employs a hardened steel shaft in a plain, high strength bronze bearing, and runs on a central thrust ball. A non-resonant friction-hinged cover is fitted to the traditional veneered plinth, and a full-sized arm board is fitted. In fact as very little plastic or metal is used in its construction, in material content the '55 might be regarded as closer to a musical instrument than a piece of audio engineering!

### Lab results

The fine measured performance testified to the 198

fact that no concessions have been made in important engineering aspects; even spectrum analysis of rumble failed to unearth any significant effects. Likewise the acoustic and vibration isolation were very good, although a low frequency platter rocking mode (not too serious) at about 50Hz prevented the use of X10 scaling for the disc impulse test, which otherwise gave a very good result.

### Sound quality

The new sample acquired for retest in this issue gave substantially the same good performance. Reauditioning with a Mission 774 tonearm, this year we felt that subjectively the performance was further improved by the use of a felt mat which appeared to reinforce the stereo imaging and give a better-defined bass. The overall effect was still slightly 'rounded' in terms of tonal balance, and consistently musical, while pitch and tempo were well preserved.

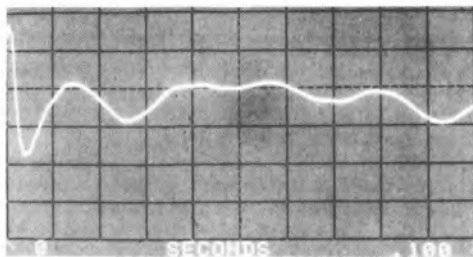
### Conclusion

At around £150 this motor unit has fulfilled its original promise. The sound quality is high — commendable at the price — and all significant aspects of its technical performance are to a respectable standard. It is worth trying it with a felt mat which has the additional advantage of being kinder to disc undersides, but as it stands the CJ55 deserves a confident recommendation.

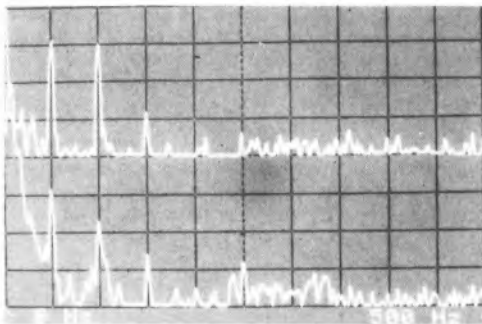


**GENERAL DATA**

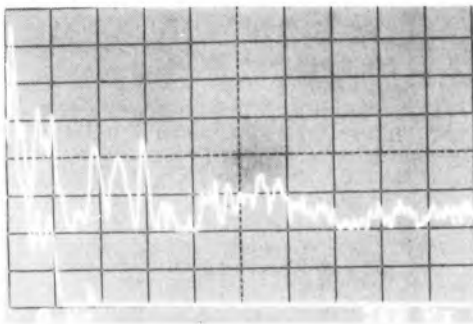
|  |                         |
|--|-------------------------|
|  | Motor unit              |
| Type .....   | belt drive, subchassis  |
| Platter damping .....                                | good                    |
| Finish and engineering .....                         | good                    |
| Type of mains/connecting leads .....                 | 3-core                  |
| Speed options .....                                  | manual change 33/45 rpm |
| Wow and flutter (DIN peak wtd, sigma 2) .....        | 0.06%                   |
| Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... | 0.11% < 0.05%           |
| Absolute speed error .....                           | + 0.2%                  |
| Speed drift, 1 hour/load variation .....             | - 0.2%                  |
| Start-up time to audible stabilisation .....         | 4.5 secs                |
| Rumble, DIN B wtd L/R average (see spectrum) .....   | 76/78dB                 |
| Ease of use .....                                    | fairly good             |
| Typical acoustic breakthrough and resonances .....   | very good               |
| Subjective sound quality of complete system .....    | good +                  |
| Hum level/acoustic feedback .....                    | very good/very good     |
| Vibration sensitivity/shock resistance .....         | very good/fairly good   |
| Estimated typical purchase price .....               | £149                    |



Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

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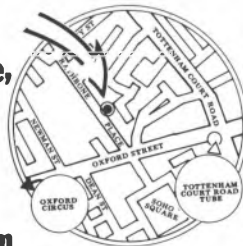
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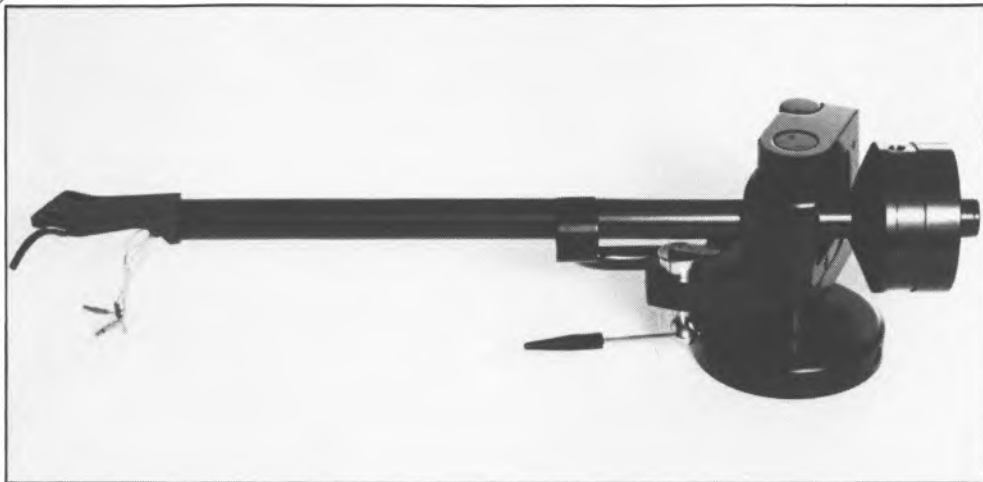
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RECOMMENDED

# Zeta

Esoteric Marketing, 49 Leys Road, Pattishall, near Towcester, Northants  
Tel (0327) 830670



Firmly in the 'super-fi' class at close on £400, the Zeta arm is a UK-designed and manufactured product with a very business-like construction and exterior.

Finished in satin black throughout, the arm comes packed in a handmade, hinged plywood case. A fixed headshell design, rigidity is its byword, with the massive construction clearly amplifying this concept. The entire pillar/base and gimbal support is machined from a solid block and likewise the oversize beam tube is a continuous structure, running right through the bearing assembly. The headshell is free of perforations aside from the cartridge fixing slots, representing an excellent mounting platform. As in the Sumiko, those few parts which are joined are thermally bonded, thus avoiding the variability of the adhesives normally-used.

The large counterweight consists of an aluminium shell containing a series of steel weights, these being selected in combination for the required counterbalance force, then locked in position. The whole assembly may then be locked on the rear arm beam section using large socket head screws and downforce must be set using an auxiliary gauge. An internal hair-spring bias compensator is fitted, integral to the pillar housing and controlled via small knurled wheel. Uncalibrated, this needs to be set by trial and error, using a tracking test record and via listening tests.

Geometrically, the offset is at 23.75 deg in order to bring the stylus tip into alignment with

the arm beam centre line and to reduce torsional excitation. Heavily gold-plated professional connectors are used for the arm cable which has fine phono plugs at the other extremity, these also gold plated. The cable was judged to be reasonably compliant and offered a low 100pF lead capacitance.

The gimbal bearings are set virtually to tightness and employed a large number of race balls on superfinished hardened surfaces. Effective mass approaches the 'heavy' category specially suited to low compliance, high performance moving coil cartridges.

## Lab report

Estimated at 16g, the effective mass would ideally partner cartridges in the 7-14cu compliance range. The geometric accuracy was excellent, and the arm was superbly crafted and finished. Friction was satisfactorily low at 25mg in both planes, and when set to 'off', very little bias was developed. At the mid click position 200mg was noted, with 325mg at 'max' this is a very sensible control range. The cue worked well with sensibly chosen rates.

Charted for resonances, the start of the graph is low down due to the mass contribution; thereafter it is distinguished by a uniquely even energy trend. A few minor resonances are present, but do not significantly disturb the result. A trace of bearing play was noted with our sample but the designer indicated that this should be typical.

### Sound quality

Immediately recognisable as a top-class product, the Zeta was most rewarding on audition. The bass was exceptionally good — deep, powerful, tight and articulate. Tonal balance as slightly 'heavy' in a relaxed, unstrained fashion — full of depth, detail and sharp stereo focusing, while the treble was sweet and transparent with negligible blurring.

### Conclusion

Here is another UK-built, front-rank audiophile product. Its constructional quality, finish and sound were all first rate and would satisfy the most discerning of purchasers, and while a high price must be paid for this, for many the results will justify the outlay.

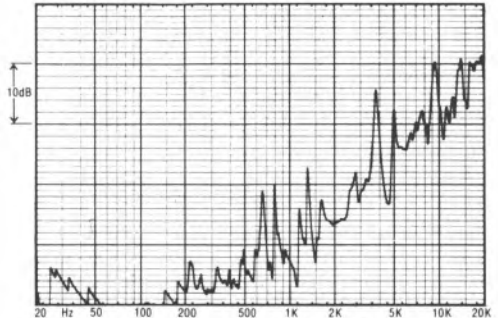
### GENERAL DATA

#### Arm Section

Approximate effective mass, inc.screws, excl cartridge. . 16.0g  
 Type/mass of headshell. . . . . non-detachable  
 Geometric accuracy. . . . . excellent  
 Adjustments provided. . . . . height/overhang/offset  
 Finish and engineering. . . . . excellent/very good  
 Ease of assembly/setting-up/use. . . . . good/good/good  
 Friction, typical lateral/vertical. . . . . 25mg/25mg  
 Bias compensation method. . . . . internal spring  
 Bias force, rim/centre (set to click-stop position)

200mg/200mg  
 uncalibrated  
 Cue drift, 8mm ascent/descent. . . . . slight, 0.7 secs/1.9 secs  
 Arm resonances. . . . . very good  
 Subjective sound quality. . . . . very good  
 Lead capacitance/damping method. . . . . 100pF/none  
 Estimated typical purchase price. . . . . £399

Tonearm



Structural arm resonances, audio band

## Recommended by this magazine



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Undoubtedly our most popular and sought after turntable, this deck has a superb performance for around £148 and can be used with a wide range of cartridges and amplifiers. This turntable is a hand-crafted product and normally subject to a waiting period for delivery so we most strongly suggest that if a superlative performance at reasonable cost interests you, book a demonstration, we are sure you won't be disappointed.



## THORENS TD160

Another popular low-cost performer for around £119 (ex-arm), the TD160 offers a good performance with the capability of accepting a wide range of tone-arms. Its main strength lies in ease of use, low colouration and its resistance to acoustic feedback. With these attributes it is understandably a popular front-end combination. If you want to know more about the TD160 why not come in for a demo?

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Models covered in this section have been tested in previous editions and in many cases have been quite highly rated. Though some units here are discontinued, many of these may be available at attractive prices.

## **ADC 1500**

Rated worth considering in the last issue, this modest belt-drive servo-motor deck may still be available. Closely-related models of BSR origin have also appeared under different brand names.

## **ADC 1700**

Achieving a similar subjective rating to the 1500, the direct-drive 1700 was regarded as less good value. Once again, 'own brand' variations may be found.

## **Aiwa LP3000**

Of 'dreadnaught' construction, this model was an earlier effort at producing a high-quality linear tracking turntable with many user-convenience features such as programmable track selection. Sound quality was only average, but isolation very good.

## **Ariston RD110**

Now superceded by more Ariston models, the RD110 motor unit returned a good, neutral if unremarkable sound quality when tested last time round.

## **Denon DP30L**

A new range of Denon products should shortly be reappearing in the UK after an absence of some months. The DP30L, no longer current, may possibly be still available at a low price. It was rated worth considering in the last edition.

## **Denon DP60L**

Again theoretically obsolete, this one-time Denon flagship offered attractive styling and features though sound quality was disappointing at the price.

## **Decca International**

This unipivot design has a moderate 12g effective mass, and gives a generally above average sound quality, characterised by a rather 'rich' balance, with some bass muddling and mid-forwardness; a good match for Decca's individual-sounding cartridges. Construction quality was a little disappointing.

## **Dual CS508**

Unrelated design-wise to the subchassis 505, the Dual 508 offers more modern plinth styling but poor isolation. It received a guarded 'worth considering' last time, as it needs to be sited carefully.

## **Dynavector DV505**

This extraordinary arm, now effectively replaced by the 501, itself weighs no less than

1.8kg, and has a correspondingly high effective mass, particularly lateral. Despite the very high price, our listening tests placed this model at only average, with a similar rating for arm resonances. Friction was on the high side horizontally, and no cueing system was fitted.

## **Hadcock GH228**

Reviewed in the last two issues, this well-known unipivot design gave good sound quality for the price, but requires skill and patience as well as enthusiasm from the user when setting up.

## **Hadcock GH220SS**

Just missing a recommendation in the last issue, the GH228 scored above average on our listening tests, with better image stability and 'focus' than the 228.

## **Infinity Black Widow**

This arm had an exceptionally low effective mass, suiting it to high compliance cartridges, but at a heavy cost in terms of structural rigidity, reflected in the poor audio band resonance results. Generally good engineering in other respects resulted in above average sound quality, though the high price makes this model uncompetitive.

## **JVC QLF6**

With an excellent motor, this earlier JVC model rated below average on sound quality, though quite good results could be obtained if placed on a solid shelf.

## **Mayware III**

While the Mayware arm received a recommendation in previous issues, the importer has declined to submit current samples for review.

## **Michell Focus Arm**

This unipivot design is packed with engineering features and adjustments, and returned quite good results with higher-compliance cartridges. It was rated worth considering in the last issue.

## **Michell Marble Electronic**

This massive and impressive-looking design needed careful siting for optimum results, and even then did not shake off a 'softness' and lack of definition in the bass register.

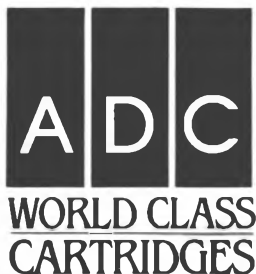
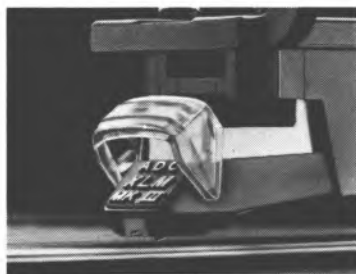
## **Monitor Audio ET500**

This solid-plinth motor-unit needed careful siting for good results, and showed some degree of the dynamic wow problem associated with this particular Matsushita direct drive motor.

## **Optonica RP5100**

An attractive deck of medium arm mass, the performance was reasonable for the price, though marred somewhat by a slight tendency

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to bass feedback and poor arm friction on our sample.

## **Philips 829**

Though separate hi-fi components are no longer marketed under the Philips brand, the 829 may possibly still be available. This fully automatic design was rated worth considering in previous issues.

## **Pioneer PL200X**

Recommended in an earlier edition, the PL200X gave a fairly good sound balance, but the 17g arm mass rules out higher compliance cartridges. Also, the deck needs careful siting to avoid breakthrough effects.

## **Pioneer PL400X**

Offering little if any advantage over the 200X, the PL400X was thus less competitive. Both models are theoretically obsolete but may still be obtainable at attractive prices.

## **Pioneer PLL1000**

This first-generation Japanese linear-tracker was massive in construction and despite unfavourable arm resonances gained a good rating for sound quality. Though too expensive for recommendation it had many good points and contained some fine engineering.

## **Revox B790**

Predecessor to the 795 and 791, this Revox deck lacked variable speed and came with a less than satisfactory cartridge.

## **Sansui SR222 II**

Long discontinued, this much-recommended product might be worth looking for on the secondhand market.

## **Sansui FRD35**

A disappointment after the 222 II, this budget deck scored low marks for sound quality.

## **Sansui FRD55**

Offering some improvement over the 35, along with the ability to programme tracks in any order, but even so could not be not recommended.

## **SME 3009 II Improved**

This classic design was still rated worth considering in the last issue, particularly the non-detachable version which was regarded as the better of the two options. In value for money terms the design may be overshadowed by the latest version of the 3009 III.

## **Stax UA7**

These beautifully finished arms are available with either aluminium or carbon fibre tubes, though there was little to choose between these options, both having a highish 16g effective mass. Rigidity limitations at the unipivot and double universal connections

limit the model's competitiveness at its highish price.

## **Syrinx PU2**

Competing very strongly with the Linn *Ittok* the unusual Syrinx PU2 showed great promise and was rated worth considering for the serious enthusiast when tested last time. Unfortunately the new PU3 model was not quite ready to meet our deadlines for this issue.

## **Technics SLB2/B3**

Reasonable though not exceptional for the price, these models are quite well balanced, but our sample had poor arm friction. Arm mass of 13g suits low/medium compliance cartridges, and careful siting is worthwhile.

## **Technics SLQ2/Q3**

A splendid motor was to some extent compromised by a rather average arm and breakthrough performance. The arm is suited to cartridges in the 10-17 cu range. Sound quality was above average, pleasantly detailed and neutral, but lacking some stereo depth and bass definition.

## **Technics SL1700 II (1600 II/1800 II)**

One of the few integrated models to rate 'good' on sound quality in the context of our last issue, this range of players was generally well balanced, the superb motor being to some extent compromised by only average ratings on audio band arm resonances and vibration susceptibility. Recommended overall, these players are best suited to cartridges in the 10-17 cu range.

## **Ultracraft AC30**

A rigid arm with fairly low mass (9g), the AC30 is a well-engineered unipivot design with variable damping, which makes it capable of almost universal application, producing sound quality felt to be of *SME III* character. At just under £100 it was recommended in the last issue.

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# CONCLUSIONS

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With ever-keener competition between manufacturers and continuing refinement of design, the task of evaluating current product has not become any easier since the last 'Turntable' issue. Our increased attention to the 'audiophile' end of the market has resulted in a move away from the mass market models where we have plenty of experience, and where cause and effect are usually clear enough. On the other hand, it has become increasingly obvious that comparatively subtle interactions between high quality components can 'make' or 'break' the performance of a 'superfi' turntable combination. Perhaps this issue should have been retitled 'Disc Playing Systems', since we feel most confident in our assessments of complete systems amongst 'superfi' components.

The Linn proved to be the classic audiophile turntable available at anything like a sensible price. It was used exactly as the manufacturer's recommend, with the felt mat, full and detailed alignment, and the latest *Ittok* and *Asak* components (not however the 'special' versions of these). It did not offer perfection — no hi-fi ever can — but in our opinion this disc player fended off all the opposition until a doubling of system price level was reached.

Our findings reinforce the view that single motor units, arms etc, cannot attain their full potential until a compatible match has been identified, enabling a set of balanced disc player components to be assembled. The separate component goal of high neutrality and universality, permitting easy interchangeability would therefore appear to be inappropriate at the high quality end of the market. Furthermore individual changes made to a balanced system which can theoretically be shown to improve matters, can actually detract from the subjective performance of the whole.

Take the case of the Pink Triangle. Its particular character was such that we felt the *Asak* cartridge was unsuitable even if used in an *Ittok*. The almost bland, neutral and comparatively recessed midrange sound needed a more 'forward' sounding cartridge; the *Koetsu* proved to give the best results. Each platter and mat combination lends its own peculiarities, and wherever possible audition of a complete and set-up system is advisable before purchase.

Leaving behind the audiophile stratosphere, several models at more modest price levels

also demonstrated the benefits of system design, and in so doing provide the consumer with foolproof, consistent and value-for-money performance. Noteworthy are the Technics parallel tracking group, with their low mass integrated cartridge/arm; these had above average structural integrity and mass, and came fitted with fine quality highly compatible cartridges.

*Choice* has never had much sympathy with those silver-plated plastic creations sporting innumerable gadgets of dubious value (such as auto track selection and quartz readouts), so it was gratifying to find that an old stalwart, the Thorens *TD166* has returned to these shores. The Swiss parent company tried to withdraw this straightforward model a year or so back, but with its new mat and despite its age, it immediately merits recommendation, showing clear advantages over younger and flashier competitors.

A similar pattern is also demonstrated by the German Dual range, where the old style sprung-chassis *505* is far more competitive than more recent orientally-styled stablemates, the *741Q* and *508*.

A few Japanese manufacturers have had some success using the subchassis principle, notably Technics, Akai and Pioneer. But the most refined example is undoubtedly the Lux *PD300*. Strong in many respects, this design seems to have undergone revision at the last moment in order to cope with an unwarranted (?) fear of subchassis instability, resulting in the addition of excess damping to the suspension (see review). With further attention paid to spring rate and damping, however, the '*300*' could well become one of the world's leading analogue turntables, and even as it stands it remains a fine performer.

Conversely, experiments in the direction of extreme mass and strength are typified by the Marantz top line models. These aim to lock the arm and platter together *via* massive inertia and rigidity in the plinth. In theory vibration will be suppressed and isolated from the playing section by this closed loop, but in practice the stylus remains excited by numerous resonances throughout the frequency range, due to imperfect dynamic balance and finite plinth chassis rigidity.

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.

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# CONCLUSIONS

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## 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 twenty 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 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. An aspect which has been looked at 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. To our knowledge there are several tonearms which have been specifically optimised, including the unipivot Michell *Focus*, the Audio Technica *AT1100*, Helius and 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 FR). Mismatch and flexure at the socket/plug join produced 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 rigidity 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 Alphason *HR100*), less desirable behaviour produces severe jumps in the energy trend, implying that the effective mass is discontinuous with frequency.

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 (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 Dual *505* series, Fidelity Research *FR12*, and Michell *Focus*).

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# CONCLUSIONS

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## 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 instruction 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 arrived 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 low 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 should be sensibly higher than this, and hence low mass arms are often fitted, unless a good low compliance cartridge is available.

## Isolation problems

With the exception of one or two mechanically inert models, and of course the suspended subchassis types, many decks in this issue failed to block effectively 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 slip and rattle. Play or looseness in the arm system adds a random indecisiveness to the effective cartridge position, which clouds detail and gives an almost 'fuzzy' effect to the reproduction. 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 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.

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Your choice here will naturally be influenced by the cartridge you intend using, the turntable you already have, and the amount of money you can afford to spend, and not necessarily in that order! Providing that an arm of decent quality is chosen, the turntable will always be the influencing factor and, to this end, a Linn LP-12 with a Basik will always sound better than, say, a Heybrook TT-2 with an Ittok. That said, the ideal of course is to have a top class arm *and* turntable, and the results from a synergistically compatible combination can be really quite remarkable—even when a relatively inexpensive cartridge is used.

We at KJ West One are proud to be able to offer a really comprehensive range of the world's best pickup arms at prices to suit all pockets. From the established Linn Ittok and Syrinx PU-2 Gold, to the new PU-3, Alphason and Zeta, the beautiful Sumiko and rare Koetsu arm, or the versatile FR 64fx, our range is broad and all-encompassing. What's more, we'll even fit the arm and cartridge to

the turntable in question, and advise on compatibility too. We can justifiably claim to offer a standard of arm and cartridge fitting that is second to none, and that's a promise. Furthermore, our specialised knowledge of fitting up-market arms, and getting the best from them, pays equal dividends when you buy your Basik arm too, because each turntable/arm/cartridge receives the same individual care and attention.

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# BEST BUYS AND RECOMMENDATIONS

As in previous editions of *Turntables and Tonearms*, there is no Best Buy category as such, and we have restricted ourselves to 'Recommended' and 'Worth Considering' differentiation. This is largely because even the best products fall somewhat short of the ideal despite being very expensive, while even the best of the cheaper models show manifest flaws to mute our enthusiasm.

This listing should only be taken as a guide, particularly where separate components are concerned, as their performance may well be determined by the quality of set-up or combination. Note also that the value judgements are based upon the prices quoted, that prices do fluctuate significantly, so some re-interpretation may be necessary.

## INTEGRATED TURNTABLES: RECOMMENDATIONS

### **B&O Beogram 8002** (£450 inc cartridge)

This elegant and sophisticated turntable includes a specially matched high-performance cartridge. With remote control via a matching receiver, it offers a linear tracking tonearm with a fine suspended sub-chassis.

### **B&O 6002** (£350 inc cartridge)

Not tested, the 6002 is substantially the same machine as the more expensive 8002, but with a belt-driven platter.

### **B&O Beogram 1700** (£95 inc cartridge)

This is a highly complete automatic player with an above average low mass cartridge plus an effective subchassis. It is however soon to be replaced by the 1800 which is an updated version with a tonearm and cartridge from the new B&O series.

### **Dual 505.1** (£80 inc cartridge)

Fitted with a sensible and compatible cartridge we were impressed by this modestly priced turntable. It epitomises the idea of a fuss free budget model offering worthwhile sound quality.

### **Linn Sondek LP12/Ittok LVII** (£627)

A top-ranking player combination, providing first-rate sound quality which is fully complemented by and compatible with the Linn Asak cartridge. Considerably more money must be spent to better this system. Only 33 rpm is available, however.

### **Linn Sondek LP12/Basik LVX** (£448)

Without involving any serious performance compromise, the choice of an LVX arm provides Linn with another disc player, this time costing just under £450. A wide range of cartridges may be used, including the better

moving coils (a virtually 'throwaway' cartridge is included with the Basik arm). Once again, there is no provision for playing 45s.

### **Logic DM101/Datum** £415)

These two Logic components do make for a logical player system of fine all-round performance for the price.

### **Lux PD370** (£199)

This well made and finished turntable is fitted with the Lux suction platter as well as a reasonably good tonearm.

### **Michell Focus/Linn Basik LVV**

(£170 inc cartridge)

Available from Michell as an integrated combination, this manually-operated player offers good value and finish.

### **Rega Planar 3** (£148)

Factory-fitted with Rega's own respected arm the *Planar 3* justified its commendable reputation under test in HFC. The *Planar 2* is also considered fine value at £114.00, this model fitted with a somewhat lighter platter.

### **Technics SL7** (£180 inc cartridge)

In our view the 'jacket size' SL7 is the best performer in the Technics linear-tracking series and well worthy of recommendation; however if a conventional-size version is required, then the non quartz *SLDL1* at £170 would be our choice. Both are foolproof automatic decks offering consistently above average performance.

### **Thorens TD166 III** (£115)

This reintroduced turntable provided a remarkably good performance for the price and is therefore confidently recommended.

### **Thorens TD147** (£240)

With the use of a well-suspended subchassis this upmark Thorens turntable has a fully-installed low-mass tonearm with Plinth control cueing and auto-stop facilities. The sound quality was fine for the price.

## INTEGRATED TURNTABLES: WORTH CONSIDERING

These models in our view failed to justify outright recommendation for reasons of cost and/or mild flaws in performance, but are nonetheless capable of fine results.

### **Aiwa LX100** (£150 inc cartridge)

An interesting package, the LX100 sounded reasonably good at the price and came with a compatible cartridge.

### **JVC LA10** (£55 inc cartridge)

One cannot argue too much at this price level if the unit works pretty well, as did the LA10.

### **Marantz TT120** (£54 inc cartridge)

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# BEST BUYS AND RECOMMENDATIONS

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## **Pioneer PL120** (£60 inc cartridge)

This model shows that despite a low price, a decent technical performance is still possible.

## **Revox B791** (£420 inc cartridge)

With detailed improvements and a superior cartridge to that of the 795.

## **Sansui SR222IV** (£85)

Sansui's relaunched 222 made quite a good impression, and is worthy of listing here.

## **Sony PSX600** (£180 or less)

Listed in this category in the last edition, the *PSX600* may now be available at an attractive price.

## **Technics SL10** (£300 inc cartridge)

This superbly designed 'jacket-size' turntable still represents quite good value for money.

## **MOTOR UNITS: RECOMMENDED**

### **Ariston RD80S** (£180)

Assessed here in revised form, this established Ariston probably remains this company's best product to date.

### **Dunlop Systemdek II** (£115)

This unusual product gave a splendid performance, belying its low price.

### **Dunlop Systemdek III** (£299)

Detail refinements have maintained this model's competitive performance while the price has also been held for some time enhancing its value rating.

### **Heybrook TT2** (£195)

A welcome newcomer, this turntable is particularly well engineered and finished.

### **Linn Sondesk LP12** (£374)

An established classic the design becomes more refined with the passing of the years. Now in 'Valhalla' form the timing and speed stability of this excellent product are even better than before.

### **Logic DM101** (£345)

Some detail refinements have occurred since the last issue notably to the suspension which might now be considered a little too compliant for optimum pitch stability, the Logic nonetheless maintains an impressive standard.

### **Lux PD300** (£340)

This superbly engineered and finished turntable is probably the best Japanese deck made at anything like the price.

### **Michell Focus** (£135)

A finely finished and engineered belt drive model, the *Focus* will accept a number of good quality tonearms and is easy to set up and use.

### **Pink Triangle** (£398)

Although more expensive than in the previous

issue, several constructional improvements have helped it to maintain its recommended placing. Easy to set up and align, the *Triangle* offers two speeds plus low coloration and excellent isolation.

### **STD 305(S)** (£160)

Still available, this turntable established good results for the price in earlier editions, and is notably uncritical of alignment.

### **Thorens TD160 Super** (£160); **TD160BC** (£110)

Both these Thorens motor units offer excellent value, the *Super* providing lower coloration and a distinctly up market performance.

### **Walker CJ55** (£149)

Now well established, this musical sounding, hand crafted wood subchassis design offers good value and is also easy to align.

## **MOTOR UNITS: WORTH CONSIDERING**

While these models in our view did not quite justify full recommendation, when suitably set up and matched they can produce fine results.

### **Ariston Superior** (£350)

While we were not entirely convinced by the sound quality from this model, the general standard was sufficient for inclusion here.

### **Dias Heavy** (£480)

This version of the Dias gave a top-ranking sound quality marred only by slight wow and motor breakthrough (a second softer drive cord unfortunately arrived too late for retest).

### **Lux PD555** (£999)

This is the original massive and luxurious vacuum platter turntable.

### **Marantz Estotek TT1000** (£999)

Another luxury dreadnought, this Marantz can give fine sound quality if well sited.

### **Michell Gyrodec** (£595)

In several respects the *Gyrodec* may be considered the British equivalent of the Oracle and indeed the sound is not dissimilar.

### **Oracle** (£747)

The Oracle is the most expensive subchassis design tested in this issue. It aspires to true greatness and only fails by a small margin – and motor torque improvements are expected soon. Major plus features are a neutral tonal balance coupled with low levels of coloration.

### **Thorens TD126 IV** (£240)

This subchassis model, now available once again in its original synchronous motor form, is slightly dated but a good overall performance is possible. The *126* also offers three speeds including 78 rpm.

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# BEST BUYS AND RECOMMENDATIONS

## **TONEARMS:**

### **RECOMMENDED**

#### **Alphason HR100S (£299)**

A newcomer to the scene, the Alphason designer aimed high with his first product and has comfortably succeeded in achieving his target.

#### **Audio Technica AT1120 (£110)**

This new fixed-head low-mass tonearm gave good results on all parameters and sports many facilities.

#### **Audio Technica AT1503 III (£155)**

One of the very few detachable-head tonearms we assessed this time, the 1503 is superbly finished and built, and delivers a fine all round performance.

#### **Grace G707 (£144)**

A long established light-to-medium mass tonearm, the Grace is well engineered and finished. It still provides a good sound for the price, and is capable of accepting top range moving-coil models.

#### **Helius (£150)**

Though the 'Aurum' version of the Helius was rather expensive for its quality range, the standard model is still recommended.

#### **Helius Orion (£395)**

A top-flight model from a designer committed to continual refinement of the model.

#### **Linn Basik LVX (£75)**

This does not provide an Ittok performance on the cheap but is nonetheless an outstanding model in its price category.

#### **Linn Ittok LVII (£253)**

Arguably the definitive model when it comes to competitively priced high performance tonearms, the *Ittok* can produce excellent results with some of the most critical moving-coil cartridge designs. However, careful attention to system matching is essential if the best results are to be obtained.

#### **Logic Datum (£73)**

Competing closely on price with the Linn LVX, the *Datum* is possibly the only rigid, medium-mass fixed-head tonearm in this category.

#### **Mission 774 (£187)**

A long established model, the 774 is one of the finest low-mass tonearms currently available.

#### **Mission 774SM (£197)**

The second model from this company, the *SM* is a medium-to-high mass design offering very good sound quality for the price.

#### **SME 3009 111 SB (£90)**

This model has been further refined with the retro-fittable *SB* additions.

#### **Zeta (£399)**

While there may be slight variations from sample to sample (watch out for bearing slack), the musically neutral presentation of this model was beguiling; once heard, hopefully, price considerations take second place!

## **TONEARMS:**

### **WORTH CONSIDERING**

The following arms fail to reach the top category for reasons of excessive cost and/or mild flaws in their performance or manufacture, but they are nonetheless capable of fine results when properly set up and matched.

#### **ADC ALT1 (£44)**

A low mass detachable head arm, the ALTI offers reasonable value.

#### **ADC LMF1 (£74)**

Much praised several issues ago, the *LMF1* still sets quite a good standard.

#### **Audio Technica AT1100 (£120)**

Pushed into second place by the new AT1120, the 1100 is still a quality tonearm.

#### **Linn Basik LVV (£45 inc Basik cartridge)**

A detachable headshell model, the original *Basik* is now somewhat over shadowed by the *LVX*.

#### **SME 3009 II non-detachable (£75)**

Somewhat long in the tooth, this, as the best value version of the 3009 II series is still worth considering.

#### **Sumiko MDC800 (£798)**

No longer alone in the 'Super arm' group, the Sumiko continues to offer a fine performance but at a rather high price.

## **SUGGESTED PLAYER COMBINATIONS**

In addition to the integrated players listed earlier, we would put forward the following turntable/arm combinations. Prices are only approximate and we must stress that this list is by no means exhaustive.

**Ariston RD80 + Linn Basik LVX** £255

**Pink Triangle + Mission 774SM or Linn Ittok** £590/£650

**Lux PD300 + Mission 774SM** £540

**Lux PD300 + Alphason HR100S** £640

**Lux PD300 + Zeta or Orion** £740

**Linn LP12 + Orion or Zeta** £674

**Linn LP12 + Alphason** £774

**Walker CJ55 + Linn Basik LVX** £225

**Walker CJ55 + Mission 774** £340

**Dunlop Systemdek II + Linn Basik LVV** £160

**Dunlop Systemdek II + Linn Basik LVX** £190

**Thorens TD160S + Linn Basik LVX** £250

**Thorens TD160S + Logic Datum** £250

**Thorens TD160BC + Linn Basik LVV** £155

# OVERALL COMPARISON CHART: TURNTABLES & TONEARMS

| Type                      | Technical motor per-<br>formance | Vibration and<br>acoustic<br>isolation | Arm<br>effective<br>mass (g) | Arm<br>resonance<br>per-<br>formance | Arm<br>friction | Arm lead<br>capaci-<br>tance (pF) | Ease of<br>setting up | General<br>quality | General<br>quality | Value<br>judge-<br>ment | Typical<br>price<br>(£) |
|---------------------------|----------------------------------|--|------------------------------|--------------------------------------|-----------------|-----------------------------------|-----------------------|--------------------|--------------------|-------------------------|-------------------------|
| ADC ALT1*                 | —                                | —                                      | 8.5                          | average +                            | good            | 180                               | v. good               | good               | average +          | W                       | £44                     |
| ADC LMF1*                 | —                                | —                                      | 6.5                          | good                                 | good            | 185                               | v. good               | v. good            | good +             | W                       | £74                     |
| Alwa APD60                | good                             | poor                                   | —                            | average +                            | —               | —                                 | —                     | —                  | —                  | —                       | —                       |
| Alwa LX100                | good                             | average                                | 6                            | poor                                 | v. good         | —                                 | —                     | —                  | —                  | —                       | —                       |
| Alwa APB110               | good                             | poor                                   | 10                           | average                              | average         | 320                               | v. good               | average            | poor               | —                       | —                       |
| Alwa AP2310               | good                             | average -                              | 8.5                          | poor                                 | average -       | 75                                | v. good               | average +          | poor               | —                       | —                       |
| Alphason HR100S**         | arm                              | —                                      | 10                           | v. good                              | v. good         | 95                                | good                  | excellent          | v. good            | R                       | £300                    |
| Ariston RD80SL**          | motor b.d.                       | v. good                                | —                            | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £180                    |
| Ariston Superieur         | motor b.d.                       | v. good                                | —                            | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £350                    |
| Audio-Technica AT1120     | arm                              | —                                      | 5(d)                         | average +                            | v. good         | 85                                | v. good               | v. good            | good +             | R                       | £110                    |
| Audio-Technica AT1100*    | arm (straight)                   | —                                      | 6(d)                         | good                                 | good            | 95                                | v. good               | v. good            | good +             | R                       | £120                    |
| Audio-Technica AT1100S*   | arm ('S' tube)                   | —                                      | 12.5(d)                      | average +                            | good            | 95                                | v. good               | v. good            | good               | W                       | £120                    |
| Audio-Technica AT1010*    | arm                              | —                                      | 16                           | average +                            | average +       | 95                                | v. good               | v. good            | good               | —                       | —                       |
| Audio-Technica AT1503 III | arm                              | —                                      | 20                           | good                                 | v. good         | 95                                | v. good               | excellent          | good +             | R                       | £155                    |
| Aurex SRM70*              | auto b.d.                        | average -                              | 20                           | —                                    | poor            | —                                 | —                     | —                  | —                  | —                       | —                       |
| Aurex SRQ770*             | auto q.d.d.                      | average -                              | 8.5                          | average -                            | average         | 175                               | good                  | good               | average -          | —                       | —                       |
| B&O Biogram 1700*         | auto b.d.                        | —                                      | v. good                      | 3                                    | —               | —                                 | —                     | —                  | —                  | R                       | £99                     |
| B&O Biogram 9002          | auto q.d.d.                      | excellent                              | excellent                    | 5.2                                  | average +       | excellent                         | —                     | —                  | —                  | R                       | £450                    |
| Dias Heavy                | motor b.d.                       | v. good                                | excellent                    | —                                    | —               | —                                 | —                     | —                  | —                  | W                       | £480                    |
| Dual CS80S-1              | auto stop b.d.                   | average +                              | good                         | 5                                    | average -       | v. good                           | 180                   | v. good            | good               | R                       | £80(c)                  |
| Dual CS917Q               | auto stop q.d.d.                 | average +                              | average                      | 5                                    | average -       | v. good                           | 150                   | v. good            | good               | —                       | —                       |
| Dual CS741Q*              | auto q.d.d.                      | excellent                              | average                      | 6(d)                                 | average +       | good                              | 150                   | v. good            | average +          | —                       | —                       |
| Dunlop Systemdek II       | motor b.d.                       | v. good                                | v. good                      | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £115                    |
| Dunlop Systemdek III**    | motor b.d.                       | excellent                              | excellent                    | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £299                    |
| Dynavector DV501          | arm                              | —                                      | 25/50                        | poor                                 | good            | 125                               | average               | good               | average +          | —                       | —                       |
| Fidelity Research FR64FX* | arm                              | —                                      | 20                           | good                                 | good            | 80                                | v. good               | excellent          | good +             | —                       | —                       |
| Fidelity Research FR64S*  | arm                              | —                                      | 35                           | good                                 | v. good         | 80                                | v. good               | excellent          | good +             | —                       | —                       |
| Grace GT07*               | arm                              | —                                      | 7                            | average +                            | good            | —                                 | —                     | —                  | —                  | R                       | £144                    |
| Helius**                  | arm                              | —                                      | 12                           | average +                            | good            | 70                                | average               | v. good            | good +             | R                       | £150                    |
| Helius Orion              | arm                              | —                                      | 11                           | v. good                              | excellent       | 73                                | average               | excellent          | v. good            | R                       | £395                    |
| Heybrock TT2              | motor b.d.                       | excellent                              | —                            | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £175                    |
| Hitachi HTL70             | auto q.d.d.                      | v. good                                | average +                    | 6.5                                  | —               | —                                 | —                     | —                  | —                  | R                       | £192                    |
| Input Design ID800        | man b.d.                         | poor                                   | average                      | —                                    | —               | —                                 | —                     | —                  | —                  | —                       | —                       |
| JVC LA-0                  | auto stop b.d.                   | average -                              | 8                            | average                              | average         | 135                               | v. good               | average            | average -          | W                       | £95(c)                  |
| JVC LF1                   | auto q.d.d.                      | excellent                              | average -                    | 8.5                                  | average         | 80                                | v. good               | good               | poor               | —                       | —                       |
| JVC QL75F*                | auto q.d.d.                      | excellent                              | average -                    | 17(d)                                | average +       | 95                                | v. good               | v. good            | average            | —                       | —                       |
| Linn Soedék LP12**        | motor b.d.                       | excellent                              | v. good                      | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £220                    |
| Linn Soedék LVY**         | arm                              | —                                      | 13.5                         | good                                 | good            | 100                               | v. good               | v. good            | good               | W                       | £45(c)                  |
| Linn Bank LVX             | arm                              | —                                      | 12.5                         | good                                 | good            | 100                               | v. good               | v. good            | good +             | R                       | £74(c)                  |
| Linn Ittck LVII**         | arm                              | —                                      | 13.5                         | v. good                              | excellent       | 100                               | v. good               | excellent          | v. good            | R                       | £253                    |
| Logic DM101*              | motor b.d.                       | v. good                                | excellent                    | —                                    | —               | —                                 | —                     | —                  | —                  | R                       | £345                    |

# OVERALL COMPARISON CHART: TURNTABLES & TONEARMS

| Logic Datum            | arm             | 10.5      | good      | average + | 135       | good | good | good | good + | R | £70        |
|------------------------|-----------------|-----------|-----------|-----------|-----------|------|------|------|--------|---|------------|
| Lux PD370              | man q.d.d.      | —         | —         | —         | —         | —    | —    | —    | —      | — | £199       |
| Lux PD300**            | motor q.b.d.    | excellent | v. good   | —         | —         | —    | —    | —    | —      | — | £340       |
| Lux PD555*             | motor q.b.d.    | excellent | v. good   | —         | —         | —    | —    | —    | —      | — | £399       |
| Marantz TT120          | auto ret b.d.   | good      | average — | —         | —         | —    | —    | —    | —      | — | £54        |
| Marantz Esotec TT1000* | motor q.d.d.    | excellent | good      | —         | —         | —    | —    | —    | —      | — | £399       |
| Michell Focus**        | motor b.d.      | v. good   | good      | —         | —         | —    | —    | —    | —      | — | £135       |
| Michell Gyrodec        | motor b.d.      | v. good   | excellent | —         | —         | —    | —    | —    | —      | — | £595       |
| Mission 775SM          | motor b.d.      | good      | good      | —         | —         | —    | —    | —    | —      | — | £497       |
| Mission 774*           | arm             | —         | 5.5(d)    | good      | excellent | —    | —    | —    | —      | — | £187       |
| Mission 774SM          | arm             | —         | 16        | v. good   | —         | —    | —    | —    | —      | — | £197       |
| Mitsubishi LT5V**      | auto b.d.       | good      | average — | —         | —         | —    | —    | —    | —      | — | £199       |
| Optonica RP7100*       | auto q.d.d.     | average   | —         | —         | —         | —    | —    | —    | —      | — | £747       |
| Oracle**               | motor b.d.      | v. good   | v. good   | —         | —         | —    | —    | —    | —      | — | £747       |
| Pioneer PL120          | auto ret b.d.   | good      | average   | —         | —         | —    | —    | —    | —      | — | £50(C)     |
| Pioneer PL7            | v. good         | average   | —         | —         | —         | —    | —    | —    | —      | — | £120(C)    |
| Pioneer PL8F           | auto q.d.d.     | excellent | average + | —         | —         | —    | —    | —    | —      | — | £299       |
| Pink Triangle**        | motor b.d.      | v. good   | excellent | —         | —         | —    | —    | —    | —      | — | £398       |
| Rega Planar III        | man b.d.        | good      | average   | —         | —         | —    | —    | —    | —      | — | £148       |
| Revox B795*            | auto q.d.d.     | excellent | average + | —         | —         | —    | —    | —    | —      | — | £339       |
| Revox B795*            | auto q.d.d.     | excellent | good      | —         | —         | —    | —    | —    | —      | — | £420       |
| Sansui SR222 Mk IV     | man b.d.        | good      | average — | —         | —         | —    | —    | —    | —      | — | £85        |
| Sansui XRQ7            | auto q.d.d.     | v. good   | average — | —         | —         | —    | —    | —    | —      | — | £270       |
| SME 3009 III SB        | arm             | —         | 5         | good      | —         | —    | —    | —    | —      | — | £90        |
| SME 3009R              | arm             | —         | 12        | average + | —         | —    | —    | —    | —      | — | £190       |
| Sony PSX600*           | auto q.d.d.     | excellent | good      | —         | —         | —    | —    | —    | —      | — | £180       |
| Sony PSX800            | auto q.d.d.     | v. good   | good      | —         | —         | —    | —    | —    | —      | — | £377       |
| STD 305S (M)*          | motor b.d.      | v. good   | v. good   | —         | —         | —    | —    | —    | —      | — | £159(£199) |
| Sumiko 'The Arm'**     | arm             | —         | 13        | good +    | —         | —    | —    | —    | —      | — | £795       |
| Technica SL020         | auto ret q.d.d. | excellent | average   | —         | —         | —    | —    | —    | —      | — | £109       |
| Technica SL5           | auto d.d.       | v. good   | average + | —         | —         | —    | —    | —    | —      | — | £119       |
| Technica SL0L1*        | auto d.d.       | excellent | good      | —         | —         | —    | —    | —    | —      | — | £169       |
| Technica SL7*          | auto d.d.       | excellent | good      | —         | —         | —    | —    | —    | —      | — | £300       |
| Technica SL10*         | auto q.d.d.     | excellent | good      | —         | —         | —    | —    | —    | —      | — | £650       |
| Technica SL15/EPA500*  | man q.d.d.      | excellent | good +    | —         | —         | —    | —    | —    | —      | — | £115       |
| Thorens TD168 II       | man b.d.        | good      | good +    | —         | —         | —    | —    | —    | —      | — | £110       |
| Thorens TD160 BC III   | motor b.d.      | v. good   | good +    | —         | —         | —    | —    | —    | —      | — | £240       |
| Thorens TD147          | auto stop b.d.  | excellent | good +    | —         | —         | —    | —    | —    | —      | — | £280       |
| Thorens TD126 IV**     | motor b.d.      | v. good   | good +    | —         | —         | —    | —    | —    | —      | — | £49        |
| Trio K09X              | auto q.d.d.     | v. good   | average   | —         | —         | —    | —    | —    | —      | — | £149       |
| Walker CJ55**          | motor b.d.      | v. good   | v. good   | —         | —         | —    | —    | —    | —      | — | £149       |
| Zeta                   | arm             | —         | 16        | v. good   | —         | —    | —    | —    | —      | — | £399       |

\* = revised and reprinted    \*\* = completely reassessed    (d) = damping    R = Recommended    W = Worth Considering    (c) = inc cartridge

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FINANCE HOUSE - WRITTEN DETAILS ON REQUEST

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.

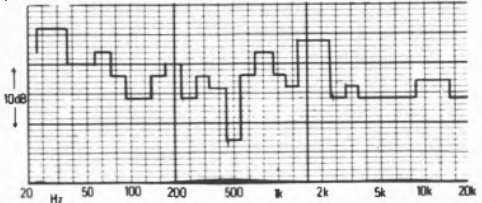
The reference curve (1) is that of the disc unsupported – that is lifted some 5mm clear of a metal platter by a thick washer at the spindle. The record was then tried on a number of available mat types, ranging from untreated plain metal to plate glass, felt, suede, and finally both hard and soft rubber. 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 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.

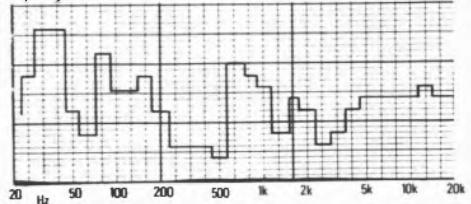
Take the case of the Sondek and its well known felt mat. Suppose a system had been constructed around it whereby the mat, player, arm, cartridge, amplifier and speaker were all complementary and produced a satisfying sound balance. The substitution of the soft composition 'Dumpa' mat would produce a 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.

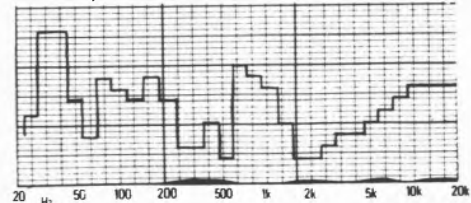
Perhaps dealers who stock and sell the more expensive 'special' mats (one glass mat currently costs around £50) could keep a loan stock and allow customers to try several at home before purchase?



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.



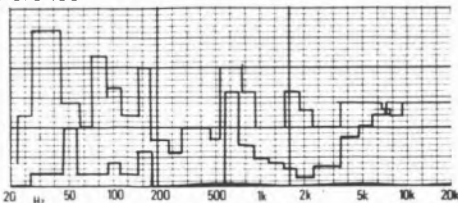
2) Placement of the record on a plain metal platter (the top surface of a *DQX 1000* without a 'label depression') provided a 6.8dB energy reduction, as well as improvements in the 1.2 to 5.0kHz range. However contact was clearly imperfect, with the bass damping uneven and potentially more coloured.



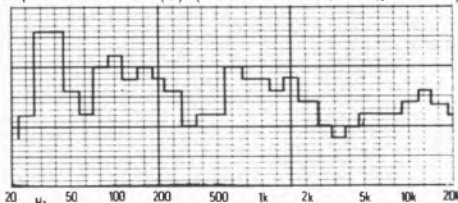
3) The addition of the soft composition 'Dumpa' mat further improved the upper mid damping, although many of the mats used here were unable to deal with the 630Hz mode, which is thought to relate to the player or arm itself. Improved damping at low frequencies if anything

# PLATTER MATS

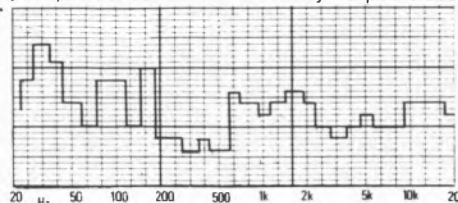
further accentuated the 30-40Hz lift, while the overall noise level was 9.5dB down on the reference.



4) This comprised the original Linn type of radially ribbed rubber 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*.)

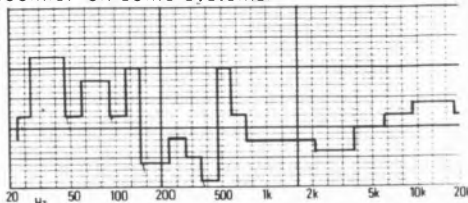


5) This strikingly good absorption result was achieved using a nominal glass mat, in this case a 10mm thick Rega platter, which approximates to the glass mats currently available. A reduction of 12dB was attained, with the 'A' weighting clearly not showing the full benefit at low frequencies. Compared with the rubber mat (4) the following improvements in 1/3-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 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.



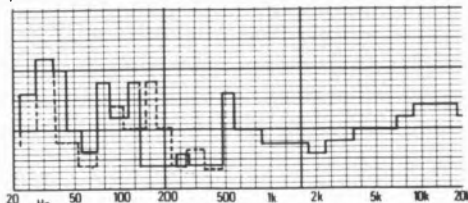
6) A Linn felt mat showed a fairly even 'neutral' character but with less effective absorption at 5.7dB.

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 not 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.

## PLATTERMATS UPDATED

The tests described above were applied to mats available at the time of the last issue; despite interesting results, we decided not to repeat them. Perhaps the main problem is that the mat cannot truly be isolated from the playing system in which it is used. Furthermore the new disc impulse transmission response test carries a



good deal of the mat termination and absorption data, which is probably more relevant than the earlier acoustic damping responses.

The role of the plattermat is complex, defying simple analysis. High disc damping over restricted areas of the frequency range may not indicate a good end result on a complete player. For example, the Linn felt mat provides a more limited absorption of acoustic and impulse energy than many others, but does so in a rather well distributed manner. Discs played on felt mats generally have a characteristic sound: a touch of mid-forwardness described by some as 'vinyl shout', plus a degree of treble 'brightness'; with some neutrally balanced turntables, their use will obviously prove detrimental.

Certain hard synthetic composition mats, as currently used by Thorens for example, can produce poor results. Not only is absorption low, but it is also unevenly distributed; in the case of the Thorens turntables this imparted an obvious 'hardness' to the reproduced sound.

Different mats will produce different effects. The Linn player has certain serious weaknesses from a coloration viewpoint, namely an intrinsic touch of bass forwardness, mild upper midrange hardness and a slightly downtitled system response with increasing frequency, all of which is somewhat exposed by a neutral type of absorptive mat such as the *Audio Ref*. However, the felt mat provides sufficient mid-forwardness to balance the bass and upper-mid levels, and sufficient mid-treble 'openness' to liven up the balance and give a subjectively even result.

In many cases where the mat sound was in question, substitution of an *Audio Ref* or occasionally an Avon mat considerably ameliorated the problems; so far these have been the best balanced 'all rounders'. Some interesting 'mats' were tried, including the amazingly effective integral suction platter of the two Lux models, which showed exemplary impulse termination. Very good results were obtained from other hard mats including the stainless steel of the Trio LO7D, and the acrylic integral plattermat of the Pink Triangle: specifically designed with effective record termination in mind, fine results confirm the design theory. The glass mat on the Marantz TT1000 was also notably successful. In fact glass mats are available as accessories from several sources, GA's *Soundisc* being one of the least expensive. Michell's luxury version has a damping laminate between double glass plates, and due to its low resonance properties such a mat can make a definite improvement to the sound of turntables

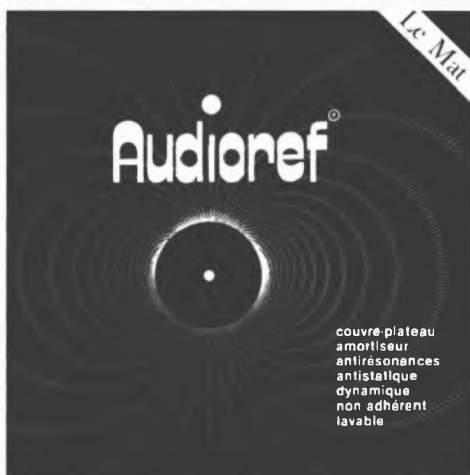
with flimsy platters. However with hard mats such as these there is the possibility of mild record damage due to microgrit becoming impressed into the disc underside; both the mats and the record therefore require scrupulous cleanliness.

An interesting mat system on the Oracle combined a highly damped 'tacky' type of mat (carbon fibre loaded to increase its rigidity) with a special stress clamp which forced the discs into full contact with the platter, even badly warped samples. The results were consistently good, and were only bettered on grounds of sheer absorption by the Lux suction models.

## Conclusion

It seems fairly obvious that mats are little problem with the most expensive turntables, where designers will have sought to optimise conditions. The greatest opportunity for mat substitution lies in the budget to middle range, where the standard item is often found wanting (though less often than of yore).

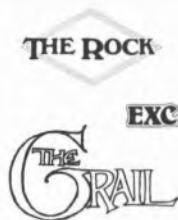
However due to the varying frequency balance and coloration contribution of different mats, one type may only be optimal for a limited number of turntables. Fortunately mats are comparatively inexpensive, so experimenting with alternatives should not prove exhorbitant. I sometimes vary the mat with the cartridge: for example, on the *Sondek* felt seems best for the *Asak*, while the *Audio Ref* suits the *Koetsu* better.



The *Audioref* mat, which suits many turntables very well

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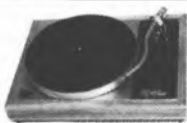
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# COMPACT DISC: INTRODUCTION

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**Though still in its early days, Compact Disc is the only new 'sound carrier' or hi-fi medium to emerge since the Compact Cassette. More important, it is the first since the introduction of stereo to offer a definite promise of inherently better sound in the home.**

In 1977, Philips demonstrated the first prototype of a new record playing system, as different in physical terms from the LP as the LP had been from the 78. They expected that the 4½in silver discs, with one hour playing time per side, would appear commercially in 1982. Now, only a little behind schedule, Compact Disc is here.

Compact Disc (or Digital Audio Disc, DAD) is a reproduction system which uses Pulse Code Modulation to store the musical information in digital form. PCM is already used for relay transmission of radio broadcasts by the BBC, and in digital tape recording systems.

The information an audio recording system has to store and later reproduce is really just a constantly-changing voltage level. In the reproduction chain, this electrical signal is used to recreate the constantly-changing air pressure which we hear as sound. An analogue recording system – conventional disc or tape – tries to capture the electrical waveform directly, but cannot produce a perfect analogue of the complex music waveforms which are produced by a microphone. There is always distortion, produced by the recording medium's inability to react fast enough and fully enough to the incredibly fast changes in level found in the signal. Also, the system adds its own unwanted noise to the recording, and because of mechanical imperfections, will suffer from fluctuations of speed, affecting musical pitch on the reproduced signal.

Digital recording promises to overcome all these problems. Instead of trying to produce a direct analogue of the musical waveform, the digital recorder samples the waveform at very frequent intervals, and the level of the signal at any point in time is recorded in the form of a binary number. If the sampling is rapid enough, these numbers can then be decoded to give a constant stream of level readings which will accurately represent the signal that was fed in originally. Because the output digital-to-analogue (D-to-A) convertor receives digital information at a constant speed determined by an electronic 'clock' frequency, any speed variations of mechanical origin are eliminated.

Sampling takes place at the rate of 44.1 thousand times a second, which is theoretically sufficient to reproduce musical waveforms containing frequencies up to 20kHz. Each sample is encoded as a binary word of 16

bits, which means that the number of different levels that can be recorded is 2 to the power of 16 – a lot! Mathematically it can be shown that this will give a signal-to-noise ratio of 96dB, which is far in excess of that offered by conventional media, unless exotic noise reduction-systems (with their own undesirable side-effects) are used. The realisation of this performance involves filtering components above 20kHz, and making sure that there is adequate error correction should the reproducing system fail to read any bits.

The disc itself consists of a metallised reflective layer embedded in clear plastic. The 'bits' are represented as incredibly small pits in the reflected layer, which are read by a very accurately-aligned low-power laser focused on them – the laser simply needs to detect the presence or absence of pits. Marks on the surface of the plastic will be out of focus and ignored, while error correction will cope with fairly large imperfections in the disc.

Although CD player prototypes have been regularly demonstrated to the hi-fi press since 1977 (admittedly only quite recently without great quantities of non-integrated electronics under the table!) it is significant that only in 1982 were journalists able to listen to demonstrations which really convinced them that the CD system did leave conventional records behind. At the Harrogate show, some manufacturers had access to the Philips player, and in the Quad demonstration it was at last possible to hear what a CD player could do for a really well-set up high-quality amplifier and speaker system. Another convincing demonstration was given by Marantz, using a pair of relatively inexpensive speakers though admittedly with quite sophisticated amplification.

So while amplifier and speaker manufacturers will undoubtedly react to CD with better products, as the medium shows up existing problems much more clearly, the same should also go for record companies. Here it will be some time before the industry gains sufficient experience of the new medium to react audibly, especially as CD sales (estimated at around 130,000 discs in 1983) will for a long time be a drop on the ocean of record sales. It is also true that digital CD players have by no means been perfected yet!

*Steve Harris*

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# COMPACT DISC PLAYERS

This preliminary user report on CD is based on our experiences with several players loaned to us well in advance of the launch of the system. The subjective assessments are backed by additional listening test results using a domestic digital tape unit (the Sony PCMF1), this containing major elements of the replay chain also used in CD players.

As readers may recall, one of the key elements of record player evaluation, including the cartridge, is the subjective comparison of reproduced disc sound quality with the original tape cutting master, this being replayed on a high-quality open-reel machine. Such comparisons show that if special care is taken over the disc player, with due consideration of the particular relationships between cartridge, tonearm and turntable, it is possible to assemble a player system demonstrating a fidelity, which (on the outer sections of well mastered and pressed records in mint condition) will stand good comparison with the original tape. Of course the sound is never quite the same, but it can be closer than you might expect, considering the acknowledged imperfections of an analogue disc system. The tape standard is set by a 38cm/sec; half-speed cutting master, generally IEC-equalised and offering a typical 70dB weighted dynamic range (A-weighted noise, to 3% peak distortion). This will be more or less comparable with disc replay on these parameters at least.

Occasionally in such comparisons the low noise level of a particular recording on disc has caused problems. Here the subjective effect has been that of a 6dB noise advantage in favour of the disc, and to make worthwhile comparisons, it was necessary to obtain Dolby A tape masters with a dynamic range improvement. If the relative high frequency noise levels are not similar, the ear's subjective treble frequency response can be affected. Given a certain level of treble sounds, the addition of some lower level hiss — not even necessarily fully audible as such — appears to enhance the apparent volume of the treble sounds. As a result, during comparisons, the programme with the higher noise level often tend to sound brighter. This problem was again encountered in Compact Disc assessment when coping with the wide dynamic range of CD programme compared with its equivalent analogue LP transcription.

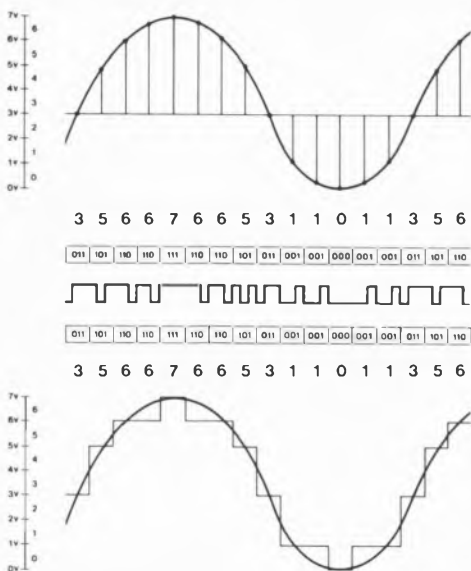
## Further tests

In further tests, spectrum measurements

showed the CD material to have more peak treble energy, but often the subjective results indicated a 'brighter', more open sound from the conventional LP — not a function of its frequency response but simply the effect of the extra surface noise.

A full understanding of the mechanics of LP record replay would lead one to anticipate a deterioration in sound quality as the arm traverses the playing radius, due to the progressively reducing groove velocity gradually compacting the music modulation. This makes it harder for the stylus tip to trace accurately. In practice however this deterioration passes relatively unnoticed, as with continued listening to a given record, one tends to assimilate changes in clarity, treble energy, separation and distortion with the changing programme — unless a particularly trying end-of-side finale or massed choral section appears, where the record player's failure to cope is only too obvious.

With CD replay, the sound is consistently



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

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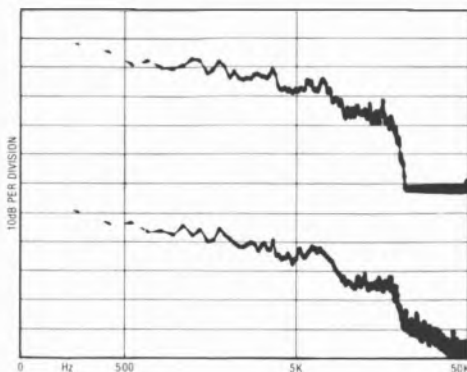
# COMPACT DISC PLAYERS

accurate from end to end, which makes comparison with LPs rather difficult. It quickly becomes apparent that the LP sound really is constantly changing, and that even with one of the finest analogue players combinations only the outer part of a mint LP is of much use. By the time that the last track has been reached, the difference is too obvious for any useful comparisons of fidelity to be made. Other problems also arise. Peak programme measurements suggest that even with well-cut records and top-flight cartridges, peak compression and distortion occurs on analogue, and even when the noisy low level sections have been avoided, and the sound balanced for a fair comparison on middle volume sections, digital replay nonetheless sounds, and actually is, brighter on transients.

If levels are not carefully judged it is all too easy to clip the monitoring amplifier and wrongly attribute the resulting hardness to the so-called 'digital sound'. This term is virtually meaningless, since good digital can be so transparent a recording medium as to be almost inaudible, a fundamental of performance sadly lacking in the current analogue systems whether tape or disc.

## Subjective qualities

Some pundits, without actual experience of good digital equipment have nonetheless speculated on digital's subjective faults, such as 'grainy treble', 'hard midrange', curtailed stereo depth and ambience, plus audible low level distortion. We however have experienced none of these with our machines; on the contrary we have discovered some unexpected virtues which I feel will assume increasing importance in the future. The most obvious and perhaps the least expected is the bass quality. As I have explained in previous issues of *HFC*, a total of up to 30 high-pass filter stages or bass roll-offs may be present in the recording chain from musician to domestic listener. In general the cumulative phase shifts and amplitude aberrations which result are not so severe as to produce serious negative listener reaction, but digital audio may change all that. The crux of the matter lies in digital's theoretic ability to record down to DC or as near to it as is either required or deemed necessary. By definition, 'phase-pure' extended bass is possible, something which escapes a tape recorder, due to wavelength effects between the head and tape, plus the inherent low frequency roll-off of the tape



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

medium.

An analogue disc cutter may have a response down to DC, but a pickup cartridge is a velocity sensitive device. Its inherent AC coupled response gives a bass roll-off, and this, with the complexities of the arm/cartridge subsonic resonance all mean that pure bass is impossible from a conventional disc reproducer. Furthermore, arguments concerning the subjective effect of IEC RIAA roll-off or bandwidth limitation in preamps and loudspeakers have not meant much in the absence of really high quality programme.

With CD replay of digitally mastered sources, the particularly good quality of the bass is immediately noticeable, the effect best described as an 'opening up' of that frequency range. The bass seems less obvious, less forward or boomy, and takes on a more natural perspective, showing greater depth, attack, damping and extension. The midrange also seems more clearly defined, the reduced bass confusion appearing to be a contributory factor here.

The potential of CD, yet to be realised in future recording productions of the right quality, will come as a revelation to the audio consumer. It will expose analogue LP weaknesses and will provide a stimulus to amplifier and speaker manufacturers alike to improve their product to match.

In absolute terms, the analogue LP chain has a tendency to soften, mask and compress the original programme in addition to applying a degree of audible frequency response filter-

# COMPACT DISC PLAYERS

ing at both extremes. Strangely enough, on a considerable quantity of current programme this failure is actually an advantage. It would appear that much of the programme is doctored, hyped-up, equalised, or otherwise produced in such a manner as to give an enhanced 'larger' and 'closer than life' effect. Moderated by the analogue chain, the end result is more or less satisfactory, but the same programme replaying in all its exaggerated glory via CD can sound dire in many cases — a travesty of the musician's and composer's intentions.

## Paradox

We therefore have an interesting paradox here — the LP can actually beat the CD player on modern programme material of typical commercial quality, when judged from a musical standpoint. Once again, there is scope for the pessimist to condemn digital reply. Conversely, given 'musically' produced and balanced programme free of emphases, CD affords the domestic user a very close approximation to a highly transparent, if delayed, link to the Studio mixing desk at the moment of programme production.

The results we have attained so far suggest that with accurate programme the CD system performs extremely well by analogue standards, and ruthlessly reveals recording eccentricities. Assuming that CD players in the £450 price range are properly constructed — most of the pre-production models loaned us showed no signs of problems on that score — the reader can be assured that its replay fidelity will happily compare with or exceed

that of a well-specified analogue player complete with cartridge and costing overall from around £1,000 to as much as £3,000! On the subject of costs it is also worth noting that the laser cartridge in a CD player does not have an infinite lifetime. It has been estimated that after a typical 1000 hours plus, the head will need replacing, the cost comparable with video head replacement at around the £100 level. Put in perspective, this is similar to the price of a replacement stylus for a moderately high-priced moving-coil cartridge, and means that assuming about five hours use a week including breaks, the laser should last about four years. During its lifetime no gradual change in sound quality will occur as with analogue cartridges; rather, once its light output has faded to a certain level, error-free audio will cease and the player will mute soon after, thereby indicating its need for service. A top-quality analogue cartridge will demonstrate progressive stylus wear, slowly increasing in noise and distortion to a level where replacement is virtually mandatory, this occurring after some 200-300 hours of play.

## Future refinements

However, lest I give the wrong impression, CD players are still imperfect and until they are refined still further, small sound differences between models are to be expected. I feel that in theory at least the 16-bit/44kHz domestic standard will be more than sufficient for top quality audio reproduction for many years to come, but it is also apparent that this 16-bit specification is not yet fully realised. Not only are master recording encoders (A/D convert-



Aurex XR-Z90



Hitachi DA-1000



# COMPACT DISC PLAYERS



Marantz



Sony CDP-101

ors) measurably imperfect, but also replay (D/A convertors) still present a difficult mass market proposition even with today's integrated circuit technology.

Take the current claimed specification quoted by all CD producers, namely a better-than-90dB signal to noise ratio with 0.005% distortion — a 16-bit system should provide 96dB with 0.0015% distortion. The shortfall, measurable on some of the CD players tried, concerning their maker's present inability to meet the last bit or so in the 16-bit ladder. Even the famous Sony *PCMF1* digital tape adaptor only claims 90dB signal-to-noise. In practice it does attain 95dB, but in fact this is not because of its paper 16-bit operation, but rather because of its use of record/replay emphasis/de-emphasis. This is worth about 10dB in signal to noise ratio improvement terms. Philips have actually avoided the imperfections of present 16-bit convertors by using an accurate 14-bit device in their players, and then, by incorporating a special oversampling conversion, a worthwhile noise reduction is achieved; in addition, a simple low roll-off rate low-pass filter may be used, possessing a good sound quality. The 16-bit conventional systems at present use a bought-in package high-slope 'brick wall' filter at 21kHz, to which some sound quality variations have been attributed. So far we cannot hear any difference between 14- and 16-bit replay. Philips have at least achieved a -96dB noise level.

## Features and facilities

From the players tried, a fair idea of CD operation and the general facilities that will be

offered was gained. All were automatic in the sense of a conventional turntable-tracks may be selected by pushbuttons in any order and the sequence stored for subsequent play. Considering the high content of digital signal processing it is perhaps not surprising that their transport systems should be highly automated via microprocessor control — in fact it could not be achieved any other way. The disc itself contains coded information by which a player reads tracks, locates them and commences play.

When a CD Player starts up, the first thing it does is to seek the start point (running inwards to outwards) and reads the disc index. It then has all the necessary information to read out the number of tracks present and their individual as well as their total duration, on its disc play. With more advanced machines a large display could also show the title of the record and those of individual tracks, while sleeve notes and even vocal scores could also be displayed. If 'play' alone is pressed, the tracks are reproduced in their normal sequence without interruption, and some of the machines have fine forward and reverse controls for track seeking.

The 'pickup' position on the record can be 'seen' in some machines by observing a timer calibrated in minutes and seconds for each track; in others the pickup will jump complete tracks without the benefit of a fine access capability within each track. In certain instances however track programming can be a rather lengthy operation, with a single entry button requiring multiple depressions to count out each track number. Others have more

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# COMPACT DISC PLAYERS

conventional numeric keyline allowing direct entry. Cordless remote control units are also available with the more lavish models, and one facility which I have not yet seen but feel would be of great use with such a remotely controlled machine is the adjustment of volume (or strictly speaking player output level). Few amplifiers have remote volume control equalisation, yet one preset on an amplifier, the CD player could supply just such a feature — an easy addition to its other automated track-seeking and selection functions.

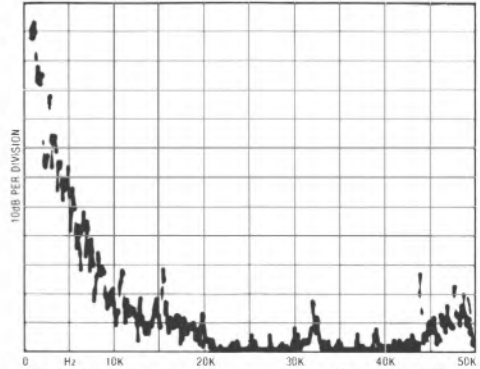
As already noted, differences in the speed of operation when reading the discs and selecting tracks became apparent during our appraisal. Several machines seemed quite slow, frustratingly so in the case of a sampler record, where rapid access was desired to try out the respective programme excerpts. However, the Aurex XR-Z90 gave a hint as to what is actually possible. A pre-production prototype, it nonetheless demonstrated a very desirable turn of speed as regards transport operation. Not only was it easy and logical to use, but it also appeared to respond with great agility. One seemed barely to have time to turn away from the machine before a selected passage had been accessed and play commenced. Access times were typically half a second, while other units took up to tens of seconds to programme, plus several seconds to find tracks.

A further facility we found convenient was the presence of a headphone socket in the front panel, as for example on the Hitachi DA1000. This was found to be very useful and I am sure that it will greatly aid demonstration at a dealer, since the customer could get acquainted with the features and operation of the fairly complicated machines without distracting others.

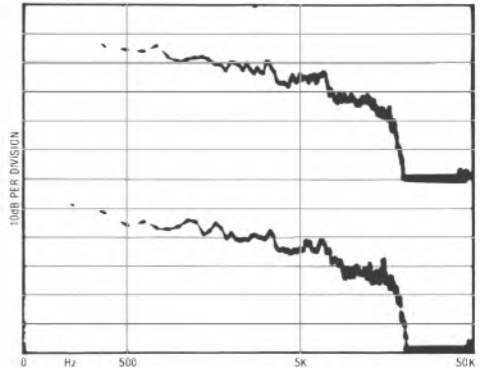
As regards loading method, we tried top loaders (Marantz and Philips) vertically orientated front-loaders (Aurex and Hitachi) plus drawertype horizontal loaders (Sony and the upmarket Marantz). CD Players have the potential to be very small indeed, since the disc is under five inches in diameter, and the horizontal types (both top and drawer loaders) hold out the greatest potential for compactness. In physical terms the basic Philips/Marantz design is the smallest so far, this a top loading design.

## Operation

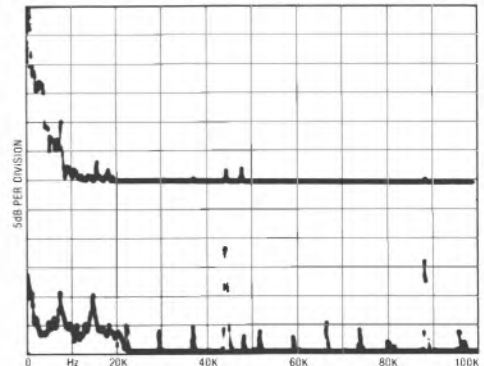
Turning to their actual operation, the CD player



Hitachi CD output spectrum — baseline is  $-100\text{dB}$  relative to peak output (scale expanded).



Spectra of music output from Marantz (above) and Aurex (below).



Spurious output from Marantz (above) and Aurex (below).

# COMPACT DISC PLAYERS

produces a line or auxiliary signal level, with a flat-response audio signal, like a tuner or cassette recorder. Thus, possibly the most difficult signal section of an amplifier, namely the cartridge input circuitry and RIAA LP record equalisation, is eliminated. Problems of input matching, sensitivity, hum and radio breakthrough do not exist with a CD record player, though it is possible that it may interfere with radio reception.

## Measurements

In the absence of test discs, some other measurements were made on four of the machines.

Spectrum analysis (graph 1) of the Marantz (early sample) and the prototype Aurex showed a difference in signal to noise ratio from 200Hz to 100kHz. This was no great surprise since Toshiba had already informed us that their prototype sample machine would measure around -70dB, this referring to the signals visible at around 8kHz and 14kHz. Further spurious were charted at 44kHz — the main digital clock frequency — and at its second harmonic, 88kHz. Both these and the audio band signals were much lower with the Marantz. The Aurex noise was clearly audible as discrete whistles or tones on the softer music passages but the Marantz background proved undetectable with no recognisable tones.

Measured on a 50kHz bandwidth, the Hitachi was not entirely clear with spurious at 11kHz and 16kHz in the audible range, as well as at the ubiquitous 44kHz at a similar level. Careful auditioning at very high volumes suggested that these spurious signals, approximately -90dB down, were just audible on quiet music passages, more so on headphones. The final version of the Philips player (results not shown) gave noise and spurious levels at around -96dB on peak signal level, and no odd signals could be heard under any conditions we tried.

## Comparison

Several runs were made to compare the peak spectrum frequency response of LP records using an essentially flat response cartridge and the same track on compact disc. That shown is for the pop record 'Rush' using their track 'YYZ', with CD above and LP below. The vertical line represents the 20kHz audible range limit while the second, right of centre horizontal scale 'tick mark' is the 5kHz cali-

bration on this conventional logarithmic presentation. The steep fall to the noise floor at 20kHz can be seen on the CD graph while the LP drifts slowly down to the disc noise floor at around 50kHz.

Analysis shows that much of the apparent ultrasonic extension of the LP is the result of tracing distortion; for example a 15kHz sine-wave at reasonable level would probably suffer 10-15% of second and third harmonic distortion, this making the distortion -15 to -20dB down. Taking into account RIAA equalisation these spurious distortion signals would appear on the spectrum analysis at 30kHz and 45kHz at around -20 and -30dB, the broad mass of such products on complex music tending to smear the apparent LP bandwidth above 20kHz. Of course some music microphones will respond above 20kHz and in theory both master tape recorders and record cutters are capable of working well beyond 20kHz. How much this matters, only time will tell. Most significant is the change in shape below 20kHz between the CD and LP replay. CD treble output clearly has better peak amplitudes from as low as 3kHz, while the integrated treble energy is also better maintained to the frequency limit, particularly noticeable from 8-18kHz. This ties in well concerning the softer, rounder impression given by LP sound as compared with CD (this track was one of the inner bands of the LP).

To conclude, the similarities between particular CD players seem much greater than their differences. The track 'Industrial Disease' from the Dire Straits album 'Love over Gold' was analysed for the Marantz and Hitachi machines (graph 5). Here the vertical line mark was set at 15.5kHz and the peak spectrum envelope could be seen to be very similar in this region.

Further analogue CD test showed that when the analyser was in sum averaging rather than peak tracking mode the spectrum differences were less, showing that CD has the greater peak dynamic range particularly at higher frequencies. A CD/LP comparison taken on the first band of an LP (graph 6) shows a very similar peak spectrum and indeed the subjective quality was also very close here ('Industrial Disease', Dire Straits, again).

As we were about to go to press we received a full production sample Sony CD player, the *CDP-101*, expected to sell at around £500 — rather more than the Philips and Marantz basic models. The *CDP-101*, however, is a luxury design with advanced features including infra-

# COMPACT DISC PLAYERS

red remote control as standard. A low-profile drawer-loader, it is styled to more or less match the *Espirit* range of electronics.

In addition to its advanced 'sound-on' rapid access cueing, multiple programming functions and timer-actuated start, it offers numeric keypad entry for fast selection of any desired track. Access time is around one second.

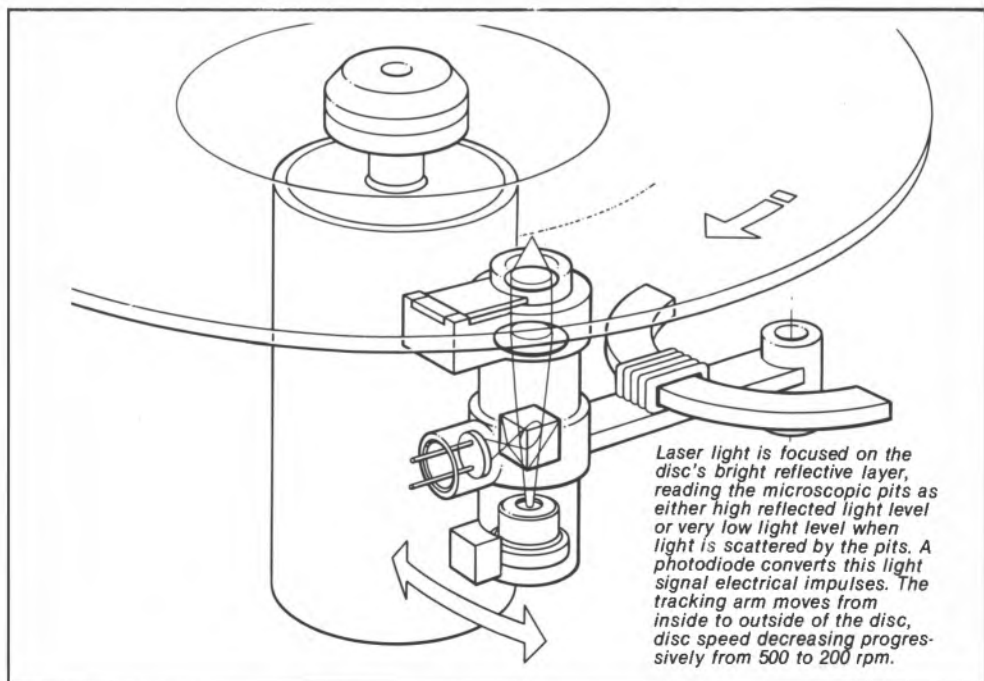
Extended listening tests indicated that the signal output was of excellent quality, justifying its higher price. We think Sony have a winner with this advanced CD player. We could not think of anything we would like to change or add, a compliment indeed!

## Conclusions

The conclusions arising from this preliminary investigation into CD players and digital sound replay in general are pretty obvious. Already extremely good, digital is clearly here to stay. With top-class programme, and a superior performance when compared with the most expensive analogue disc players, the next few

years will see a steady growth of CD players in the medium £250-500 price range, with a strong market penetration and eventual acceptance even by the most pessimistic of analogue users.

It will be some time before CD presents a serious alternative to analogue, though, because of the finite rate of expansion of the CD record catalogue. At first, only a few hundred titles will be available, and no-one with an established library of LPs is going to scrap these and their associated analogue equipment. Initially a secondary music source, CD is however expected to expand in the next few years to make serious inroads into the analogue and LP market, to an ultimate stage where the analogue equipment and source material will be rendered obsolete except for archive purposes. *Hi-Fi Choice* in future must reflect the growth of CD and find new ways of discriminating between digital audio players. Good programme material and above all the availability of test discs will help greatly in achieving this.



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# PRODUCT INDEX

## INTEGRATED TURNTABLES

|                        |     |
|------------------------|-----|
| ADC 1500 (s)           | 203 |
| ADC 1700 (s)           | 203 |
| Aiwa APD60             | 36  |
| Aiwa LX100             | 38  |
| Aiwa LP3000            | 203 |
| Akai APB110            | 40  |
| Akai APQ310            | 42  |
| Aurex SRM70            | 58  |
| Aurex SRQ770           | 60  |
| B&O Beogram 1700       | 62  |
| B&O Beogram 8002       | 64  |
| Denon DP30L            | 203 |
| Denon DP60L            | 203 |
| Dual CS505             | 70  |
| Dual CS508 (s)         | 203 |
| Dual CS617Q            | 74  |
| Dual CS741Q            | 76  |
| Hitachi HTL70          | 94  |
| Input Design ID600     | 98  |
| JVC LA10               | 100 |
| JVC QLF6 (s)           | 203 |
| JVC LF71               | 102 |
| JVC QLY5F              | 104 |
| Lux PD370              | 120 |
| Marantz TT120          | 126 |
| Mitsubishi LT5V        | 140 |
| Optonica RP5100 (s)    | 203 |
| Optonica RP7100        | 142 |
| Philips 829 (s)        | 203 |
| Pioneer PL120          | 146 |
| Pioneer PL200X (s)     | 205 |
| Pioneer PL400X (s)     | 205 |
| Pioneer PL7            | 148 |
| Pioneer PL88F          | 150 |
| Pioneer PLL1000 (s)    | 205 |
| Rega Planar 3          | 154 |
| Revox B795             | 156 |
| Revox B791             | 158 |
| Revox B790             | 205 |
| Sansui SR222 Mk IV     | 160 |
| SansuiXRQ7             | 162 |
| Sansui FRD35 (s)       | 205 |
| Sansui FRD55 (s)       | 205 |
| Sansui SR222 Mk II (s) | 205 |
| Sony PSX600            | 168 |
| Sony PSX800            | 170 |
| Technics SLQ20         | 176 |
| Technics SL5           | 178 |
| Technics SL7           | 180 |
| Technics SL10          | 180 |
| Technics SLDL1         | 180 |
| Technics SL15/EPA 500  | 186 |
| Technics SLB2/SLB3 (s) | 205 |
| Technics SLQ2/SLQ3 (s) | 205 |
| Technics SL1700 II (s) | 205 |
| Thorens TD166          | 188 |
| Thorens TD147          | 192 |
| Trio KD9X              | 196 |

## MOTOR UNITS

|                         |     |
|-------------------------|-----|
| Ariston RD80SL          | 46  |
| Ariston RD110 (s)       | 203 |
| Ariston RD111 Superieur | 48  |
| Dias                    | 68  |
| Dunlop Systemdek II     | 78  |
| Dunlop Systemdek III    | 80  |
| Heybrook TT2            | 92  |
| Linn Sondek LP12        | 106 |
| Logic DM101             | 116 |
| Lux PD300               | 122 |
| Lux PD555               | 124 |
| Marantz Esotec          | 128 |
| Michell Focus           | 130 |
| Michell Gyrodec         | 132 |
| Mission 775SM           | 134 |
| Oracle                  | 144 |
| Pink Triangle           | 152 |
| STD 305M/305S           | 172 |
| Thorens TD160BC III     | 191 |
| Thorens TD126 IV        | 194 |
| Walker CJ55             | 198 |

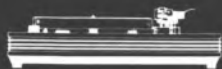
## TONEARMS

|                              |     |
|------------------------------|-----|
| ADC ALT1                     | 34  |
| ADC LMF1                     | 35  |
| Alphason HR100S              | 44  |
| Audio-Technica AT1100/AT100S | 54  |
| Audio-Technica AT1010        | 54  |
| Audio-Technica AT1120        | 50  |
| Audio-Technica AT1503        | 50  |
| Dynavector DV501             | 82  |
| Dynavector DV505 (s)         | 205 |
| Fidelity Research FR64S      | 84  |
| Fidelity Research FR64FX     | 84  |
| Grace G707                   | 87  |
| Hadcock GH228 (s)            | 203 |
| Hadcock GH220SS (s)          | 203 |
| Helius                       | 88  |
| Helius Orion                 | 90  |
| Linn Basik LVV               | 110 |
| Linn Basik LVX               | 112 |
| Linn Ittok LVII              | 114 |
| Logic Datum                  | 118 |
| Mayware III (s)              | 205 |
| Michell Focus (s)            | 205 |
| Mission 774                  | 137 |
| Mission 774SM                | 138 |
| SME 3009 Series III SB       | 164 |
| SME 3009R                    | 166 |
| SME 3009 II Improved (s)     | 205 |
| Sumiko MDC800                | 174 |
| Syrinx PU2 (s)               | 205 |
| Ultracraft AC30 (s)          | 205 |
| Zeta                         | 200 |

## COMPACT DISC PLAYERS

|                 |     |
|-----------------|-----|
| Aurex XR-Z90    | 229 |
| Hitachi DA-1000 | 229 |
| Marantz         | 229 |
| Philips         | 229 |
| Sony CDP-101    | 229 |

(s) = summary review



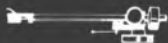
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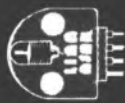
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**Acoustic breakthrough:** Sound that gets into the turntable and hence the cartridge from the air and thereby creates a risk of acoustic feedback (see separate entry).

**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 (33 $\frac{1}{3}$  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 resilience. 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 to 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

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# GLOSSARY

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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<sup>1</sup>/<sub>3</sub> 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.

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# ADVERTISERS' INDEX

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|                          |           |                              |         |                              |     |
|--------------------------|-----------|------------------------------|---------|------------------------------|-----|
| ADC.....                 | 204       | Denmead Hi-Fi.....           | 228     | Reading Cassette.....        | 201 |
| A&R (Cambridge).....     | IBC       | Eastern Audio.....           | 115     | Russells Hi-Fi.....          | 214 |
| Absolute Sound.....      | 236       | Elite Electronics.....       | 224     | Peter Russell.....           | 214 |
| Allenton Audio.....      | 175       | Esoteric Marketing.....      | 206     | SME.....                     | 67  |
| Ambience Audio.....      | 136       | Fiveways Hi-Fidelity.....    | 214     | STD.....                     | 53  |
| Russ Andrews Hi-Fi.....  | 190       | Forum (Leicester) Hi-Fi..... | 47      | Scottish Hi-Fi Desalers..... | 173 |
| Ariston Acoustics.....   | 57        | Gulliford House.....         | 214     | Sound Advice.....            | 99  |
| Audio Centre.....        | 86        | Hampshire Audio.....         | 226     | Sound Organisation.....      | 109 |
| Audio Projects.....      | 83        | KJ Leisuresound.....         | 212     | South East Audio.....        | 33  |
| Audio Technica.....      | 30        | Linn Electronics.....        | IFC     | Spaldings.....               | 32  |
| Audio T.....             | 55,79,238 | Marantz.....                 | 18      | Studio 99.....               | 113 |
| Avalon Hi-Fi.....        | 232       | Mecom (Heybrook).....        |         | Swift of Wilmslow.....       | 232 |
| Badgertracks.....        | 214       | Acoustics.....               | 26      | Technics.....                | 2/3 |
| Bang & Olufsen.....      | 22        | Mission Electronics.....     | OBC     | Technosound.....             | 91  |
| Basically Sound.....     | 211       | Moorgate Acoustics.....      | 119     | Thorens.....                 | 97  |
| Best Hi-Fi.....          | 83        | Pendle Hi-Fi.....            | 195     | Tonbridge Hi-Fi.....         |     |
| WA Brady.....            | 216       | Phase 3 Hi-Fi.....           | 214     | Consultants.....             | 232 |
| Cam Audio.....           | 220       | Phonograph Ltd.....          | 45      | Billy Vee.....               | 202 |
| Noel Cloney.....         | 108       | Pink Triangle.....           | 6,10,14 | West Midland Audio.....      | 224 |
| Philip Copley Hi-Fi..... | 33        | Quad.....                    | 8       | Eric Wiley.....              | 211 |
| Critics Choice.....      | 214       | Rayleigh Hi-Fi.....          | 175     | Yeovil Audio.....            | 214 |



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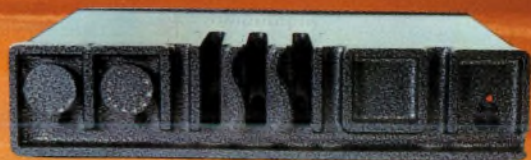
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