

**HI-FI CHOICE**

The most comprehensive guide to buying hi-fi ever published.

# BEST BUY GUIDE



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## How Sony straightened out Mozart's little problem.

Poor old Mozart. If he could hear how his Clarinet Concerto gets mangled when recorded and played on an average cassette tape, he'd turn in his grave.

Because it's such a delicate piece of music it requires a particularly sensitive cassette tape to do it justice.

Sony's CD-Alpha is that tape.

For a start the tape's surface is coated with extra-sensitive gamma hematite crystals, smaller and more receptive to nuances of sound than the magnetic particles of most other brands.

Under an electron microscope you'd be able to see for yourself how all the needle-shaped crystals lie neatly in rows, rather than higgledy-piggledy on the base film.

In translation, this means the tape surface is smoother. The dynamic range is broader. And when you record on it, the sound is 'printed'

evenly from beginning to end of each and every C60 or C90.

As for CD-Alpha's MOL performance, it's impeccable. The lows, middles and highs are audibly free from distortion.

Sony appreciate that however sensitive a tape may be, it is still capable of mutilating Mozart if the mechanics of the cassette itself aren't engineered to the nearest microns.

Look inside any CD-Alpha cassette and you will find two things you won't spot in any other brand of cassette.

First, an inner liner made from graphite coated polyester. (Some other manufacturers are content to make their liners from paper.) Onto this are moulded two parallel ribs.

Secondly, you'll observe the tape hubs are 'stepped'. Each has a deep groove that runs around its circumference, and into this slot the ribs of the liner. It's the same principle which keeps a train on the tracks.

Simple. Only no-one ever thought of it before.

Sony call it their SP mechanism. It makes jamming a problem of the past. It also ensures that the tape transport over the heads as you record is constant on both A and B sides.

Now every Sony cassette is made this way. So that whatever kind of tape deck you have, there's a cassette to suit it.

The only pity is that now this problem's finally been sorted out, Mozart isn't around to enjoy the recordings of his own music.

Sony Tape. Remarkably close to the original sound. **SONY**



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**Typesetting and makeup** arranged through  
 Time Brokers, Upper Nordens, High Hurstwood,  
 Near Uckfield, Sussex. Tel: Buxted 3168

**Printed** by The Riverside Press Ltd.,  
 London and Whitstable.  
**Published** by Sportscene Publishers Ltd.,  
 14 Rathbone Place, London, W1.  
 Tel: 01-631 1433  
**Distributed** by Argus Distribution Ltd.,  
 12-18 Paul Street, London, EC2  
 Hi-Fi Choice Series, Sportscene Publishers Ltd.  
 This edition © 1981 Felden Productions

**Any enquiries regarding the content of this book should be made in writing to Hi-Fi Choice Editorial, 14 Rathbone Place, London W1. Enquiries cannot be dealt with by telephone.**

**Note:** many of the value judgements in this publication are based on the original estimated typical prices printed. While every effort has been made to check prices and to list both the price at the time of review and at the time of publication, prices are subject to variation and fluctuation and are clearly only applicable to the UK market. Readers should bear in mind current prices when interpreting value for money comments.

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# HOW TO USE THIS BOOK

The *Hi-Fi Choice* publications have produced a fund of experience gained from the detailed and rigorous examination of a wide cross-section of product from every category of hi-fi equipment. Each publication involves a sophisticated lab measurement programme and extensive listening tests in order to give the most accurate and comprehensive data to enable the hi-fi buyer to choose wisely.

Bringing the Best Buys and Recommended products together into one publication can offer a unique guide both to the purchase of individual items of equipment or to the putting together of complete systems. That one publication is the *Hi-Fi Choice Best Buy Guide*. A few words on how it is best used seem in order.

*Putting together a system* offers basic advice on how to approach the problems of buying hi-fi equipment, how to work out a budget for a system and where to buy from. The importance of demonstrations and personal audition is stressed, and hints are given on how to get the best out of a shop demonstration. More detailed advice on how to choose and match turntables, arms and cartridges, amplifiers and speakers, is given later in the chapter, along with answers to the more common questions asked when choosing a system. The chapter concludes by looking at 'price-point' systems, popular combinations of equipment at £300, £500 plus, £1000 to £1500 and £3000 plus. Alternative products and compromises are suggested along with advice on how to choose a system that offers the best potential for later upgrading. How to site it once you've got it is also covered.

Each group of reprint reviews is prefaced by a newly written introduction. This gives background to the products under review, and basic information on how to read the technical side of the individual reviews. These introductions carry on from the advice given in the chapter *Putting together a system*, and offer more specific advice on the installation and alignment of

arms and cartridges and on the maintenance of products like cartridges and cassette decks.

*Tuners* haven't been looked at by *Hi-Fi Choice* for some time, so rather than print old material the editor has produced a couple of pages of Tuner Best Buy/Recommendations taken from the *Tuner & Amplifier* issue. This chapter also contains advice on how best to choose and set up an aerial for FM stereo reception.

Similarly, rather than reprint reviews of reel-to-reel tape decks, the pros and cons of reel-to-reel *versus* cassette are weighed up and a summary of the reviews published as part of the Introduction to the chapter on *Cassette Decks*. Recommendations for *Cassette Tapes* are handled by a comparison chart taken from Angus McKenzie's comprehensive review of cassette tapes published as part of the *Hi-Fi Choice Cassette Decks* issue. There is an additional one-page summary of tape types which explains the basic differences.

The *Best Buy Guide* concludes with a short reprint section covering only Best Buy rated headphones, though all other Recommended models are listed in summary form in the introduction to this chapter.

Naturally in reprinting reviews produced over a period of a year and the reassessments of even older products, some of the information could be out-of-date. But every effort has been made to contact manufacturers and publish details of small design or cosmetic changes, in Update paragraphs or as revisions to the reprints. Where a price has gone up or gone down, the price current at the time of the original review was published has been listed alongside the new price, to enable the reader to put into perspective the value for money assessments made in the reviews. Details of price, distribution or specification changes have been listed on nearly a third of the reprint material.

For the readers of *Hi-Fi Choice* who

already have one or more of the issues which contain reviews reprinted here, it is best to point out that there were no Best Buy recommendations made in the original turntable issue nor are some Best Buy and Recommended products now available. Any old favourites that have been dropped in recent months are listed as part of the sections in the chapter Introductions called *Other Models Worth Considering*. It may be that a now deleted but highly esteemed model can be found on the market at a saving on its then current price. Bargain hunters are recommended to turn to these sections to check out prices and likely products.

Readers of this *Best Buy Guide* who seek elaboration of any point or who want to get a wider range of products from which to choose are recommended to turn to the original issues of *Hi-Fi Choice* from which the reprint material is taken. Issues 19 to 22, 24 and 25 are the relevant publications. These contain in-depth consumer and technical introductions explaining in full the background to the tests and products reviewed. They also contain *Overall Comparison Charts, Conclusions* which discuss the findings of the project in general terms and useful *Glossaries* to help explain some of the necessary technical terms and descriptions used.

The danger of relying too heavily on the mere inclusion of a product in this *Best Buy Guide* cannot be stressed too strongly, and readers are advised to read back up into the reviews rather than rely on the summaries. The review proper may contain important provisos on the application or suitability/compatibility of certain products. Whatever, the *Best Buy Guide* is a first step only for the hi-fi buyer, and it needs the support, the help, and the advice of a good dealer, plus the listening facilities he can put at your disposal.

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# PUTTING TOGETHER A SYSTEM

What exactly do you want from hi-fi equipment? Decide that and you're more than half way towards buying the right products. I look on hi-fi as a means of recreating in the home a musical experience that is related to, but not interchangeable with, live music. I don't care what it looks like; I don't want LEDs to look at and knobs to twiddle. That information helps cut down the market to a manageable size. What to do with the shortlist follows in a few paragraphs!

There is a syndrome which afflicts many hi-fi buyers which causes them to chop and change equipment costing pretty much the same money. It stems from having no appreciation of one's expectations of domestic music reproducing equipment. For the first-time buyer I'd suggest quiet reflection on what you get out of music and what you expect to get from hi-fi. For the user who is dissatisfied, I suggest reflection on what aspects of your current equipment don't come up to expectations.

Then you should measure your expectations against reality. Hi-fi shows are becoming better places to do this (dealer shows, at least) and dealers' showrooms can often do a good job. Go along and ask to listen to a system that can be recommended at say £350, or at a price you can afford. Then ask to hear one which costs twice or three times that price and is again recommended. Presuming your dealer knows his stuff (and that is why it is as important to audition dealers as it is equipment), then you will come away with a monetary measure of your expectations.

Cost, coupled with the information on what you want from hi-fi (wide dynamic range, smooth flat response, tangible imagery, deep bass, etc), and what you can expect to get for your

money, can almost pinpoint the products to shortlist and audition.

The dealer is an essential part of this evaluation as he can put your ideas into music and let you hear just what you'd be compromising by getting the system you really want, but buying a cheaper cartridge say to be able to afford the package now. He can let you hear systems that show the way to successful upgrading. If all he listens to though is the rattle of the cash register you'll be better off elsewhere. Choosing your dealer is as important as the equipment. Preparedness to demonstrate and take time to show the options available is to my way of thinking more important than an extra half per cent discount.

## How to apportion a budget

Formulae for one-third here, a quarter there spell disaster. At the end of the day you want a good music reproduction system for your money. If you have achieved that by spending 70 per cent on the turntable and just 10 per cent on the amp, so what? A budget should be apportioned to give as much money as possible to the basics.

The most important aspect to me of a hi-fi system is its ability to excite. Musical excitement seems to be 'coded' in wide dynamic contrasts and clean transients. The basics for a system that can come up with these goods are a turntable that can offer wide dynamics and stable imagery, coupled with above average sensitivity speakers and a fair sized amp to provide the necessary headroom. If I can't afford all that I must decide on the single most important item. Speakers are going to reproduce what is fed to them, amplifiers likewise; it is the turntable that is responsible for the integrity of musical dynamics, and I should therefore buy the best turntable I can, leaving aside

enough for cheap, but good, speakers and an amplifier.

You may decide that a smooth flat response is the single most important aspect of owning hi-fi and will decide to apportion the greatest amount to a pair of wide bandwidth, low colouration speakers.

A word of caution is required. Most folk intuitively, and wrongly, assume that the transducers in the system, the cartridge and speakers, will have the greatest effect on the sound. They will certainly produce the biggest differences in tonal balance and colouration level but it is the turntable that sets the seal on the dynamic range and potential detail retrieval, as its job is to provide an isolated environment for the stylus/disc interface. No fancy transducer can make up for what it's not getting.

Face the problem of budgeting with your dealer, get him to play to you two systems costing roughly the same, one with money spent on the turntable and one with money spent on speakers or an amp with tone controls. Listen to the budgeting options before deciding.

## How to approach a demonstration

Make appointments if possible to give the dealer time to accommodate your needs. Make the listening options as simple as possible and approach the task with some degree of scientific rigour. Change one item at a time to ensure you know what caused the change in sound quality. Use a few pieces of familiar music – and perhaps one piece of music you can't abide, as that often affects the way you listen.

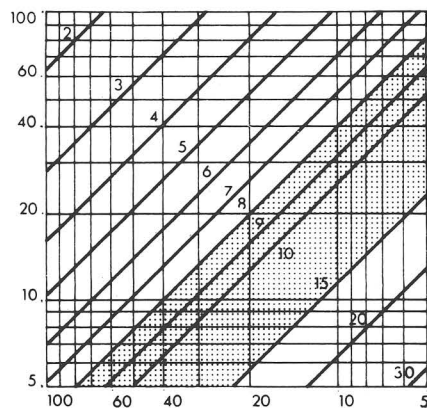
If you go into a dealer to buy speakers, try to have them demonstrated with equipment similar to your own; don't pick speakers after a demonstration using cassettes, if you only use records for instance.

### Record players – choice and installation

The turntable performs the essential task of isolating the disc/stylus interface. You should think how your surroundings are going to influence the way in which it does its job. If you like your music loud you will need a turntable that can cope with air-borne vibrations. If you live in a room with a wooden suspended floor then you will need a turntable with a suspension that can cope. The reviews printed later in the book can help with the choice.

I have laid stress on the importance of the turntable and this leaves you the option of economising on arm and cartridge to get the best motor unit you can. Upgrading arm and cartridge at a later date is less painful than changing the whole front end.

It surprises many people that a good turntable can make a system sound more dynamic. A turntable with less than good isolation is going to produce lots of low frequency signals when put into a room with springy floorboards. The amplifier is going to amplify this rubbish as well as the music signal and can lose valuable headroom and power in trying to drive loudspeakers at subsonic frequencies. It may be the arm/cartridge combination that's at fault here too. There is a simple graph printed below that will help you to choose a cartridge and arm combination that will not have a fundamental resonance in an unfortunate area. The reviews give you all you need for this graph – the effective mass of the arm, the mass and compliance of the cartridge.



### 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.

Once chosen, you can have your dealer deliver and install the turntable/arm/cartridge package, though you may prefer to install the cartridge yourself. Details of how alignment can minimise distortion due to tracking error is included in the introductions to the chapters on *Turntables & Tonearms* and *Cartridges*. The protractor printed here should be used to square the cartridge to a radius of the disc at two points. This means that the arc tracked by the arm cuts the imaginary radius along which the record was cut at two points, which minimises distortion across the whole disc surface. (This is often known as *overhang adjustment*, as to get the geometric alignment right the cartridge must be set forward in the arm to 'overhang' the spindle or centre of the turntable.) Rather than go for a single measure of overhang it is better to use a two-point protractor (the one published here is produced for minimum distortion on records with minimum groove radii up to 58mm, different zero points will be achieved using the 60mm IEC standard).

Full details of tracking weight, bias setting, etc, are included in the above-mentioned chapters.

### Suggested combinations

Prices are approximate, and this is not a comprehensive list.

- *Ariston RD80* + *Linn Basik* (£205.00) or *SME III S* (£250.00) or *Mayware* (£220.00).
- *Dunlop Systemdek* + *Linn Ittok* (£530.00) or *Helius* (£430.00) or *Mission 774* (£450.00) or *Syrinx* (£500.00).
- *Pink Triangle* + *Ittok* (£530.00).
- *Lux PD300* + *Ittok* (£730.00) or *Sumiko* (£1,300.00) or *FR64FX* (£770.00).
- *STD 305 S* + *Mayware* (£220.00).
- *Thorens TD160 S* + *Mission 774* (£340.00) or *Helius* (£320.00) or *AT1100* (£270.00) or *Ultracraft* (£270.00).
- *Thorens TD160 BC* + *SME III S* (£205.00) or *Mayware* (£160.00).
- *Walker CJ55* + *Hadcock 220* (£230.00) or *Basik* (£180.00) or *Helius* (£285.00).

### AMPLIFIERS AND SPEAKERS

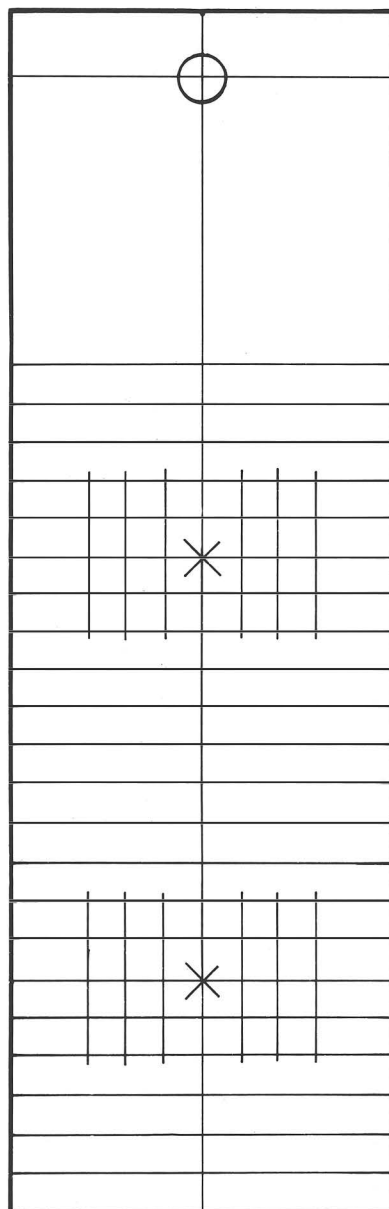
These items are handled together here because the matching of amplifiers and speakers is one of the commonest problems encountered in putting together a hi-fi system. Nearly always the wrong question is asked, namely 'how many watts do I need?' What you do need to know though is how loud you want your hi-fi system to go in your listening room. The 'wattage' of the amplifier doesn't tell you this.

There are three influences on the perceived loudness once a good signal from the turntable is assured. The amplifier power, the sensitivity of the loudspeakers and both the furnishings and size of the listening room. Big heavily furnished rooms need more energy pumping into them for the same perceived loudness as a small reflective (sparsely furnished) room. As explained in the introduction to the chapter on *Loudspeakers* our reviews give a range of amplifier powers for each speaker giving the minimum requirement (which should suffice for average levels in smaller than average sparsely furnished rooms) to the maximum power handling which should represent the kind of amplifier power required in a larger than average room furnished with heavy drapes, thick carpets and plenty of furniture. (Average room = 80 cu metre.)

Many people are nervous about damaging loudspeakers by over-driving them with their amplifiers. As explained in the chapter on *Loudspeakers* a big amplifier is unlikely to damage speakers even peaking well above their power handling for a short space of time. A small amplifier constantly running out of steam and clipping is more likely to damage loudspeakers. How well an amplifier performs as it approaches the limits of its power output is covered in the individual reviews.

### How to make your amplifier sound twice as loud

An outrageous claim you'd think. But the answer is simply change your speakers for ones having an extra 3dB sensitivity. The tailoring of ranges of amplifiers by the major Japanese manufacturers with models every ten watts from 30 watts to 70 watts implies that there is an important loudness difference coupling up a 40 watt amp after a 30 watt amp. I'm afraid not – the



Alignment Protractor



difference would be barely discernible. Changing from a speaker rated at about 85dB/1w/1m sensitivity to one with a figure of a just above average 88dB would produce a sound twice as loud. The point worth making here is that chasing after those extra few watts when buying an amplifier is pointless as the difference would be wiped out ten times over by even a slightly more sensitive speaker.

### Electrical matching

An amplifier's ability to drive a difficult impedance load is shown by its doubling of power from the normal 8ohm figure to the 4ohm load and a further attempt to double the output when driving a 2ohm load. The amplifier reviews contain this information. Match this information up with the quoted impedance and ease of drive mentioned in the speaker review.

The ability to drive difficult loads is the factor behind the superior auditioning performance of small amplifiers like the NAD 3020 and the Nytech receiver when compared with run-of-the-mill oriental designs of three times the 8ohm power.

The loudspeaker cable you choose to put between the amp and speakers can have a deleterious effect on the sound quality. Don't use odd bits of wire but invest in 5amp mains cable for shortish runs or 13 amp cable for 10 metre lengths. Specialist cables offering high-quality stranded copper cores can be recommended. Do be careful how the wire is wrapped off around the amplifier terminals and don't let short circuits happen.

### Speakers and rooms

Size and furnishings have already been mentioned but there are other factors to take into consideration to achieve a smooth response and good stereo imagery. Use the speakers where they are designed to go. Some speakers like the ARC 101AP are designed to be mounted back against a wall to achieve a balanced bass output. Other speakers, say the Rogers *Studio 1*, are designed to be stand mounted and used in free space at least 1m from the back wall for their bass output to be correctly balanced. Corner mounting doubles up bass output again over wall mounting.

A rough rule of thumb is that the speakers and listeners should be at the corners of an equilateral triangle with the speakers angled in to the listening position. There is nothing better than experimentation in the home, as in some instances the speakers can afford to be further apart or angled to have their axes cross in front of the listening area. Use a simply-miked recording and adjust the speaker positions until you get a firm image extending right between them and existing in depth.

Be careful over where you position your loudspeakers in relation to your turntable as there is no point making its job harder by pointing a loudspeaker directly at it. While on the subject of turntables and speakers it is sometimes better to sacrifice bass extension in a speaker system than to buy big bassy speakers and expect clean bass from the poor turntable, so ending up living in an environment swamped with low frequency junk.

### Receivers versus tuner and amplifier

Is it better to buy separates or save money and go for a receiver – a tuner and amplifier all in one? If you can accept the level of facilities that are provided as a match on the tuner and amp section by the receiver manufacturer then a receiver can offer a saving. If, though, for example, you wanted the simplest-to-use tuner with fair FM stereo performance yet wanted to use two tape decks and a cassette player with your amplifier you'd have to choose a cheap tuner and a facility-laden amplifier; no receiver manufacturer offers that kind of package.

### Upgrading

Whatever you choose and finally buy, think ahead to the time when you will either want to replace part of the system or improve its performance. Some systems offer a simple route to hassle-free upgrading which gives good improvements each time. Take for instance a good quality first-time system that could be recommended by many dealers and is indeed produced to allow for painless upgrading. This is a Linn *Sondek* fitted with the Linn *Basik* arm and cartridge using a Nytech or A&R A60 amplifier with ARC 101AP speakers. The first upgrade move could be to use a moving-coil cartridge in the *Basik* arm and change the input card in the amplifier. The Supex 901S (which would run into the magnetic input already in use) or the Supex 900 *Super* seem current favourites. The next move could be to a better arm: Linn have designed their £40 *Basik* arm so that its base can be used for their £253 *Ittok* arm, and this would be a logical move. The next upgrade could be to take the active option on the speakers, dispense with the modular crossover and to use an electronic crossover and an extra power amplifier (both A&R and Nytech make power amplifiers specifically designed for this job). This upgrading scheme shows the benefits of an integrated systems approach, which is becoming the norm with some UK manufacturers following similar design philosophies: for instance, there are the modular Meridian pre/power amplifier designs, the amplifiers from Crimson Elektrik, and the newer NAD designs which offer bridging facilities.

One popular and cheap/simple way to upgrade is to fit a new stylus to an existing cartridge. Buying a better stylus having a more sophisticated profile can be a good idea if the arm in use is still compatible with any changed compliance. Shure cartridges, the A&R designs and some of the Ortofon offer simple exchange stylus improvements.

### Suggested systems

Suitably the £300 system, indeed the cheapest system, that could be put together using this guide is one which is already selling well in the dealers. The Dual CS505 is one of the few recommendable budget turntables now available; couple this with the JVC AX1 amplifier and a pair of Marantz HD445 speakers plus a little extra expense for a smoother cartridge than an absolute budget design (say the ADC VLM/III) to assemble a capable system. The NAD 3020 amp and Mission 700 speakers are an even more popular package, particularly with cheap Ortofon or Grado

cartridges. KEF *Celeste IV* and Celestion 130s would offer a little more than the basic speakers too. The choice of the NAD amp would enable the use of sensitive speakers up to and including designs like the £215 Audiomaster *MLS4s* to be used eventually.

The next worthwhile step would be represented by something like the Michell *Focus/Linn Basik* or Rega *Planar 3*, A&R A60, Audiomaster *MLS4* system at £575. Alternative speakers like the KLH 317, KEF 103.2, Castle *Kendal*, Celestion 200 or LS3/5A designs could be used to suit alternative rooms, pockets or tastes. The *Basik* or Rega arms could later take better cartridges like the Supex 901S or Coral MC81, as they are well suited to these lower compliance designs. The Walker CJ55 or Thorens TD160C/III turntables could be substituted to suit the needs for a suspended subchassis design or different arm compatibility.

The £1000 to £1500 bracket would be inhabited by systems like the Linn *Sondek/Ittok/Asak*, Nytech CTA252 XD/II, ARC 101AP system mentioned previously, or the cheaper type of system that would appeal to the listener looking for a smooth frequency response above all else as provided by a Thorens TD160S/Mission 774/Supex 901S, Rogers A100, Rogers *Studio 1* system. The potential for cartridge alternatives here would include designs like the Mission 773 or B&O MMC20CL as the Mission arm offers wide compatibility. The SME III S arm does good work with cartridges like the Goldring G900IGC or Shure V15 IVHE in this type of system. Speakers like the BC1 from Spendor or the Mission 770/II offer obvious potential too.

Ultimate systems in the £3000 to £5000 category would be built around decks like the Lux PD300, Linn *Sondek* or Dunlop with arms like the *Ittok* (Sumiko perhaps) and cartridges of the *Asak*, and Koetsu class. (A Lux PD300 with Sumiko and Koetsu would cost around £1800 for a record player alone, while the Oracle would take this to over £2000). Amplifiers like the Lentek, Exposure and Meridian designs are likely to be sold with this equipment for use with speakers like the Proac *Studio 3* or Spendor SA3.

Remember these systems are examples of the type of system that can be assembled at any given price. There is no recommendation from me that can remove the need for personal audition.



## Why Sony changed their

If some Japanese speakers sound a little oriental in tone, it's not that they're any less well-engineered than their European counterparts but simply because they're tuned to different tonal values.

What sounds ideal in Japan, however, can sound rather off-key to a European ear and vice versa.

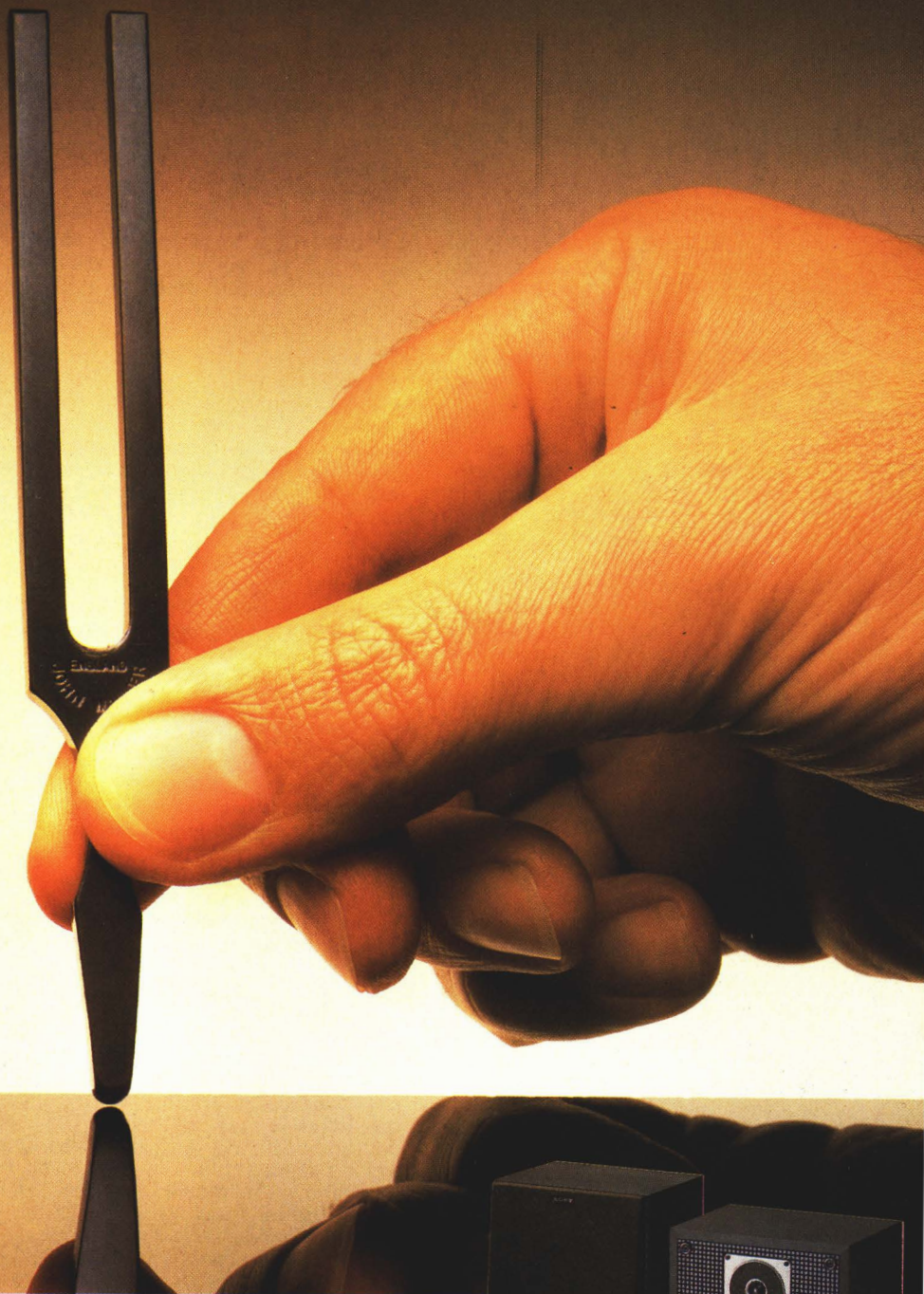
Which is why Sony have taken the rather unusual step of building their loudspeakers in

Europe and tuning them to the ears of a European listening panel, rather than those of a Japanese engineer.

The result is a tonal balance of which any European loudspeaker would be proud, together with an enviable level of engineering designed to optimise sound performance and not merely flatter the eye.

In our SSG series all three cones are "plumb-in-line" so that the sound waves travel

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the same distance to the ear, thus minimising phase distortion.

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Further information: Sony UK Ltd., Pyrene House, Sunbury on Thames, Middx. TW16 7AT.



# TURNTABLES AND TONEARMS

Let's get our terms sorted out first. Strictly speaking *turntable* refers only to the revolving platter; the term used throughout this book to describe a turntable-only unit is *motor unit*. Such a unit will normally be complete with motor, base (plinth), cover and arm mounting board. Its essential companion is the separate *tonearm* or *pickup arm*.

The most familiar turntable unit is the *record deck*, *integrated player* or *turntable system*, which combines the motor unit and a pickup arm in a plinth system, often with the addition of auto arm-return facilities or even full automation from record size sensing to arm lowering. Integration should enable designers to produce well worked-out design compromises which would offer good performance for a fair price but it is sad to say that few manufacturers adhere to this line of 'systems' thinking.

## What should a turntable do?

The turntable's basic job is to provide a stable unvarying platform for the interaction between the LP record and the cartridge, to enable the cartridge to derive as much of the best possible information it can from the disc. The turntable should do this without creating its own noise and it should help isolate the disc/stylus 'interface' from the vagaries of vibrations in both the air and the structure on which it sits.

The tonearm is part of this system and is the outcome of the practical limitations on disc replay by a device that bears some relationship to the cutter head mechanism which cut the disc in the first place. Records are mouldings from metalwork stampers. These stamps are literally grown by depositing metal onto a cellulose acetate disc which has been cut with a heated stylus driven by the audio signal. This *lacquer* as it is called is vacuum clamped on the massive platter of the cutting lathe, and is addressed by the cutter head which travels in a straight line along a radius of the disc. The head is in fact driven out across the disc, cutting the screw thread of the record groove as it goes.

To replay this groove you are faced with the problem that there is no way to clamp the replay stylus in a head mechanism and drive it across the surface of the disc – the pitch of the groove cut in the record varies with the level of the cut and the desired running time of the LP anyway. Not only that but mass produced records, even the best pressings, would be too off-centre

and warped for such replay. The typical compromise is to use a pivoted tonearm which is free to move across the disc and up and down. The replay cartridge is fixed to the end of this arm about 9 inches from the pivot, where it can effectively track the groove of the record, passively.

The job you are asking this piece of precious gemstone called the stylus to do is outrageous. Some of the smaller modulations on the record groove are about the size of the wavelength of light (about a millionth of an inch).

## Turntable assessment

We need to know how accurate the rotational speed of the turntable is and how closely it keeps to this speed. The vibrations generated by the motor and bearing need to be measured too, as does the turntable's effectiveness in cutting out/down the vibration reaching it through the air around it and from the shelf on which it sits. The term *microphony* describes how some turntables pick up these vibrations and let them interfere at the stylus/disc interface where they are amplified. Once passed to the speakers these vibrations are out in the real world again and can upset the turntable for a second time. This is known as feedback when it happens again and again.

We need to know that the pickup arm bearings won't impede the cartridge's progress across the disc and that the geometry and alignment of the arm permits the adjustment of the cartridge for minimum distortion. Additionally the effective mass of the arm will help us to decide on what type of cartridge will be compatible. We also need to know how the pickup arm will cope with vibrations put into it by needle chatter. Of course the complete unit should then be auditioned.

## Speed

The turntable must be able to rotate the disc for replay at the same constant speed at which the lacquer was cut. The problem for the turntable is that this is relatively easy to do as long as the stylus isn't tracking the groove and causing drag which varies with the severity of the cut on the disc.

The speed of the turntable can drift over longer periods of time often caused by tolerances or cyclic changes in balance or even the electronics used to stabilise the speed. Shorter term changes in speed cause wavering of the pitch of notes, which is very noticeable with records of piano music. This

is known as *wow*, the effect heard when you slow the turntable down with your finger. Shorter term variations still are called *flutter*, often caused by motors imparting a jerkiness to the platter's rotation, or by rough finishes on bearings and the like.

The stylus drag mentioned earlier on can cause similar problems to wow which are not commonly picked up in simple measurement tests. This is known as *dynamic* or *transient wow*. When the stylus hits a rough patch (a loud music signal) or has to cope with a big, quick excursion (a transient), the drag on the turntable increases, and the note may lose its attack and be 'smeared out'. This is then followed by a cycle of wows as the turntable attempts to stabilise. Servo systems are one attempt to solve this problem. A servo senses the speed change and acts to correct it, and that's where the problems with servos stem from – an error has to exist before it is corrected. Poorly designed servo systems merely add their own frequency of operation to the wow and flutter problems already there.

The other way to overcome these problems is to have a platter of high enough inertia to 'flywheel' its way through the stylus drag changes. (High torque motors are a third solution but there are the associated problems of increased vibration levels and the inherent problems of motors 'pulsing round' rather than running smoothly.)

## Rumble

Rumble is a very low frequency problem picked up by the cartridge through the record from the main bearing of the turntable or from hum or grumbles in the plinth from the motor system. Rumble, if fed into a hi-fi system, may not be heard but can sap the power of the amplifier by driving the speakers hard at very low frequencies. The interaction of rumble, recorded rumble off disc, turntable isolation (or lack of it) and a cartridge's low frequency performance is one of the areas covered in *Putting together a system*.

## Do not disturb

The area of turntable performance that seems to receive the least attention from the major manufacturers is that of the turntable's resistance to outside disturbances; in other words its isolation character. One of the best approaches seems to be to hang the platter, arm and cartridge systems on a sprung subchassis from the plinth.

These systems may work well for filtering out certain frequencies of vibration, but they are often little help in dealing with shock. Such wobbly suspension systems are often a big minus point for some buyers simply because they aren't confident in operating a floating turntable.

Vibrations in the air may come from passing traffic or from the loudspeakers reproducing your favourite music, either way the turntable is susceptible to this air-borne vibration. Often moving the turntable to a different part of the room can help if the turntable itself isn't designed to cope. Martin Colloms has made some assessment in the following reviews of the capability of different systems to handle vibration and feedback of all kinds.

### Tonearms

The tonearm should be part of the inert suspension system that enables the stylus alone to follow the modulations of the record groove, getting as close as possible to the path made by the cutter. The conventional way is to use a fixed pivoted arm some 9 inches long and to reduce the tracking error by offsetting the headshell end by some 25 degrees from the line of the arm. Further details on how tracking error is minimised is included in the introduction to the chapter on *Cartridges*.

Some arms aim to reduce tracking error to zero by following the straight line cutter path, these are known by a variety of often misleading names, *parallel tracking*, *straight line*, *radial tracking* or *tangential tracking arms*. The practical problems are many-fold but some companies manage to overcome them to some extent though only the Technics *SL7/10* models did sufficiently well to merit recommendation and inclusion in this guide.

The unfortunate fact of minimising distortion tracking by offsetting the headshell is that the stylus drag is now not in the line of the arm pivots and so causes a force to be generated which tends to pull the arm in to the centre of the record. As the drag changes with the modulations in the disc so to does this force, but it seems sufficient to correct for it with a progressive bias force set to correct for the highest level signals. This bias compensation (often called *sidethrust compensation* or erroneously *anti-skating*) is built into the arm mechanism and can be effected by weights on cords, magnetic interaction or by calibrated springs. Our arm reviews comment on the efficacy of the bias compensator fitted to every tonearm. Of course the straight-line tracking tone arms have no offset and so produce no sidethrust force, therefore needing no bias force.

### Tracking

The interactions between cartridge and arm mass and the compliance of a cartridge are covered in the chapter on *Cartridges* later in the book. The relationship between mass/compliance and fundamental arm/cartridge resonance is covered by a simple graph in the earlier chapter on *Putting together a system*.

### Arm damping

Many cartridges contain some form of damping at the hinge or pivot of their cantilever system to help control the

low frequency resonance. Some arms provide for pivot damping to help the cartridge cope with this low frequency resonance. Damping helps to reduce the sharpness and amplitude of the resonance but in doing so it spreads the range of frequencies that will excite it. Arm damping may therefore change the sound of a certain cartridge but not necessarily for the better. Over-damping can reduce the arm's ability to follow warps and so the cantilever system will be flexed over the warps instead of the arm and cartridge rising and riding over the hump. This will not only cause tracking problems and rotation of the stylus contact points causing distortion but it may well feed high energy subsonic signals to the amp and speakers, which again may cause havoc with feedback or may just drain the amp of the power it needs to drive the music signals. Comments are made in the tonearm reviews on the effectiveness of damping and in the cartridge reviews on the need for additional damping with certain cartridges.

### Plattermats

The vogue turntable accessory is the plattermat but their action is only just beginning to be understood. Rather than provoke wholesale mat swapping I would suggest that with the more expensive designs the mat interaction is often taken into account in designing the turntable. With budget and mid-price record decks the mats are so often designed for visual appeal rather than record support and here is where the benefits in mat substitution will be found. Remember though that a £20 mat on a £70 turntable may not be a cost effective solution to improving the sound quality of your hi-fi.

The **Audio Ref** and **Avon** mats were found by Martin Colloms to be the best 'all rounders', while hard glass mats from **GA Audio** and **Michell** produced fine results on turntables with flimsy platters.

### Other models worth considering

There were just over half a dozen integrated record decks that can be considered of above average performance though not included as *Choice* recommended products. The three ADC models costing between £70 and £105 were found to offer reasonable value for money in that they were fitted with high quality cartridges (the 1500 excluded). The **ADC 1700DD** model has quartz locking, the **1600** is cheaper as it does not include this facility while the **1500FG** was spoiled by high rumble figures though should offer good performance at the price especially when used with ADC's own QLM 34/III.

The **APQ70** (£170) is Akai's best model to date being above average in many respects and coming factory-fitted with a compatible Ortofon cartridge. The **Denon DP30L** (£130) was thought to offer good quality construction and finish for an inexpensive direct drive model. The **Philips AF829** (£165) was criticised on the grounds of the arm and fitted cartridge being of limited compatibility but nevertheless this player was felt to be a generally competent all-round performer. The **Mitsubishi DPEC7** (£179) was described as an honest medium-priced direct drive model being well engineered and offering fairly good value.

Sony's **PSX600** (£180) was also found to be well made and to offer automatic facilities with good shock isolation.

Of the motor units the big **Lux PD555** (£1700) proved, because of its price, to be beyond any value recommendation but with its suction platter it achieved much in terms of sound quality. The similarly expensive **Marantz TT1000** (£1000) also offered a high standard of sound quality.

The well engineered **Oracle Delphi** (£680) was liked on the basis of its good measured performance and fine sound but again price mitigated against recommendation. The **Image** (£500) now rechristened the **Dias** in a confusing change of distributors had the potential to be a very good turntable - time will tell. The semi-pro **Technics SP15** (£315) offers great reliability and state-of-the-art measured performance but requires careful siting for best results. The **Logic DM101** (£300) demonstrated great potential but there are design points in the suspension which need finalising. The **Ariston RD110** (£250) was found awkward to set up but achieves good sound quality and deserves mention here, as did the **STD 305M** (£200) which has been overtaken in the value for money stakes by the cheaper **STD 305S**. The **Thorens TD126 III** (£230 and up) offered good sound quality with both Thorens and SME arms. The **TD126** is one of the very few decks with a 78rpm facility and I believe the only one currently produced with variable pitch too - an ideal recommendation then for the record collector with a collection put together across the years.

The **Audio Linear TD4001** (£200) achieved a good standard but it was felt that the price was now too high to justify recommendation.

There were ten separate tonearms which came into the 'Worth Considering' category. The **Sumiko** (£800) deserved inclusion for its very good sound quality though there were some reservations, not the least of which is the price. The **Fidelity Research FR64S** (£300) and **64fx** (£270) models both offered fine sound quality though the **S** is of limited compatibility due to its high mass and high inertia. The **fx** offers improved geometry, lower mass and lower inertia making it suitable for a wider range of cartridges.

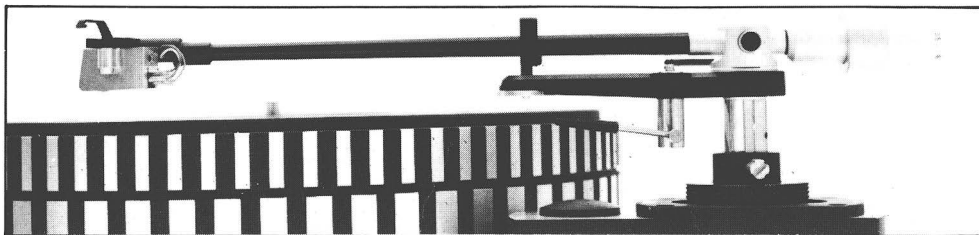
The **Syrinx PU2** (£190) was found to have some drawbacks but offered good sound for the price.

In the £100 and below bracket the **Hadcock GH220** (£100) was prevented from gaining a recommendation because of continued quality control problems but it does have fine bearings and offers good sound. The **Michell Focus** (£85) proved versatile and offered very good geometry but suffered weakness such as insecure counterweight fixing. The **Hadcock GH228** (£78) offered good sound quality in a low mass unipivot design but again quality control problems preclude recommendation. The long established **SME 3009/II** (£70) is well made and offers above average sound and engineering value. The **ADC LMF2** and **ALT1** models (£70 and £30) were well calibrated and offered good value, though the **ALT** clearly is the better buy.

RECOMMENDED

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

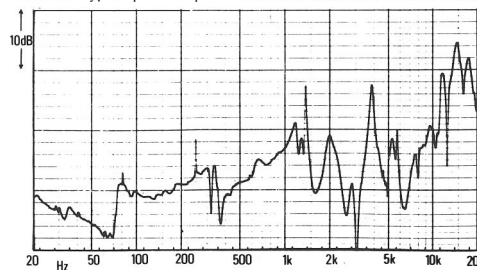
ADC, BSR Ltd., Powke Lane, Cradley Heath, Warley, West Midlands, B64 5QH.  
Tel (0384) 65191



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/280mg/250mg	
Cueing: drift/8mm ascent/8mm descent	..... negligible/1.5secs/6secs	
Downforce calibration error 1g/2g	..... -0.1g/-0.125g	
Amount of damping	..... none	
Arm resonances	..... good	
Subjective sound quality	..... very good/above average	
Motor recommended	..... TD160, note large rear clearance	
Estimated typical purchase price	..... £70	



Arm resonances (*LMF1*)

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.

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RECOMMENDED

# Ariston RD80

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



## Features and design

At something like two-thirds the cost of its luxury finish brother the 110, the RD80 sacrifices little considering the price difference. The finish is plainer, but nonetheless the plinth is wood veneered and the machined alloy platter weighs 2.45kg. A single large pulley and foolproof drive runs at a 33 $\frac{1}{3}$ rpm via a conventional rubber belt, the three point sprung steel subchassis successfully isolating the platter/arm system from environmental disturbance.

Although improved since last reviewed, setting up is still time consuming, though helped by using underside bolts accessible without removing the bottom cover. Possibly as a result of the reduced platter mass, this deck was more stable in its set up and remained so for longer than the RD110. The plinth will accept some of the longer arms, and the lid is a generously thick dark-tinted PVC moulding.

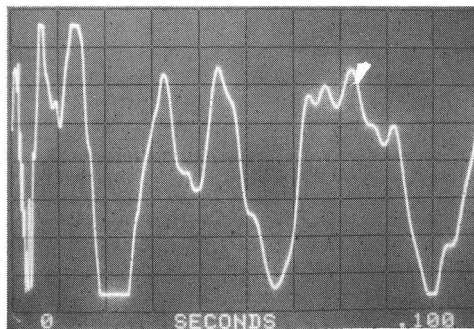
## Lab results

Performing well on the lab tests, wow and flutter, torque, rumble, start up time and speed error were all very good for the class and type of deck. A trace of 100Hz motor breakthrough was however present, measuring -65dB unweighted. The sensible flat mat gave an above average disc impulse result, allowing a X10 scaling for the photo.

If anything its isolation and acoustic rejection were superior to those of the 110, probably because of the more stable subchassis behaviour, and good to very good results were obtained here.

## Sound quality

In tonal balance the RD80 was judged quite good with a well integrated character, if slightly dull. The sound field was quite secure and stable, demonstrating fairly good bass as well as a precise image, with good focus and fair depth - all strong plus points at the price.



Disc impulse transmission, magnified X10.

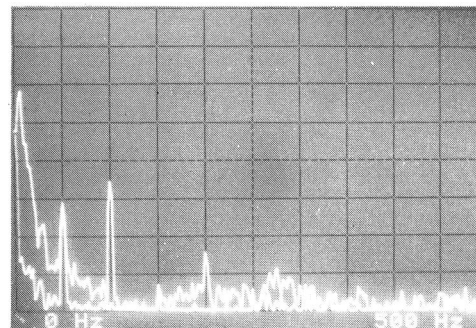
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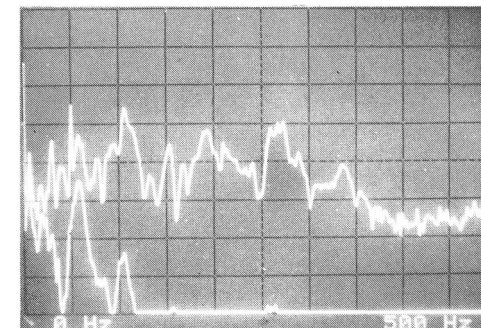
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Rumble (0-500Hz line), (electrical component superimposed).



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

## Conclusion

The RD80 has come out well in virtually every respect, paralleling and in some areas proving marginally superior to the performance of the recommended Thorens TD160S. As such, it clearly merits recommendation itself, and will happily partner many good quality tonearms costing up to £150 or so.

## GENERAL DATA

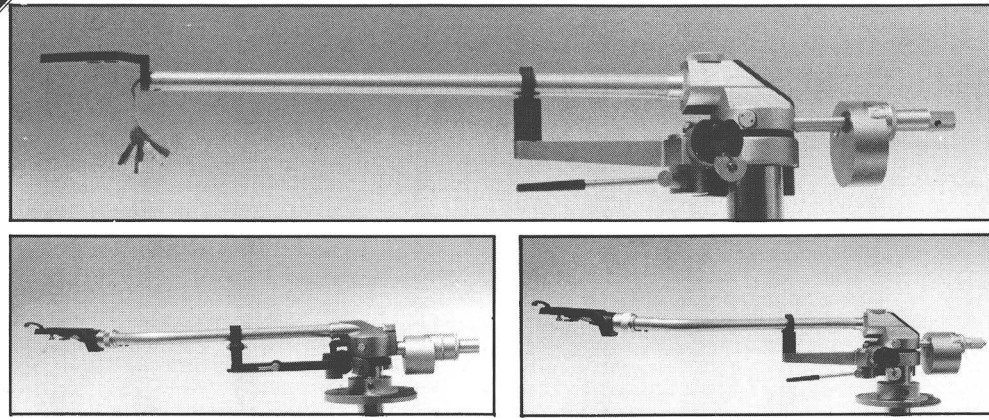
Type	Motor Unit
Platter mass/damping	belt drive
	2.45kg/good

Finish and engineering	good/very good
Type of mains lead/connecting leads	3 core/phono + earth
Speed options	33rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.07%
Absolute speed error	+0.35%
Speed drift 1 hour/load variation	synchronous/-0.15%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-76.5dB
Size/clearance for lid rear	44.5(w) x 36.0(d) x 17.0(h)/4cm
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	good/fairly good
Estimated typical purchase price	£170

RECOMMENDED

# Audio Technica AT 1100/1010 (re-assessed)

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



## 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*

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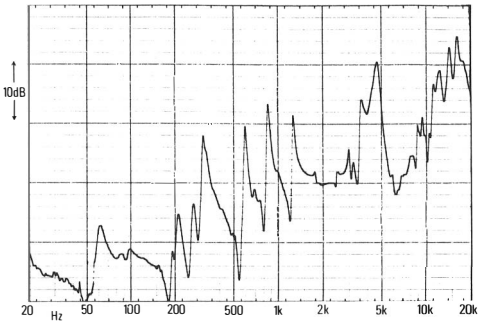
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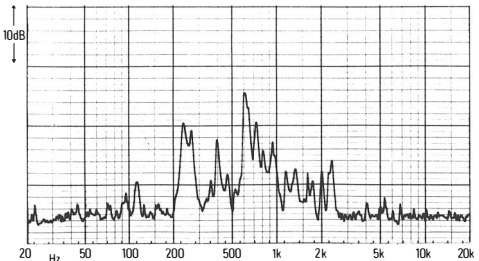
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Advice is gladly provided, with emphasis placed on system matching, and the free local installation service is recommended. Home evaluation is also available and an in-house service department provide the best after-sales service. A complete understanding of pick-up arm geometry and cartridge behaviour ensures that turntable and arm combinations are set up to provide optimum performance.

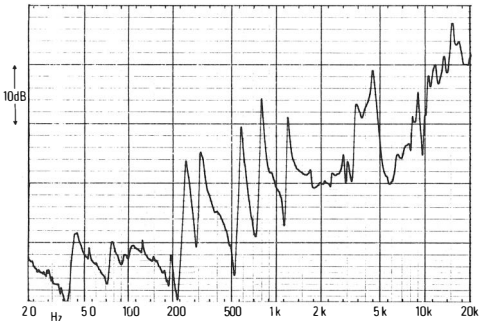
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- ARR
- ARC
- ARISTON
- B&O
- B&W
- CELESTION



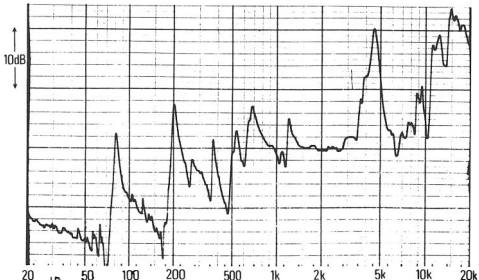
Arm resonances, tight damping, AT1010.



Vibration transmitted via AT1010 measured on Logic arm board.



Arm resonances, loose damping, AT1010.



Arm resonances, 'S' version with heavy counterweight.

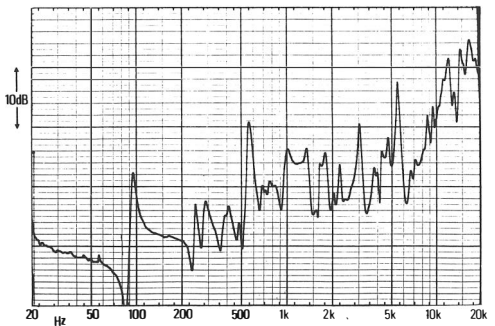
considerable merit, allowing the use of headshell cartridges as well as models of lower compliance.

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..... £100

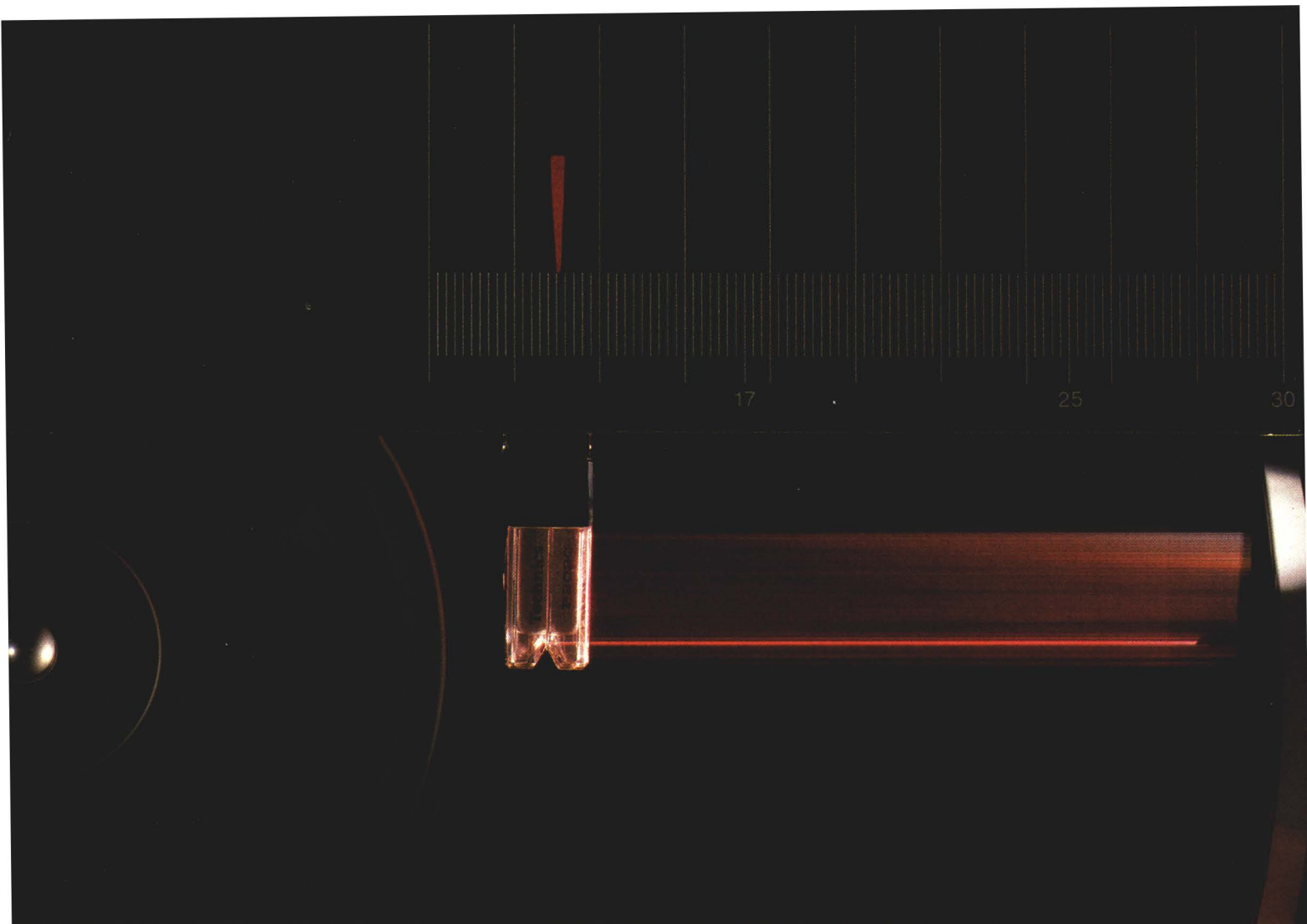
**GENERAL DATA** Tonarm  
 Approximate effective mass inc screws, excl cartridge..... 12.5g  
 Type/mass of headshell  
 universal detachable on accessory 'S' tube/9g  
 Geometric accuracy..... excellent  
 Adjustments provided..... tilt, overhang, height  
 Finish and engineering..... excellent/very 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..... £150



Arm resonances, fixed light counterweight, AT 1100.

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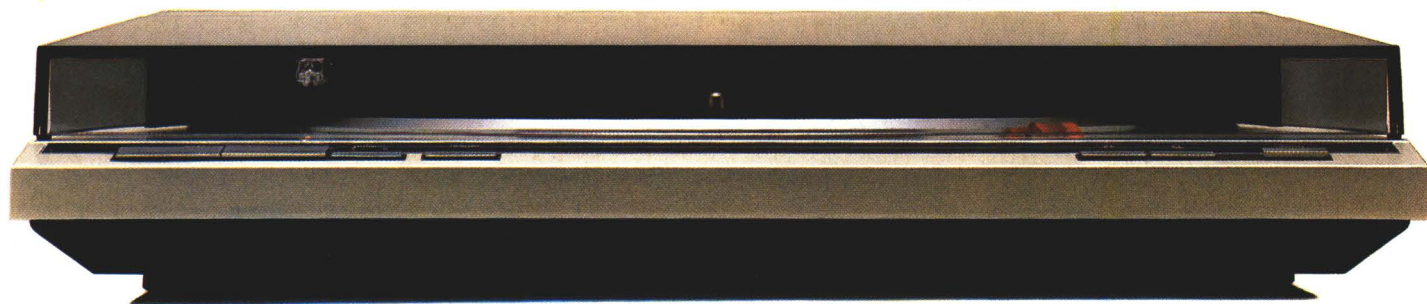
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Sole U.K./EIRE Distributor: Cambrasound Limited, Freedex House, 4-10 North Road, London, N7 9HN. Tel: 01-607 8141. Telex 264773 Metros G.

RECOMMENDED

# 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 unweighted, 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.

## GENERAL DATA

Integrated Turntable

### Motor Section

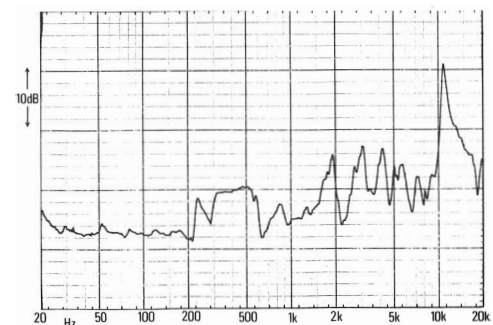
Type..... belt drive, fully automatic  
 Platter mass/damping (outer platter)..... 0.45kg/fair  
 Finish and engineering..... very good/good  
 Type of mains lead/connecting leads..... 2 core/DIN  
 Speed options..... 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2)..... 0.08%  
 Wow and flutter (LIN 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

### Arm Section

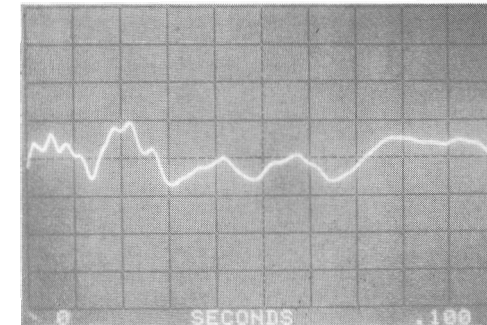
Approximate effective mass inc screws ..... 6g incl cartridge  
 Type/mass of headshell..... N/A/ N/A  
 Geometric accuracy..... very good  
 Adjustments provided..... downforce  
 Finish and engineering..... good/fairly good  
 Ease of assembly/setting up/use..... excellent/excellent/excellent  
 Friction: 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..... graphed with B&O cartridge N/A

### System as a whole

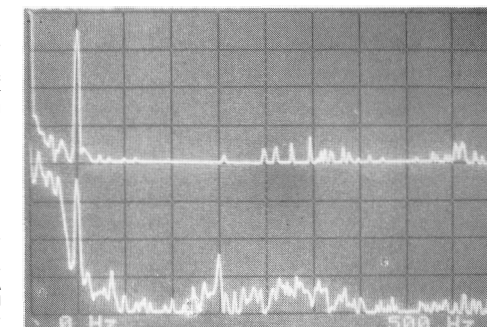
Size/clearance for lid rear... 44.0(w) x 33.0(d) x 9.5(h)/not required  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... very good  
 Subjective sound quality of complete system..... above average  
 Hum level/acoustic feedback..... very good/excellent  
 Vibration sensitivity/shock resistance..... very good/very good  
 Estimated typical purchase price..... £95



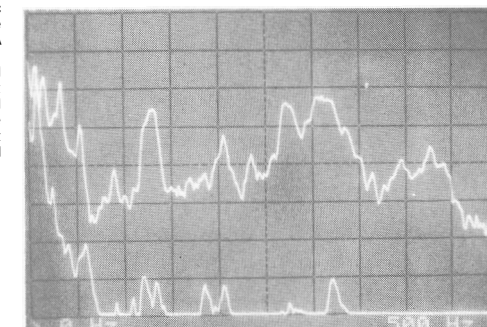
Arm resonances, B&O 20S cartridge.



Disc impulse transmission, standard X1.



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



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

**RECOMMENDED**

# Dual CS 505

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



## Features and design

Dual's somewhat confusing model range begins with the black-finished 505 which is the cheapest deck they produce, and its 'twin' silver-finished 505-1. Developed from the CS506 reviewed last year, it is related to another new model in the range, the 506-1 (£96), black only, which unlike the 505 comes supplied with a cartridge (ULM 45E). An improved motor and spring suspension has been fitted to all models.

The 505 retains Dual's traditional flanged steel deck plate chassis, mounted on four plastic foam-damped steel coil springs. The belt drive uses a new 16-pole synchronous motor, fitted with Dual's ingenious vari-pitch control mechanism, which employs an expandable motor pulley. The light 1.1kg platter carries strobe markings and in the case of the 505 relies on external illumination; a lamp is fitted on the more expensive 506-1. Both decks have the Dual 'two ring support' rubber mat, which leaves considerable scope for improvement, as can be seen from the 'X1' disc impulse display.

Dual's forte is the production of high quality tonearm mechanisms, which are fitted even to their cheaper models, and the 505 proved to be no exception. The arm is designed for dynamic balance, and the well engineered gimbal bearings showed little play and were free of 'notchiness'. The overall effective mass of 6.5g suggests cartridges in the 12-30cu range (to some extent

dependent on the weight of the cartridge concerned). The cartridge mounting bracket clips in beneath the fixed headshell, and is locked in position by a lever. It may be further secured by a tiny grub screw which is visible on the top surface of the headshell itself - a type of fixing common to all models in the new Dual range. An anti-resonator system is fitted in the counterweight, but it had remarkably little effect on the subsonic resonance of our test cartridge in common with its predecessors.

## Lab results

Employing our new automated sigma 2 measurement for wow and flutter, the first sample produced a marginal 0.15%, which is poorer than spec; although not fully on target, a second model was quite satisfactory at 0.11%. Torque was also satisfactory, giving a reasonable start up time, and the rumble reading was much better than for last year's model at a fine -73dB, although some motor rotational harmonics can be seen between 25 and 200Hz on the rumble spectrogram.

The disc impulse response (X1 scaling) illustrates poor damping of the narrow higher frequency components, which show large peak amplitudes; the longer duration ringing at 27 Hz was probably the platter itself. The acoustic isolation was promising if rather 'lumpy', and would have been improved with a better and heavier mat. Vibration isolation was above average for the price, but was again irregular, with prominences at 50 and 275Hz.

The tonearm gave good basic results, and was generally quite accurate on all its settings, with the bias values nominally correct if slightly in the wrong ratio. However, it proved unexceptional in terms of audio resonances, with minor modes at 55Hz and 140Hz, and a major flexural resonance (probably torsion) at 200Hz, displacing the energy trend by 15dB. Above this point and for a whole decade (200Hz to 2kHz) the behaviour was very good, leading to a final major mode at 2.5kHz.

## Sound quality

Rated as 'average', a fine result at the price, the 505 demonstrated a stable, relaxed quality, with quite decent presentation of stereo, bass extension and ambience; the arm sounded more integrated in character than the resonance graph might have suggested. The substitution of a good mat helped quite considerably (Audio Ref used, though others are also suitable), serving to clean up the sound and improving detail, depth

and clarity in the bass. The arm even coped with an Asak cartridge, although this is not a recommended combination!

## Conclusion

Dual have at last arrived at a well-balanced turntable, offering a fine performance at a budget price, the end result determined by the choice of cartridge and mat. Inevitably it gains a full recommendation in terms of value for money. Theoretically the 506-1 should qualify similarly, but here the final value judgement must be reserved, depending on the quality of the supplied cartridge, the alternative of a 505 with quality cartridge and mat appearing the best option.

## GENERAL DATA

Integrated Turntable

### Motor Section

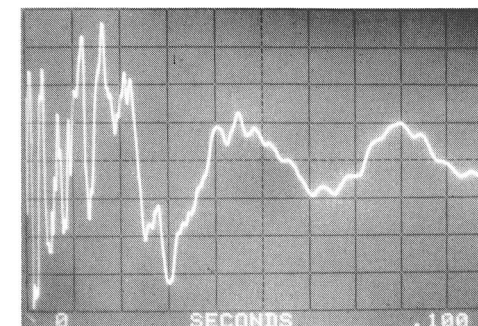
Type ..... belt drive, manual and auto stop/lift  
 Platter mass/damping ..... 1.1 kg/fair  
 Finish and engineering ..... very good/good  
 Type of mains lead/connecting leads ..... 2 core/phonos + earth  
 Speed options ..... variable 33/45rpm  
 Wow and flutter (DIN peak wtd sigma 2) ..... \*0.15%  
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ..... 0.4%/0.16%  
 Absolute speed error ..... fine variable control  
 Speed drift 1 hour/load variation ..... synchronous/-0.4%  
 Start up time to audible stabilisation ..... 2.5secs  
 Rumble: DIN B wtd L/R av (see spectrum) ..... -73dB  
 \*Second sample result ..... 0.11% DIN, 0.22% W, 0.15% F

### Arm Section

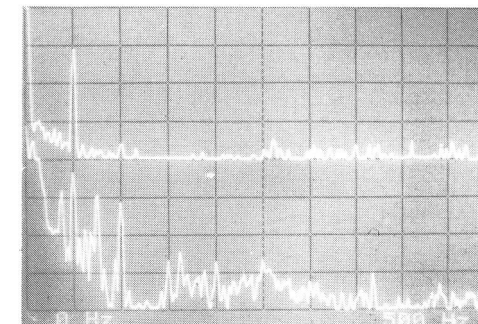
Approximate effective mass inc screws, excl cartridge ..... 8g  
 Type/mass of headshell ..... detachable, special bracket/N/A  
 Geometric accuracy ..... very good  
 Adjustments provided ..... overhang, lateral angle  
 Finish and engineering ..... very good/very good  
 Ease of assembly/setting up/use ..... very good/very good/good  
 Friction: typical lateral/vertical ..... less than 20mg/less than 20mg  
 Bias force: rim/centre (set to 1.5g elliptical) ..... 200mg/150mg  
 Downforce calibration error: 1g/2g ..... +0.1g/0g  
 Cue drift/8mm ascent/descent ..... negligible/2secs/1sec  
 Arm resonances ..... average  
 Subjective sound quality ..... average  
 Lead capacitance/damping method ..... 150pF/seismic counterweight

### System as a whole

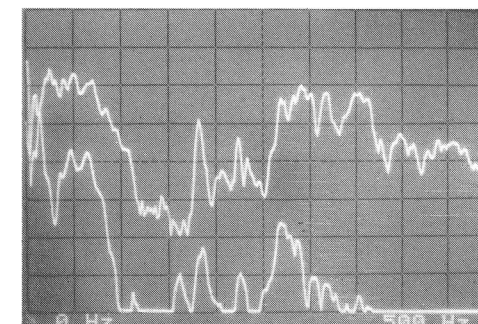
Size/clearance for lid rear ..... 42.0(w) x 36.5(d) x 11.3(h)/6cm  
 Ease of use ..... very good  
 Typical acoustic breakthrough and resonances ..... fairly good  
 Subjective sound quality of complete system ..... average ++  
 Hum level/acoustic feedback ..... good/good  
 Vibration sensitivity/shock resistance ..... average/good  
 Estimated typical purchase price ..... £75  
 † with better mat substituted



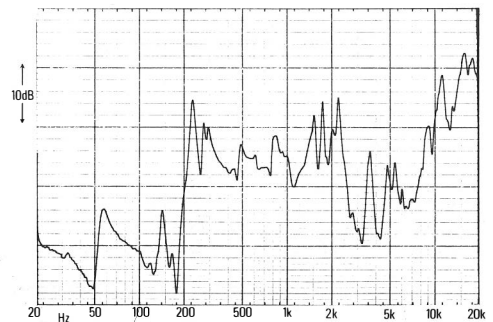
Disc impulse transmission, standard X1.



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



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

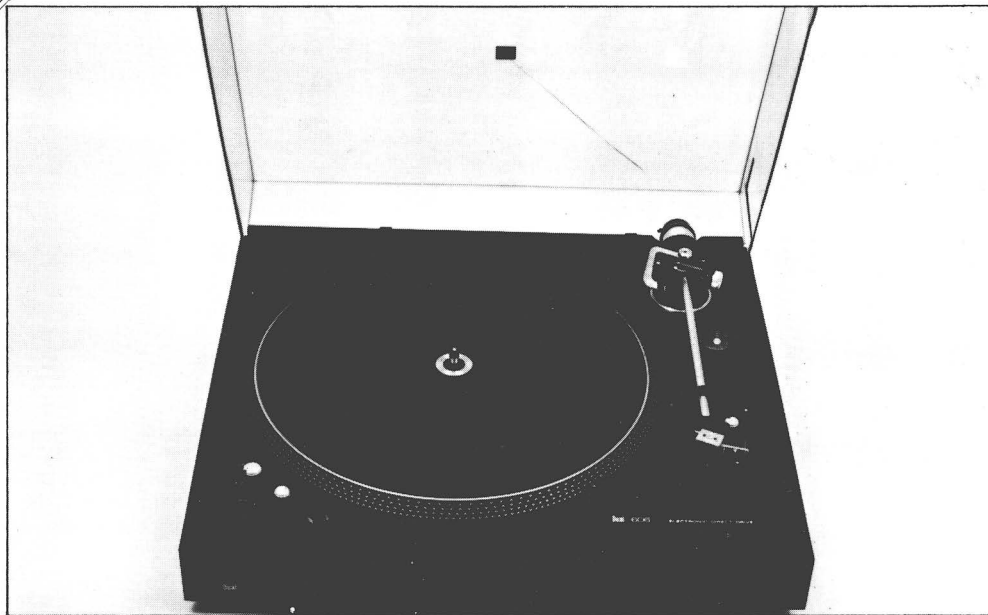


Structural arm resonances, audio range.

RECOMMENDED

# Dual 606 (revised & reprinted)

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



### Features, facilities, setting up and use

This manual direct drive model was fitted with a moderate mass pressed platter of poorer than average edge-weave and centration, although the steel chassis/deck plate gave a reasonably low suspension resonance of 6Hz on its damped coil springs. Once again, with this technique lid-borne feedback was not coupled to the arm, thereby reducing acoustic breakthrough. Not quartz locked, the motor offered two speeds plus fine variable control with the usual mains illuminated strobe reference, and as with the 506.

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

### Lab performance

A good wow and flutter result was recorded despite a higher than average wow only figure. Speed accuracy and stability were fine, with the

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

The arm itself proved well adjusted and aligned, with low pivot frictions, and the biasing was effective, adding no additional friction; however, on our sample it did give rim/centre values in the inverse ratio, although of about the right sort of magnitude. Downforce calibration was fairly accurate and cue drift negligible, with sensible rates. Despite the 60Hz counterweight mode, the tidy and relatively continuous nature of the arm resonance curve merited an above average rating, and with a conventional cartridge the excitation of those resonances will in fact be less, due to lower mechanical resistance compared with

the lab test model (a Dynavector 10X).

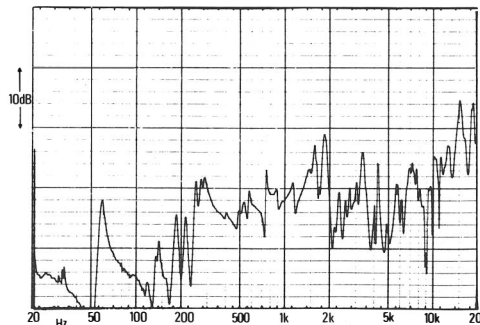
Judged good on acoustic breakthrough, the 606 improved on the 506 vibration isolation by achieving an above average rating, some 10dB better, for example, at 100Hz. Both feedback and impact shock resistance were well above average.

### Sound quality

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

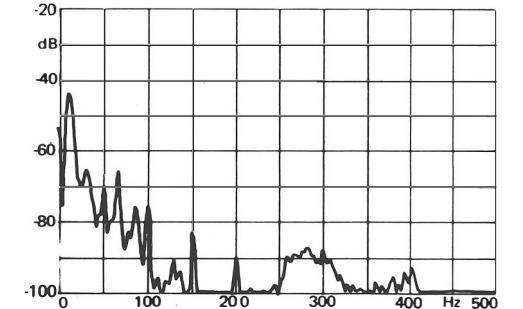
### Conclusion

In many respects this turntable was above average, and in its latest form it is available at a much lower price than when this review was prepared, albeit without a fitted cartridge. Although not quite as good value as the newer 505, the overall price-vs-performance ensures recommendation in the context of the project as a whole.

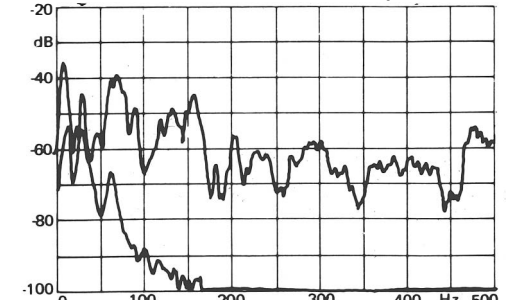


Arm resonances

GENERAL DATA		Integrated Turntable
<b>Motor Section</b>		
Type	.....	direct drive
Platter mass/damping	.....	1.40kg/fairly good
Finish and engineering	.....	very good/very good
Type of mains lead/connecting leads	.....	2 core/phones + earth
Speed options	.....	33 <sup>1</sup> / <sub>3</sub> , 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%/0.06%
Absolute speed error	.....	+0.15%
Speed drift 1 hour/load variation	.....	<0.15%/-0.05%
Start up time to audible stabilisation	.....	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	.....	71/73dB
<b>Arm Section</b>		
Approximate effective mass inc screws, excl cartridge	.....	7g
Type/mass of headshell	.....	special detachable/N/A
Geometric accuracy	.....	very good
Adjustments provided	.....	lateral angle, overhang
Finish and engineering	.....	very good/good
Ease of assembly/setting up/use	.....	very good/good/very good
Friction: typical lateral/vertical	.....	20mg/<10mg
Bias compensation method	.....	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	.....	250mg/175mg
Downforce calibration error: 1g/2g	.....	-0.1g/-0.15g
Cue drift/8mm ascent/descent	.....	negligible/1.8secs/0.8secs
Arm resonances	.....	above average
Subjective sound quality	.....	above average
Lead capacitance/damping method	.....	175pF/seismic weight in c/wt
<b>System as a whole</b>		
Size/clearance for lid rear	.....	42.5(w) x 37(d) x 15.5(h)/5cm
Ease of use	.....	good
Typical acoustic breakthrough and resonances	.....	good
Subjective sound quality of complete system	.....	above average
Hum level/acoustic feedback	.....	very good/above average
Vibration sensitivity/shock resistance	.....	above average/good
Estimated typical purchase price	.....	£95 (excl cart)



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



Acoustic breakthrough (upper) and vibration breakthrough

RECOMMENDED

# Dunlop Systemdek (re-assessed)

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



## Features and design

Since its introduction the *Systemdek* has begun to establish itself firmly in the quality category. Some minor teething problems have 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 subchassis, an aluminium extrusion reinforcement 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. In conjunction with the high 4.8kg platter, the unit had a tendency to rock or sway from side to side, resulting in slightly high pure wow readings and some handling sensitivity.

In the latest version the 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 they lie in a state of greater compression and are physically shorter. This has considerably improved lateral stability, which is confirmed by the new low wow figures. Furthermore the tricky special spanner arrangement formerly used for alignment is now avoided by the use of surface mounted alignment 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.

## 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 -70dB, but this proved to be inaudible as a specific effect when auditioned.

The results for vibration isolation and acoustic

breakthrough were both very good, the slight lumpiness on the acoustic trace attributable to the disc on 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.

## Sound quality

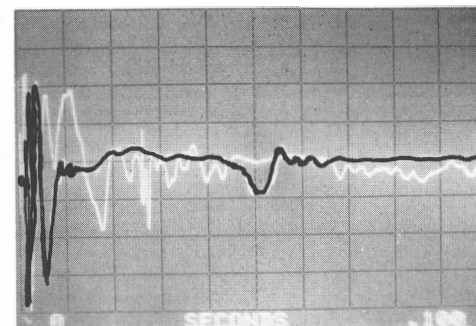
Already setting a top class standard as a motor unit, the *Systemdek* was considered to have been further improved with a slightly firmer and more stable quality imparted to the stereo image than before. The bass register was open, deep but slightly 'heavy' in balance, while coloration was very good, only showing a mild 'thickening' in the lower midrange (eg tenor), which also affected bass transients slightly. 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 'flutter' models such as the *Karat* and the *Technics EPC205*, the *Audio Ref* mat gave a more relaxed perspective, with greater midband depth and ambience.

## Conclusion

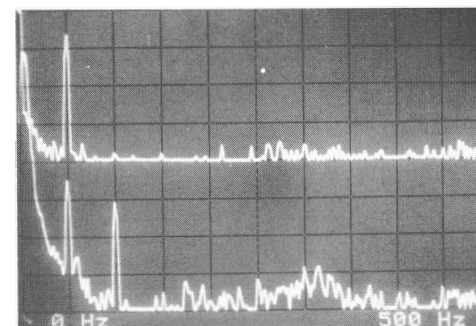
The *Systemdek* continues to set an enviable standard for its price, and can be confidently recommended as representing fine engineering and acoustic value for money. Compared with its established competitors, it can offer the two speed option, simpler alignment procedures, leveling feet, and easier arm fitting. But in common with many other motor units it lacks some of the special benefits resulting from the complete system design of an integrated/optimised player.

## GENERAL DATA

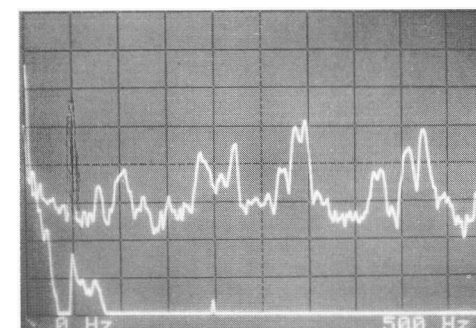
	Motor Unit
Type	belt drive
Platter mass/damping	4.8kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/N/A
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.13%/0.09%
Absolute speed error	+0.15%
Speed drift 1 hour/load variation	negligible/-0.01%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-78/77dB
Size/clearance for lid rear	46.0(w) x 37.0(d) x 15.5(h)/4.0cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good+
Hum level/acoustic feedback	good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£300



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



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

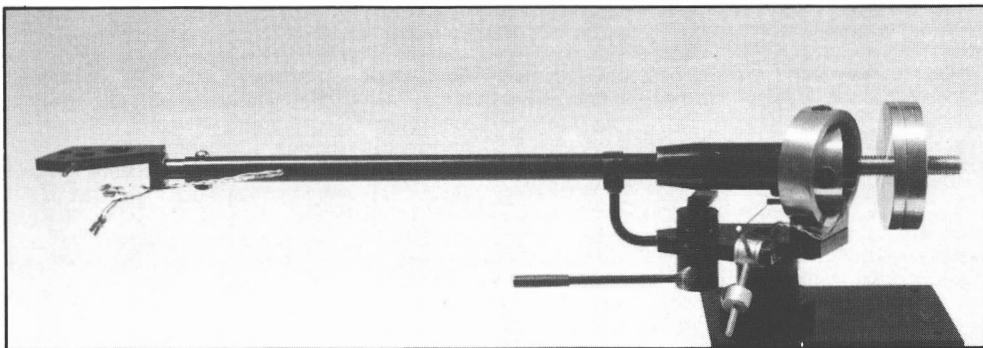


Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

**RECOMMENDED**

# Helius

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



### Features and design

A recent British introduction, the Helius belongs to the middle group of audiophile tonearms, and costs a not inconsiderable £150. As a result it has to be pretty good, and on the basis of the performance of our review sample, the price is justified. (Our example used new bearings, different from those employed when the arm was first marketed.)

The design aims to provide a moderate effective mass, with sufficient material employed to maintain the strength and rigidity of the product. Nominally a fixed headshell design, the front cartridge platform may be detached, but is normally held in position by a split section of arm tube, clamped by a vertical nut and bolt. In practice this is rather more secure than the description might suggest, and the joint provides for limited cartridge tilt as well as overhang adjustment.

The thick alloy cartridge platform has permanent fixing centres, and is arranged to offer secure contact (typically 70%) with the cartridge mounting surface. The geometry is intended to provide minimum distortion over the playing area, and the bearing axis passes through the stylus tip; as the designer put it: 'reducing the torsional excitation of the tube/beam, the latter approximating to a sectioned taper in order to break up even harmonic bending modes such as 1/2- and 1/4-waves'. The finish is good, although the lacquer on the brass counterweights proved easy to mark. Large and small counterweights are provided, and when balanced these are contra-locked on the threaded rear section of the arm (a separate stylus scale is required to set downforce). The whole is suspended on generous gimbal bearings, pre-loaded to eliminate play, and a special lubricant is used to provide a trace of resistive damping.

The bias is uncalibrated, and we have taken test readings with the weight centred on its rod: these are appropriate for 1.5g elliptical stylus tracking. The maximum downforce obtainable is appropriate for 2.5g downforce, the minimum corresponds to 1g - a sensibly proportioned range.

### Lab results

Possessing an estimated effective mass of 12g, this arm is suited to cartridges in the 10-25cu range on compatibility grounds. Geometry was excellent and the mechanics worked well, including the cue control which offered variable rate descent. Friction was genuinely low, and measured better than 25mg in all planes, with no 'notching'.

The resonance behaviour in the audio range was promising, though exhibiting the complex fine detail which is characteristic of arms with rigid counterweights (see also Syrx). The 140Hz mode was confirmed as the counterweight mounting flexure (shown by its absence on a graph taken with an experimental decoupled counterweight). The long rod finger lift was suspected of causing the resonance at 1 kHz: this was confirmed by cutting off some 70% of the rod, which caused this mode to disappear entirely on the second graph (Helius have now modified the lift). In fact the main tube was quite rigid, as shown by the first flexure at 600Hz.

### Sound quality

This arm made a good impression using a number of cartridges, including the notoriously 'difficult' Asak. Sounding slightly 'live', the tonal balance was more open than average, showing some similarities with the *Ittok*. The bass register was firm and clear, with solid extension and just a little clouding in the upper registers - perhaps

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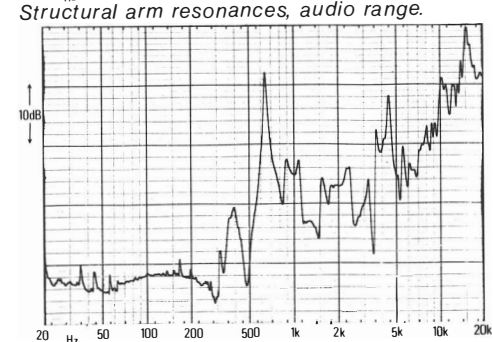
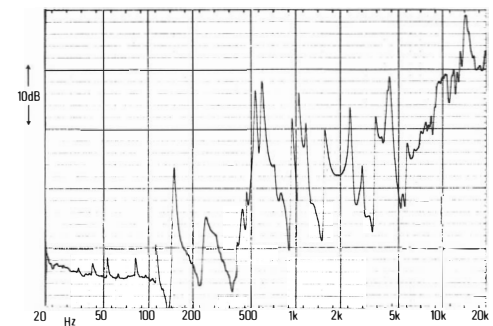
this is the counterweight mode we noted. Stereo was stable and well-focused, and vocal coloration in the upper range was at a moderately low level, and was further improved with the amended finger lift. One listener felt that the sound conveyed something of both the Mission and the *Ittok*.

### Conclusion

The Helius is rather expensive, and at the time of this review (June '81) lacked proper documentation. No calibrations are provided, so the user/dealer must use accessory scales to set it up, as well as needing to estimate the appropriate biasing. However, it can be recommended on performance-vs-price grounds, as the sound quality is very good, it has been intelligently designed, and is well engineered.

### GENERAL DATA

Approximate effective mass inc screws, excl cartridge	..... 12g	Tonearm
Type/mass of headshell	..... special/N/A	
Geometric accuracy	..... excellent	
Adjustments provided	..... tilt, height, overhang	
Finish and engineering	..... very good	
Ease of assembly/setting up/use	..... very good/good/very good	
Friction: typical lateral/vertical	..... less than 25mg/less than 25mg	
Bias compensation method	..... optimum angle weighted lever	
Bias force: rim/centre (set to 1.5g elliptical)	..... 160mg/220mg	
Downforce calibration error: 1g/2g	..... N/A	
Cue drift/8mm ascent/descent	..... negligible/(var) 0.5sec/1.5secs	
Arm resonances	..... good to very good	
Subjective sound quality	..... very good	
Lead capacitance/damping method	..... 95pF/negligible	
Estimated typical purchase price	..... £150	



Arm resonances, shortened fingerlift and experimental absorptive c/w.



**RECOMMENDED**

# Linn Sondek LP 12 (re-assessed)

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



## Features and design

Since the last edition minor revisions have been made to this contentious but legendary design, which have not only resulted in an improvement in quality, but have also helped to make setting up easier and the set-up condition more stable. This *Nirvana* kit modification can be retro-fitted, and is standard on current production. It involves a number of details, such as high tensile screws for firm cartridge mounting; a better drive-belt; modified socket-head screws for the motor and main bearing mountings; and revised springs plus rubber seatings. The subchassis stability has also been improved (usually), with better centring and control of drive-belt tension.

Briefly summarising, the *LP12* is a long established belt drive turntable, based on a heavy two-part *Mazak* platter, running on a rigid single-point bearing of high quality. The 4.5kg platter dominates the dynamics of the lightweight flanged and reinforced steel subchassis, the latter asymmetrically suspended on three adjustable coil springs.

Alignment and adjustment is a nuisance, since the bottom cover must be removed, and the under-chassis clearance is limited, suggesting the use of side entry arms to attain successful lead dressing. Three tiny screws fix the wood composition armboard in place surprisingly firmly. Linn have tailored the subchassis design towards minimising stylus movement, rather

than to satisfy a simplified theory of perfect chassis dynamic balance in one or two modes of freedom only.

A modified version of a Philips synchronous lowspeed motor provides power, and the mounting arrangements are carefully designed so that vibration in the motor frame is dissipated harmlessly in the plinth system, and not allowed to vibrate the drive pulley, thereby feeding energy to the disc *via* the belt. Good at blocking high frequency pole 'cogging', belt drive is less effective at coping with frame vibration; however, it may be seen that the 100Hz rumble component in the spectrogram for the *LP12* is lower than for almost any other synchronous-powered belt drive model in the report.

The current acrylic plastic lid now has sprung hinges to balance its weight, and offers some additional acoustic isolation when lowered. The plinth is built from seasoned hardwood, and the base is intentionally cut from a soft grade of hardboard, chosen for its energy absorbtive properties.

## Lab results

Whether weighted or separately assessed, wow and flutter readings were all the lowest yet measured for an *LP12*, confirming the worth of the *Nirvana* kit. The deck ran very close to speed, with a satisfactory slowing under load, while start up was improved to 3.8 seconds. Rumble was

also better by several dB, measuring a near threshold  $-77/-78$ dB and with the conspicuous absence of the 100Hz component already mentioned.

The large but rapidly damped initial transient on the disc impulse test necessitated X1 scaling, and the X10 presentation with the standard felt mat is also included for comparison with the response using the *Audio Ref* substitute: the latter changed neither the low frequency mode (14Hz) or the fine ringing at 300Hz, but was much better at damping the transient start. For interest's sake, the Fourier transformed frequency responses of the two impulse conditions has also been plotted: the felt mat shows a higher amplitude but a more even characteristic. Very good acoustic and vibration isolation which further improved with the lid down was shown.

## Sound quality

During the course of testing it was found that the *Ittok* arm was the best match for the *LP12*, and so the two were auditioned together. Furthermore (surprise, surprise!) we discovered that this arm was optimised for the *Asak* cartridge, and when installed the complete player offered a level of disc reproduction that was difficult to equal; random changes to any part of this system significantly upset the balance. The *Asak* was a recommended product in the last *Choice: Cartridges* book, but we found that if properly fitted in the latest *Sondek/Ittok*, it could successfully compete with far more expensive models such as the *Koetsu*.

The Linn sounds likeable and musical, with a quality of 'liveliness', pleasing tonal balance, 'drive' and detail that produced good listener reactions. Stereo imaging showed exceptional focus and stability with great resolution of detail.

In the limit the upper bass was slightly 'weighty' and 'forward', and the midrange a trifle 'loud' and 'boxy', but this did not spoil the impression of a coherent integration of frequencies throughout the audible range.

## Conclusion

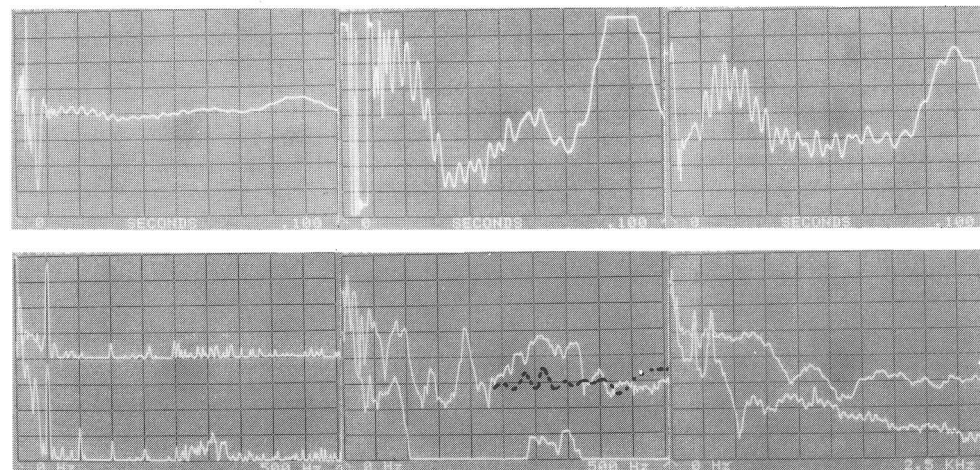
The *LP12* is a fine motor unit in highly refined state of development, and will give its best when partnered by its matched components, where the compatibility and mutual compensation has reached a remarkable level. The system is undoubtedly good value, and even taken on its own the *LP12* has continued to maintain its competitiveness.

## GENERAL DATA

GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	4.1kg/good
Finish and engineering	both excellent
Type of mains lead/connecting leads	3 core/—
Speed options	33 $\frac{1}{3}$ rpm only
Wow and flutter (DIN peak wtd sigma 2)	0.075%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.08%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	synchronous/—0.3%
Start up time to audible stabilisation	3.8secs
Rumble: DIN B wtd L/R av (see spectrum)	-78/-77dB
Size/clearance for lid rear	44.5(w) x 35.8(d) x 14.9(h)/5.7cm
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	£340

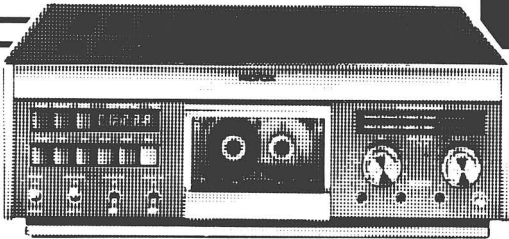
\*see text

**Spectrogram Captions (L to R):** (top row) *Disc Impulse Transmission* (a) standard X1; (b) magnified X10; (c) *Audio Ref* mat, X10; (bottom-row), (d) *Rumble* (electrical/total); (e) *Breakthrough*, acoustic (white, lid up, black, lid down)/vibration; (f) *FFT frequency responses* from *Disc Impulses*, felt mat above *Audio Ref* mat.

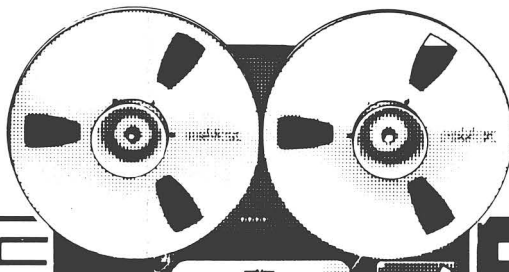


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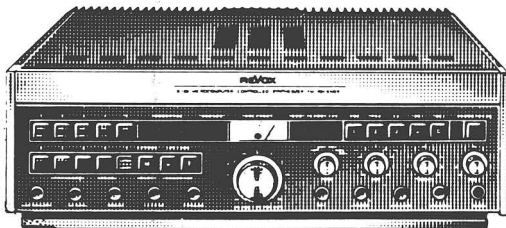
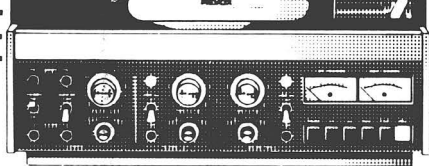
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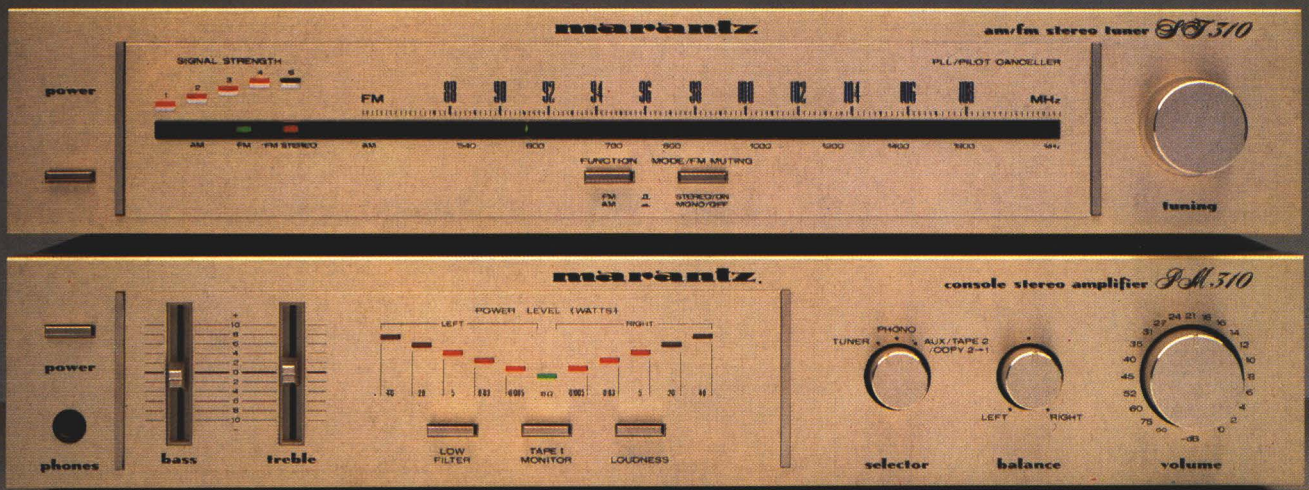
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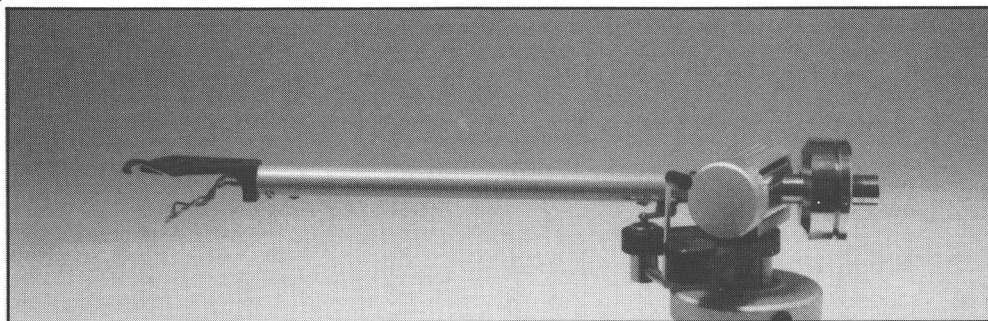
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**RECOMMENDED**

# Linn Ittok LV11 (re-assessed)

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



## Features and design

This Linn-designed and Japanese-built tonearm won immediate acceptance upon its introduction and *Choice* were amongst the first to try it, in the last issue. Located at the upper end of the middleweight class, it has an estimated 14g effective mass including the steel fixing bolts, and it is suited to low compliance cartridges with some low frequency damping; *ie* compliances in the 8–16cu range and up to 10 dB LF resonance rise.

The arm appears more weighty than the effective mass would suggest, and the metal used for its construction has been optimised for maximum strength. In the context of the average tonearm, Linn's label 'direct coupled' is not so very far from the truth, as the *Ittok's* rigidity is so good that it strongly couples broadband energy from the stylus to the arm mounting board. The large area die-cast magnesium headshell is itself one of the strongest made, and offers excellent contact for cartridge mounting, while the generous alloy tube is securely locked at its fixing points, offering no tilt adjustment in case this would prejudice stiffness.

The counterweight is decoupled, but not in the usual loose manner which imparts clear resonances below 100Hz; rather the fit is sufficiently tight for the counterweight and its lossy synthetic liner to act as a wave termination to resonances in the midband. To illustrate this, a curve was run with a softly decoupled counterweight and the low frequency resonance suppressed by damping; compared with the normal condition the resonances above 200Hz were more severe and more numerous (notably at 400Hz, 900Hz and 1.6kHz).

The arm proved convenient to use, and is fitted with a cueing system controlled by a long lever with a roller at the tip, assisting shock-free action on subchassis turntables. Well-calibrated dials

are fitted for bias and downforce, and since the latter is based on a spring mechanism, dynamic balance is attained after alignment.

Improvements noted with the latest sample include revisions to the pillar locking socket-head bolt and the main arm pillar itself, both much increased in size. The arm tube is now hard-anodised in a grey finish coated with a surface lacquer, and while the lead-out cable has been reduced in stiffness to aid chassis isolation, the same strong three-point-contact pillar locking is retained.

## Lab results

Virtually a textbook example of tonearm design, the lab performance was excellent. Possessing fine geometric accuracy, setting up was however complicated by the need to remove the arm to finally tighten a cartridge before use, as the force required to do this properly with the arm *in situ* might otherwise damage the precisely adjusted 'zero play' bearings. Friction was excellently low, downforce calibration very accurate, and the biasing effective—of the correct values and in the right ratio.

The audio resonance trace was improved over the original model in the uniformity of the general energy trend, particularly in the area around 600Hz. The main beam mode did not appear until 900Hz, which is a further improvement in rigidity over the original 800Hz, and represents an exceptional performance. A graph of the acceleration at the arm base taken on the *Sondek* mounting board shows the coupling factor. For comparative purposes, the trace above this represents the same situation, but with the *Ittok* mounted on a heavy rigid subchassis and arm plate (Lux *PD300*), demonstrating much reduced excitation. However the resonant behaviour of the arm as seen by the cartridge was now worse, with significant exag-

geration of several modes pointing to increased coloration, particularly at 110Hz, 300Hz and 1 kHz.

## Sound quality

Possessing a trace of hardness in the upper midrange – the high soprano region – where a suspicion of stereo vagueness was occasionally detectable, the sound was otherwise of exceptional quality. The tonal balance was on the 'open' side, and had a detailed transparency over the whole spectrum which proved revealing of all components including discs. The bass was tighter than before, with fine transients and good extension. Stereo precision was outstanding, and in our view is as yet unmatched by any other model.

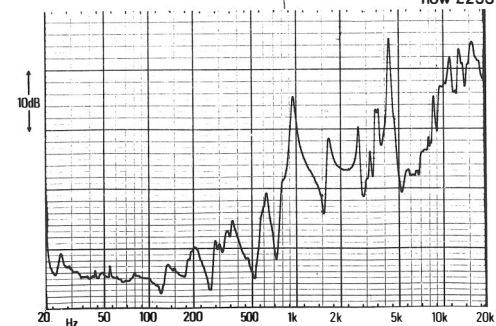
It performed well on all players we tried but undoubtedly sounded tonally the most neutral with the *Sondek*, especially as regards the mid-range area, where the pillar termination is crucial. In the Lux *PD300* it was found necessary to use a 'softer' balanced cartridge than the *Koetsu* if the mid-harshness was to be controlled, for example.

## Conclusion

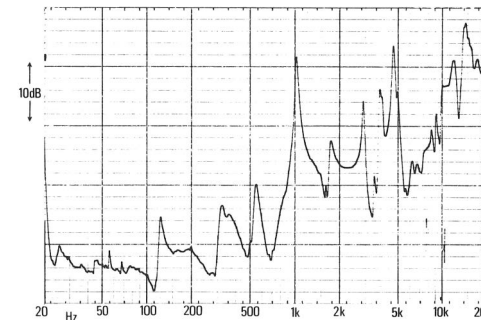
This excellent product carries a mandatory recommendation, despite its high price. But as it is so revealing, every care should be taken to establish a complementary and compatible system of motor unit, arm and cartridge in order to get the best results.

## GENERAL DATA

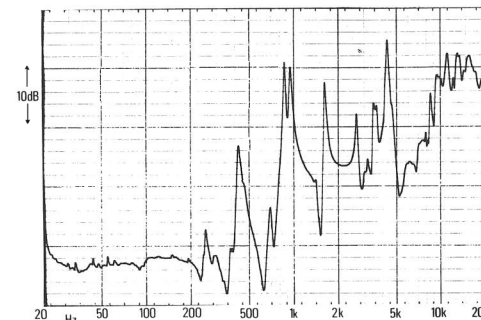
Approximate effective mass inc screws, excl cartridge	13.5g	Tonearm
Type/mass of headshell	rigidly fixed/N/A	
Geometric accuracy	excellent	
Adjustments provided	height, overhang, lateral angle	
Finish and engineering	excellent/excellent	
Ease of assembly/setting up/use	very good/very good/very good	
Friction: typical lateral/vertical	less than 10mg/less than 10mg	
Bias compensation method	frictionless internal spring	
Bias force: rim/centre (set to 1.5g elliptical)	175mg/195mg	
Downforce calibration (error: 1g/2g)	<0.03g/<0.035g	
Cue drift/8mm ascent/descent	negligible/0.8sec/1.7secs	
Arm resonances	very good	
Subjective sound quality	very good	
Lead capacitance/damping method	85pF/none	
Estimated typical purchase price	£230 when reviewed, now £253	



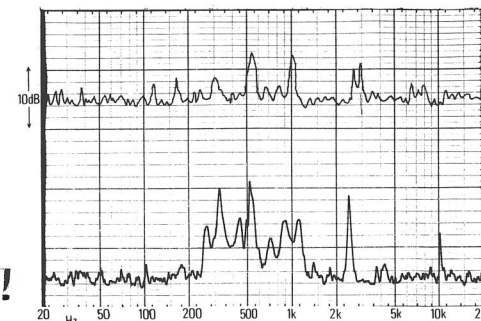
Structural arm resonances, audio band.



Arm resonances on PD300.



Arm resonances, new arm, loosely decoupled counterweight.

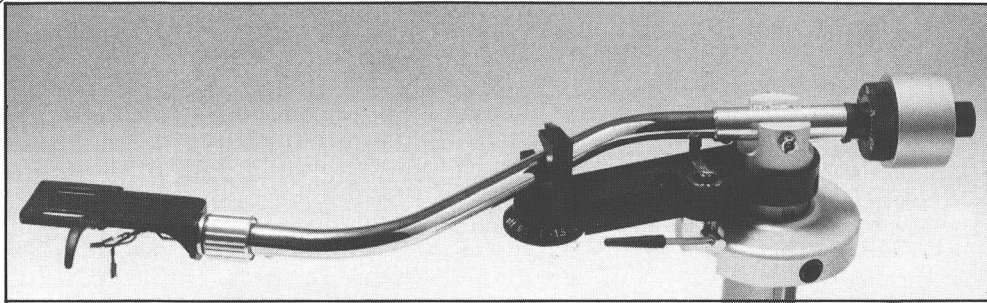


Acceleration of Ittok arm board near pillar: above, Lux 300; below, Sondek.

**RECOMMENDED**

# Linn Basik

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 brushness 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.

## GENERAL DATA

Tonearm  
 Approximate effective mass inc screws, excl cartridge... 13.5g  
 Type/mass of headshell incl 'S' cartridge... universal detachable/7g  
 Geometric accuracy... very good  
 Adjustments provided... overhang, lateral angle, height  
 Finish and engineering... excellent/very good  
 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

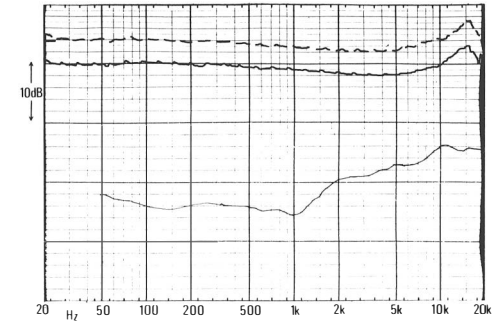
## Trackability

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

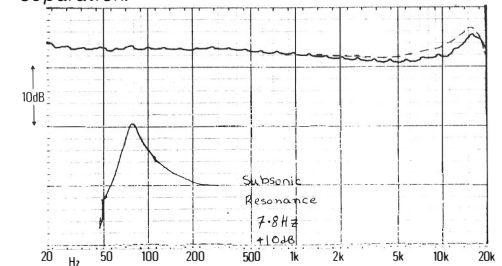
## Distortion

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

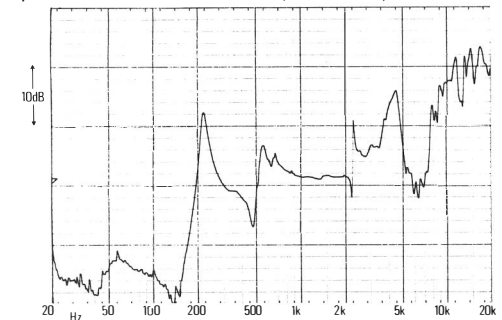
\*Uncritical of loading in practice



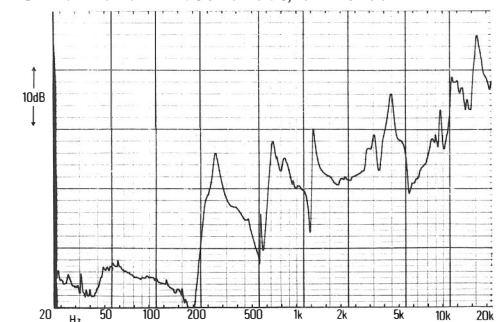
Cartridge response, channel balance and separation.



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



Structural arm resonances, audio band.



Arm resonances with *ATH-8* shell substituted.

RECOMMENDED

# Lux PD 300

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



### Features and design

Following the introduction of the costly PD555, Lux have released an 'economy' model, which nonetheless costs a substantial £500. A completely new design, this 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 a simple and relatively quick modification which freed the 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 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. We used a disc with a quiet surface for repeated tests without any pre-cleaning of the platter, and it turned out to have become noisier when the underside was played later.

### Lab report

With its substantial 3.4 kg 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; as a result, however, 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 transmission 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 it best – for example, something like the Breuer or Sumiko sound perhaps.

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 exhibited by the modified model.

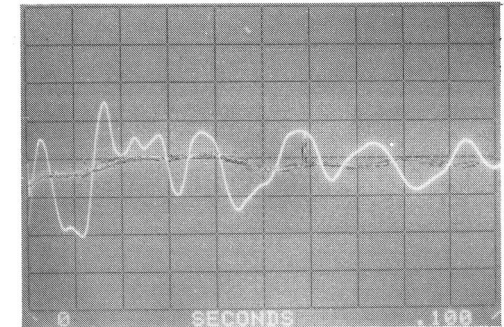
### Conclusion

Potentially this is one of the cleanest and most transparent sounding decks we tested, and it can be recommended. In engineering terms the £500 is justified, although various compromises need to be worked out concerning its use and appropriate matching components. Performance tests suggest that if an Ittok is to be used, it would benefit from an absorptive interface rather than the ultra-strong metal platforms supplied – perhaps a laminated wood arm base would be suitable if possessing a suitably matched resilience. Finally, the risk of damaging dirty discs remains a slight disincentive.

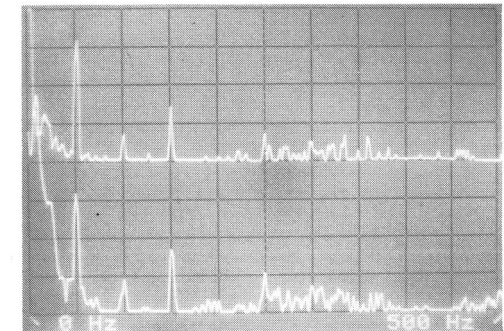
### GENERAL DATA

Type.....	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 0.2–6 Hz/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

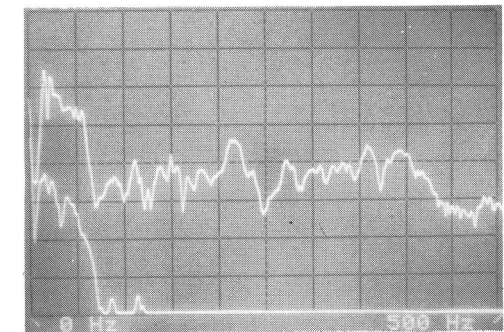
\*see text



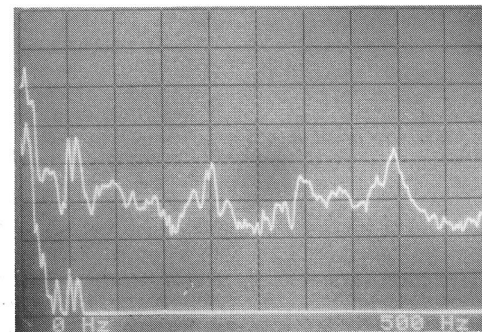
Disc impulse transmission, magnified X10.



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



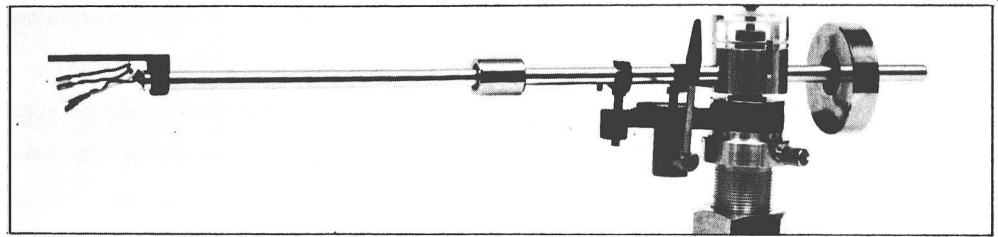
Breakthrough (0–500Hz lin) as supplied: above, acoustic; below, vibration.



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

**RECOMMENDED**

(revised and reprinted) **Mayware III**  
 Mayware Ltd., PO Box 58, Edgware, Middx. HA8 9UH. Tel. 01-958 9421



**Features, facilities, setting up and use**  
 This Japanese made arm was one of the first low mass component tonearms to be produced for an independent distributor, in this case the British firm Mayware. Since its introduction a few years ago a number of improvements have taken place. In pursuit of very low mass a rather flexible alloy sheet was used for the headshell in the original model, and this has now been replaced by a substantial strong casting; nonetheless the effective mass remains low at 7.5g.

A beautifully engineered and finished unipivot design, the *MK III* offers variable damping at subsonic frequencies using a silicone fluid well around the unipivot, with convenient access via a removable pillar cap made of clear acrylic. The counterweight was decoupled on a rubber bush and afforded some upper range damping, while a calibrated downforce scale using a rider weight on the main tube was also incorporated, and proved a trifle loose on our sample. The thread/pulley/lever bias compensator was also calibrated, the arm proving easy to set up and align, and offering full geometric adjustments; a tracking protractor was provided. Readers may recall this arm being recommended in the last issue when it cost around £70.00, and as the price is now £58.00 despite inflation (a petrocurrency benefit!), things looked promising indeed.

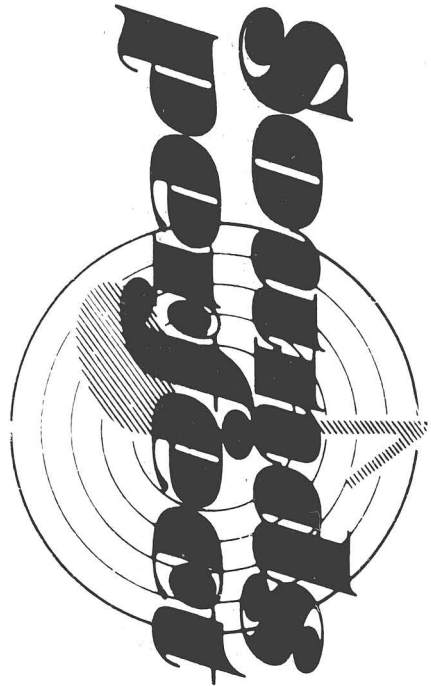
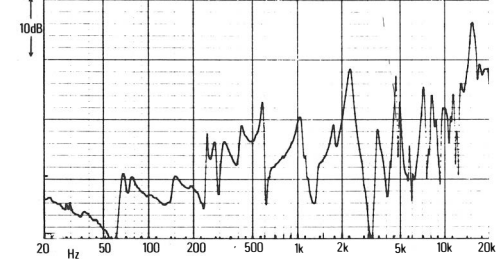
**Lab performance**  
 At 4.5g the effective mass was low, as was the lead capacitance at 85pF, thus rendering the matching flexibility good. As with other low mass arms extra mass may be added if required by using a backing plate on the cartridge, and this may well prove worthwhile with some low compliance moving-coil models. The *MK III* also proved very well aligned, and delivered excellently low friction. Although the bias compensator gave high values, these were easily corrected and the mechanism added little extra friction. Downforce was accurately calibrated and cueing fine, if a trifle slow in descent.

Numerous 'breaks' were apparent, but resonances were classed as above average due to the maintenance of the correct energy trend. The upper register was a bit 'scrappy': the mode at 62Hz was due to the counterweight bush and that at 600Hz to the arm tube, the latter also related to the smaller amplitude flexure at 300Hz. In sequence a 1.2kHz mode was also present, with that at 2.4kHz possibly related, though it could have been coincidental.

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

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

GENERAL DATA		Tonearm
Approximate effective mass inc screws, excl cartridge	7.5g	
Type/mass of headshell	special detachable/N/A	
Geometric accuracy	excellent	
Adjustments provided	tilt, height, overhang, lateral angle	
Finish and engineering	excellent/very good	
Ease of assembly/setting up/use	very good/good/very good	
Friction: typical lateral/vertical	<20mg/<15mg	
Bias compensation method	thread and lever	
Bias force: rim/centre (set to 1.5g elliptical)	250mg/265mg	
Downforce calibration error: 1g/2g	<0.02g/<0.03g	
Cue drift/8mm ascent/descent	negligible/0.8secs/2.2secs	
Arm resonances	above average	
Subjective sound quality	good	
Lead capacitance/damping method	85pF/fluid well unipivot	
Estimated typical purchase price	£58	



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# Michell Focus Motor (re-assessed)

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

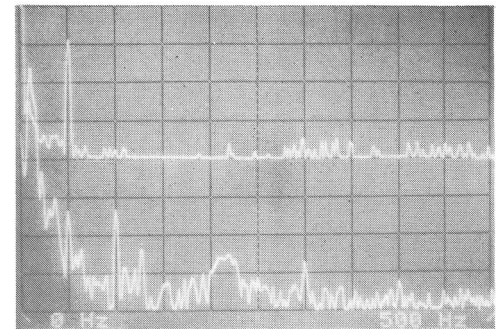
For some reason the deck never seemed quite at home with the *Focus* arm, but it provided pleasantly balanced and relaxed results in partnership with the Linn *Basik*. Above average with the lid installed, the bass was reasonably clean, the midrange quite transparent and detailed, and the stereo presentation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

## Conclusion

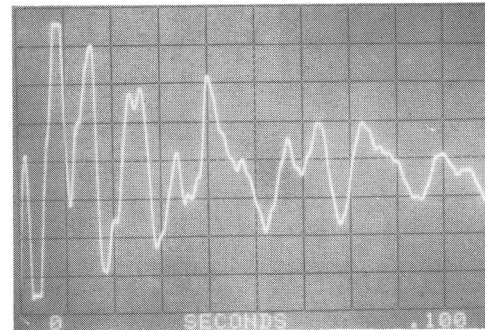
Possessing a fine handcrafted finish and distinctive styling, the *Focus* has improved significantly in mechanical terms since its introduction. It is now available at an attractive package price (£170), factory fitted with the Linn *Basik* arm/cartridge. This package gains a comfortable recommendation,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

## FOCUS MOTOR CONT.

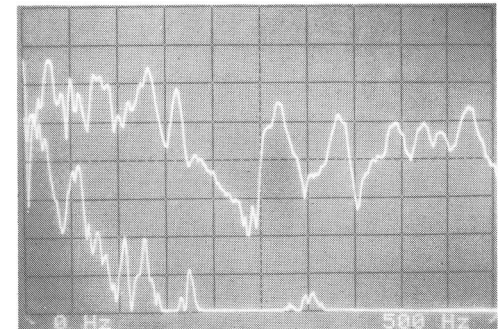
GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	2.0kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core + earth/-
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.1%/<0.05%
Absolute speed error	<0.1%
Speed drift 1 hour/load variation	synchronous/-0.3%
Start up time to audible stabilisation	3secs
Rumble: DIN B wtd L/R av (see spectrum)	-74.5dB
Size/clearance for lid rear	43.0(w) x 37.0(d) x 13.0(h)/9cm
Ease of use	good
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£130 (£170 incl Basik)



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



Disc impulse transmission, magnified X10.



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

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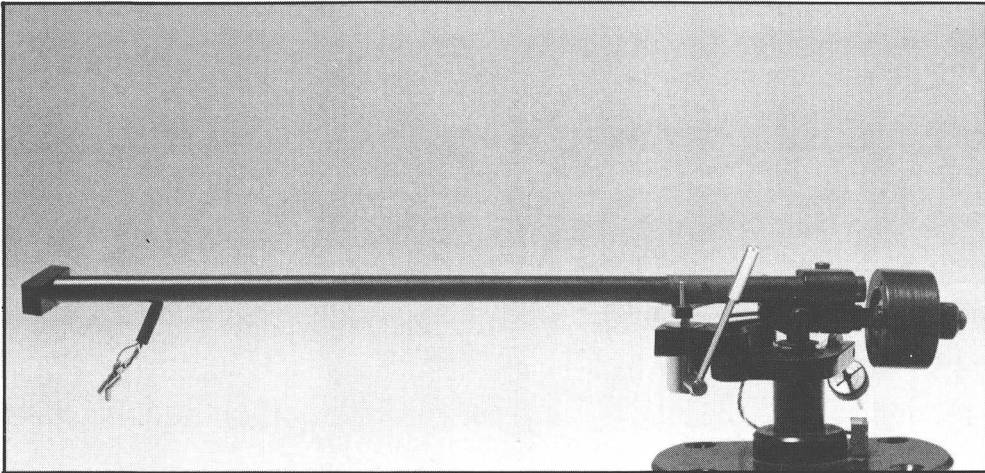
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**RECOMMENDED**

# Mission 774 (re-assessed)

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



## 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 *A732* 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 counterweight 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 twoset a little less than halfway 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

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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.

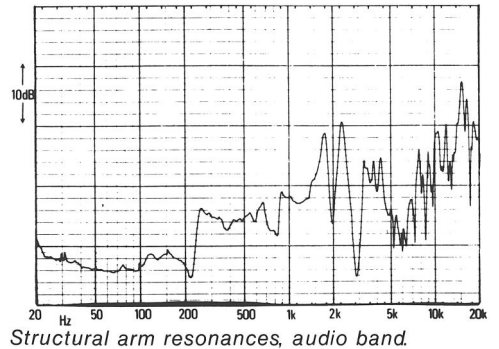
## Sound quality

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.

<b>GENERAL DATA</b>	Tonearm
Approximate effective mass inc screws, excl cartridge	5.5g
Type/mass of headshell	special detachable arm/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, height, overhang, damping
Finish and engineering	good/very good
Ease of assembly/setting up/use	fair/requires care and skill/very good
Friction: typical lateral/vertical	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/1 sec/1.2secs
Arm resonances	good
Subjective sound quality	very good
Lead capacitance/damping method	180pF/variable, silicone fluid well
Estimated typical purchase price	£157



# 'I THOUGHT DUAL ONLY MADE TURNTABLES'



A lot of people are pleasantly surprised when they discover that the Dual range and reputation covers more than just turntables.

For example, the C 814 Cassette Deck (shown here) is to tape what our famous CS 505 turntable is to records: a precision made, reliable instrument that provides quality and value for money.

Naturally, it features all the accepted advances in Tape Deck technology including Direct Load and Lock, M+X head, 4 position tape selector, and clearly defined recording level meters.

Everything is designed in the Black Forest in West Germany which probably explains why we care as much about the inside performance as the outside appearance. It pays in the long run, so we don't mind waiting a little longer for fame to reach our cassette decks.

Dual

RECOMMENDED

# Pink Triangle

Pink Triangle Products, 1 Cossington Court, Alder Road, Sidcup, Kent. Tel 01-302 1257



## Features and design

From the outside, the name and distinctive logo may seem all that is remarkable about this new 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. Black or bronze mirror glass may be selected for the upper deck, and can be lifted out in sections to aid alignment or to set the fine speed adjuster which controls the DC micro-motor drive.

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, with two alternatives for the thrust cup, the more expensive one employing an ultra-rigid ruby which adds some £60 to the price. 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 Syrnix, 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, accessible to a special nut runner.

An expensively executed slide switch mechanism controls the selection of 33 $\frac{1}{3}$ , 45 and off; this is unfortunately unlabelled, so it needs a little practice to memorise the positions. The lid is a low resonance type, hand-fabricated from clear acrylic stock.

## 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, and as received the 33 $\frac{1}{3}$  rpm was a little fast (+1%), but could easily be corrected using the adjuster.

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

Low coloration and neutrality were the dominant features of this desk. It happily partnered the *Ittok* arm, which can react unfavourably with some turntables, and very secure, stable tracking ensued, with well-focused imaging, plus fine stereo and ambience rendition. The bass was even, slightly 'dry' but vaguely suggestive of a slight 'weight loss' at the very lowest frequencies, and it also demonstrated very good feedback immunity.

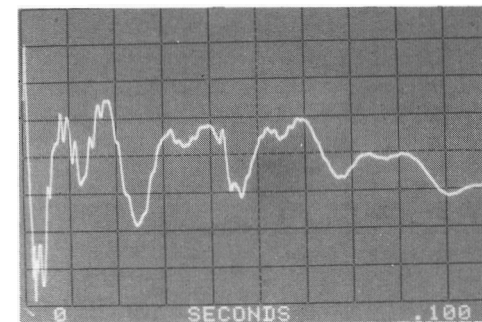
The Koetsu cartridge gave the best system sound, and the new less expensive model should also prove compatible. Thus equipped, the Pink Triangle delivered a clean relaxed and musical performance of the highest quality, and provided a valid if different interpretation of disc sound in comparison to several established reference turntables.

## Conclusion

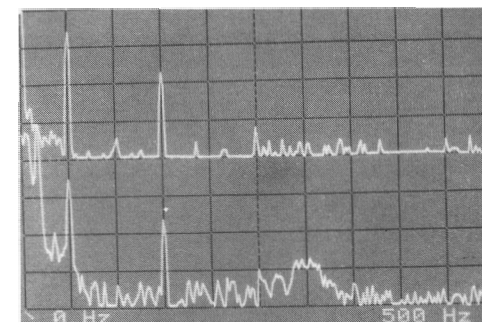
This is a low coloration device best suited to neutral speakers possessing comparatively low levels of coloration. Despite one or two teething and handling troubles which a good dealer should be able to solve (and which also occur with its immediate competition), the Pink Triangle makes a definite contribution to analogue turntable design, and is a high class performer in its own right, worth recommendation.

## GENERAL DATA

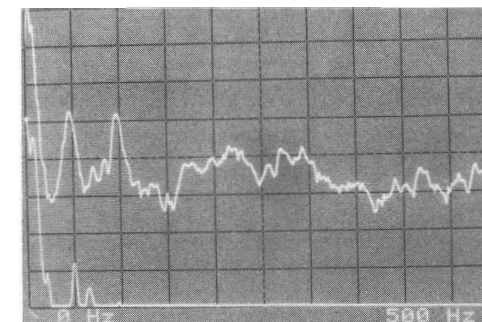
Type	Motor Unit belt drive
Platter mass/damping	1.7kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/-
Speed options	33/45rpm (internally variable)
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.06%/0.07%
Absolute speed error	adjustable, +1%
Speed drift 1 hour/load variation	+0.2%/-0.5%
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	£300/£360
	(depending on choice of platter bearing)



Disc impulse transmission, magnified X10.



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

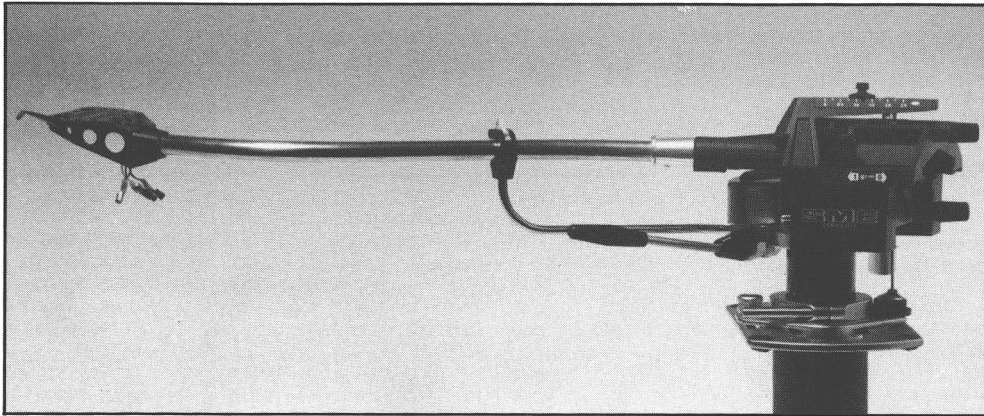


Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

**RECOMMENDED**

# SME 3009 Series 111(S) (re-assessed)

SME Ltd., Steyning, Sussex BN4 3GY. Tel (0903) 814321



## Features and design

This review covers the two models in the SME Series 111 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 mild 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 88Hz, a shell/tube mode at 220Hz, 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.

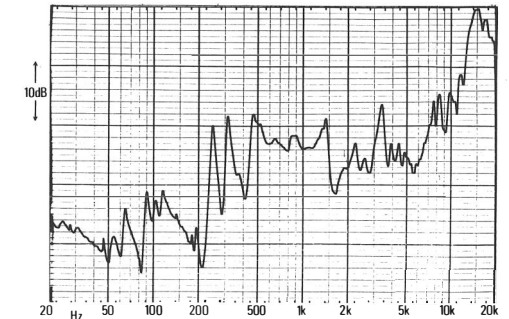
## Sound quality

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.

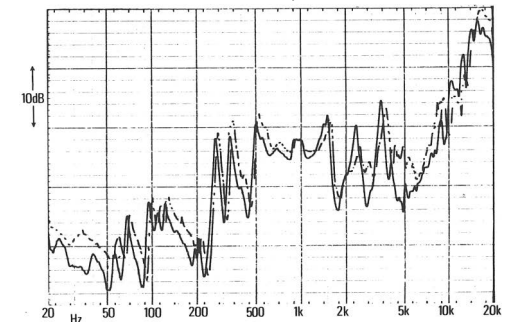
## Conclusion

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.

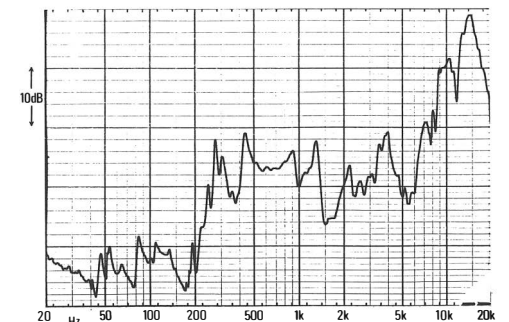
GENERAL DATA		Tonearm
Approximate effective mass inc screws, excl cartridge	.....	5.0g
Type/mass of headshell	.....	plug in arm tube/N/A
Geometric accuracy	.....	excellent
Adjustments provided	.....	overhang, tilt, arm height
Finish and engineering	.....	excellent/very good
Ease of assembly/setting up/use	.....	good/good/very good
Friction: typical lateral/vertical	.....	less than 10mg/less than 10mg
Bias compensation method	.....	suspended weight (pulley)
Bias force: rim/centre (set to 1.5g elliptical)	.....	275 mg/275 mg
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.

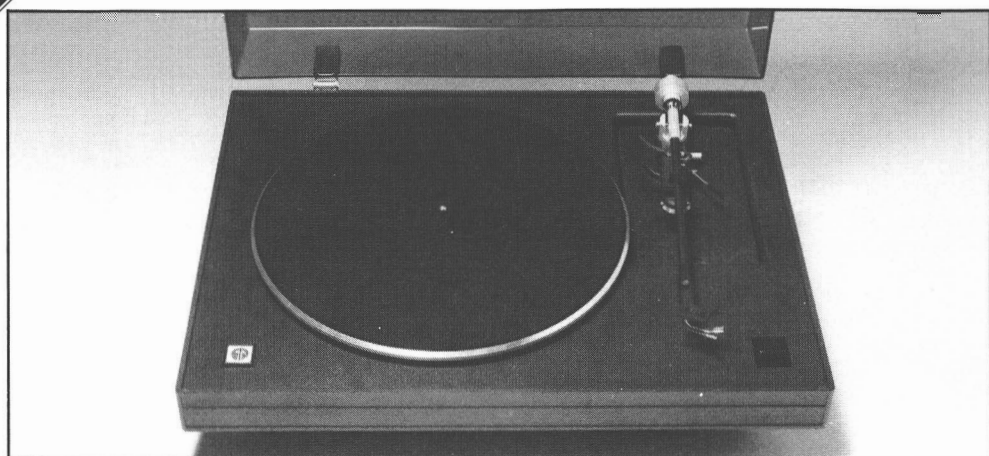


Arm resonances with headshell mass loading.

**RECOMMENDED**

# 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

**Recommended**

**TURNTABLES**  
Dual Ariston  
Linn Systemdek  
Thorens

**AMPS**  
A&R, Crinson, Quad  
Rogers, Lantek,  
Exposure, NAD

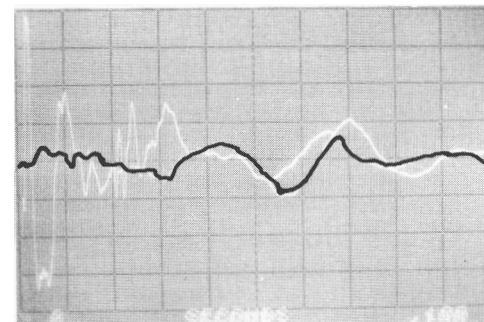
**SPEAKERS**  
Castle, KEF, Linn,  
B&W, Tannoy, Heybrook,  
Mission, Tangent

Come and have  
a good listen!  
1st floor  
Rawson Sq, Bradford 309266

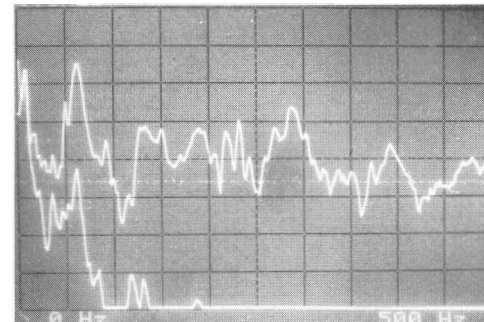
Open 6 days — please ring



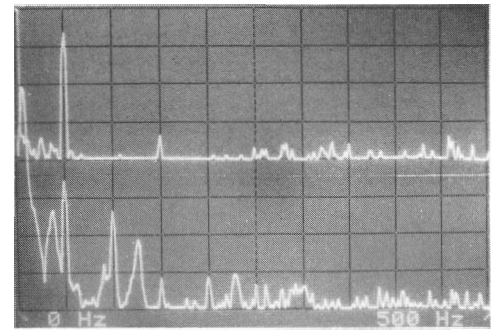
**Erricks' of Bradford**



Disc impulse: black *Audio Ref* mat; white, STD felt mat (X10).



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

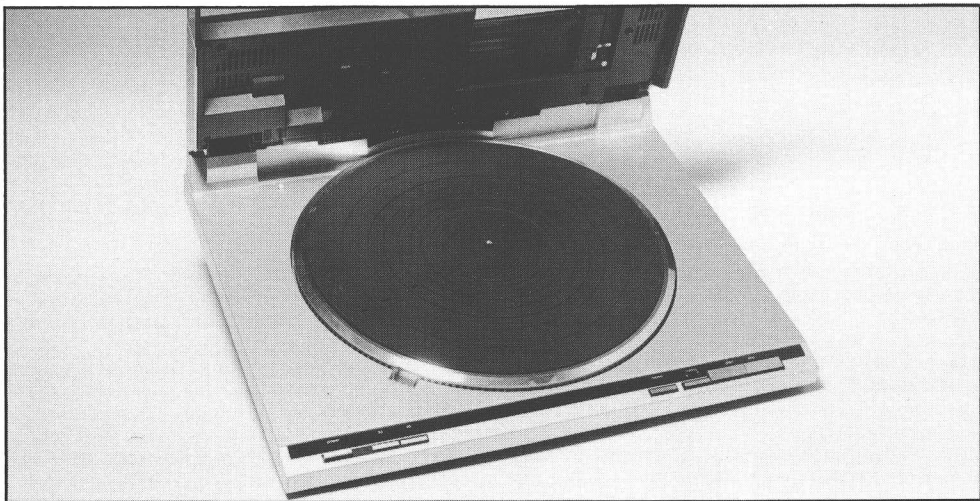


Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

RECOMMENDED

# Technics SL7/10/ DL1 (15/QL1)

Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 34522



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 (10-12Hz). 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 +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 III L*, 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.

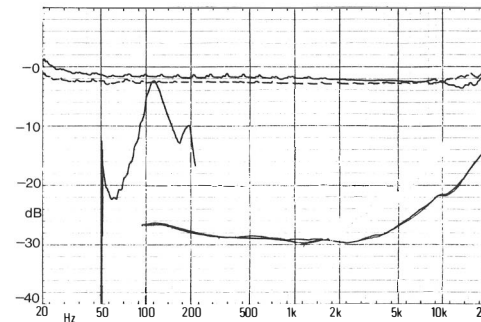
All the cartridge masses are identical, and hence are interchangeable without any necessary readjustment. In addition Ortofon have now built a compatible version of one of their own *30* series, though appropriate electrical loading should be applied here to give the best results.

### Lab results

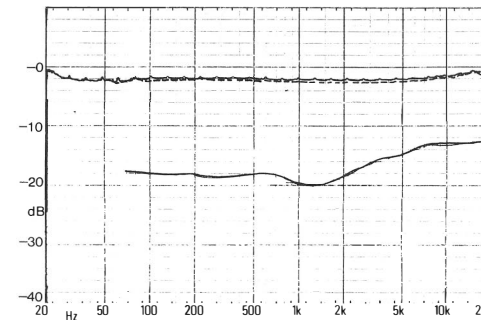
Not every unit in the range has been tested, but key models have been evaluated which are generally representative of the group as a whole.

### SLDL1

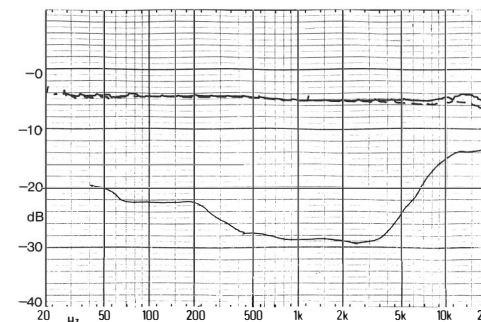
The *SLDL1* delivered an excellent mechanical performance with high torque, overshoot-free, with low drift and negligible wow or rumble. The arm performed well, judged largely by the fine stability and tracking performance of the supplied



Cartridge response/crosstalk/subsonic resonance raised (X decade): P202ED (on SL7).



Cartridge response/crosstalk: P202 (on QL1).



Cartridge response/crosstalk: P23E (on DLI).

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  $\pm 1$ 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.

**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

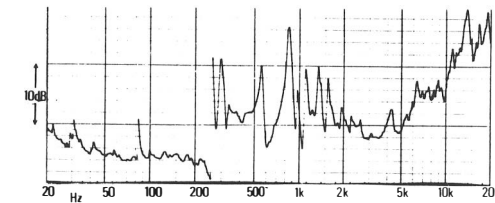
**Arm Section**

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

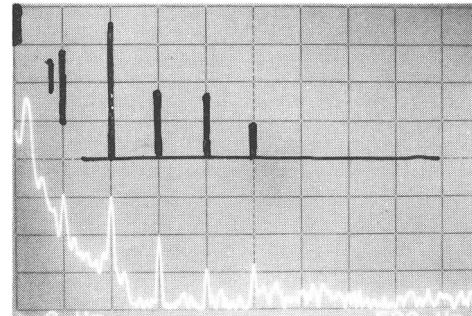
**System as a whole**

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

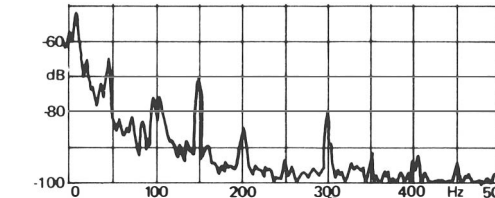
A +10dB resonance at an ideal 11Hz was recorded for the arm/*P202* cartridge combination, but channel balance was slightly erratic: 1 dB out at low frequencies, it was matched at 7 kHz and then diverged above 10kHz to a maximum of 1 dB, 15kHz, so the frequency balance of the two channels will be slightly 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.



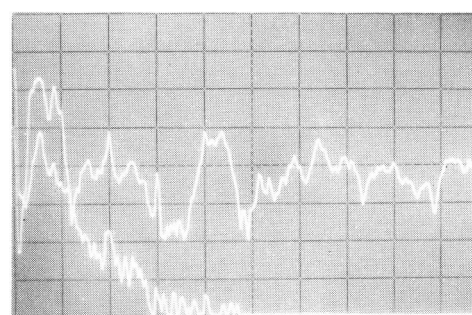
Structural arm resonances, audio band.



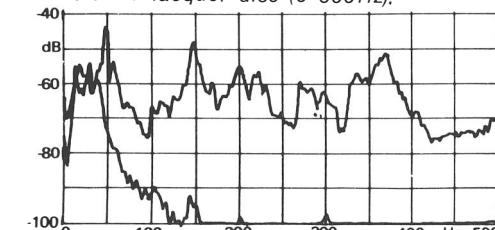
Rumble via lacquer disc (0-500Hz lin).



Rumble via lacquer disc (0-500Hz).



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



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

**GENERAL DATA**

Integrated Turntable

**Motor Section**

Type..... direct drive, quartz, parallel tracking  
 Platter mass/damping..... N/A/good  
 Finish and engineering..... both excellent  
 Type of mains lead/connecting leads..... 2 core/phonos + earth  
 Speed options..... 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

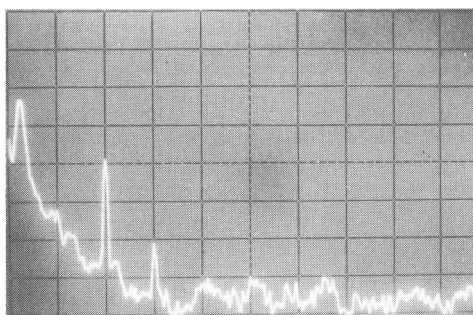
**Arm Section**

Approximate effective mass inc screws, excl cartridge..... 4g  
 Type/mass of headshell..... none/N/A  
 Geometric accuracy..... excellent  
 Adjustments provided..... downforce  
 Finish and engineering..... both excellent  
 Ease of assembly/setting up/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 ascent/descent..... good/1.0sec/1.2secs  
 Arm resonances..... good  
 Subjective sound quality..... good  
 Lead capacitance/damping method..... N/A/none

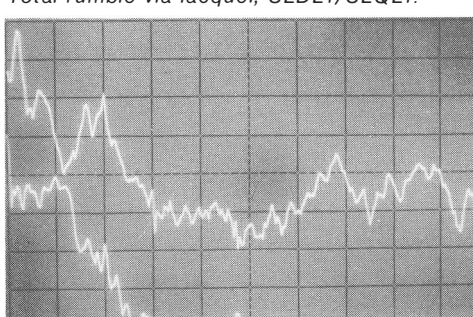
**System as a whole**

Size/clearance for lid rear..... 31.5(w) x 31.5(d) x 8.8(h)/none required  
 Ease of use..... excellent  
 Typical acoustic breakthrough and resonances..... very good  
 Subjective sound quality of complete system..... good  
 Hum level/acoustic feedback..... very good/very good  
 Vibration sensitivity/shock resistance..... above average/very good  
 Estimated typical purchase price..... £300 (inc cart & head amp)

continued overleaf



Total rumble via lacquer, SLDL1/SLQL1.



Breakthrough SLDL1/SLQL1: above, acoustic; below, vibration.

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

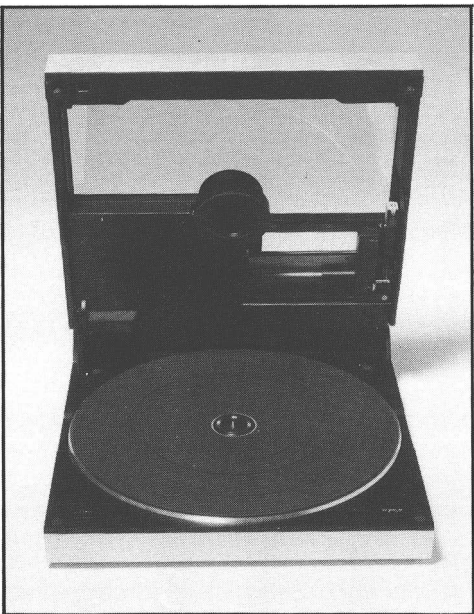
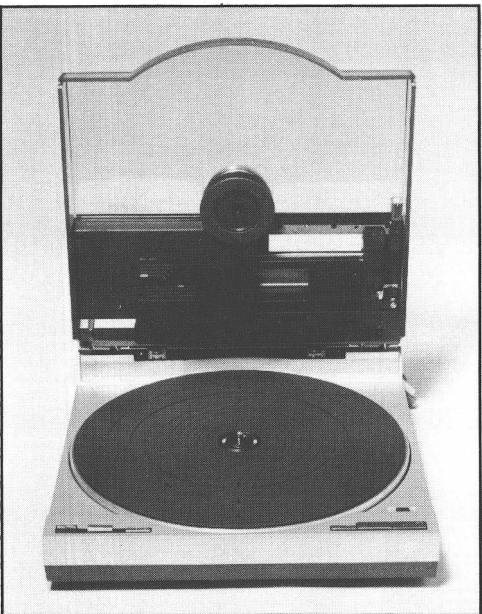
a trifle 'hard' and 'forward' in the midband, if not unduly so. The frequency balance gave an 'open' and 'lively' effect, with good clarity in the treble, and the overall impression was of a 'light' and 'lively' balance.

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.

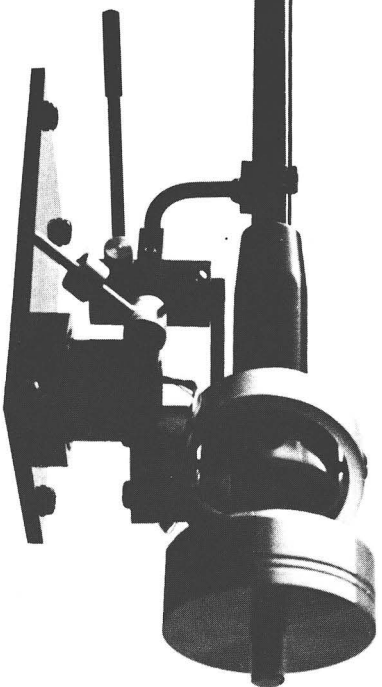


# Helius

Since its launch, Helius has made a dramatic impact on the pick-up arm market, and has developed an enviable reputation for offering excellent value for money.

Helius is an exceptionally rigid, undamped arm designed to extract the best from today's high energy cartridges. Equally important is its versatility, it can be used with either moving coil or magnetic cartridges with masses up to 17gms, and will fit on any turntable with its SME type baseplate, or where this is not ideal, one of our more specialised plates.

So if you're in the market for a pick-up arm, speak to one of our dealers, they will be glad to demonstrate Helius to you, and from there the decision is academic.



For more information contact  
Helius Designs, 11 Falstaff Way, Hartford  
Huntingdon, Cambs, PE18 7SY.  
Telephone: 0480 59037



**RECOMMENDED**

# Thorens TD105 II *(re-assessed)*

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



## Features and design

Currently the least expensive of the Thorens models, the 104/105 II models are basically the same deck, the difference being the addition of an auto-return facility on the 105. Previously reviewed in *Choice*, they have been re-assessed this time round on the advice of the UK agent, as certain small improvements have been made, notably to the damping of the top deck and by the substitution of a better mat.

This turntable has a low mass tonearm with a detachable carrier tube, but the lead capacitance remains at a rather high 300pF, which rules out a number of the more load conscious cartridges. The only cure would be to rewire the signal leads with low capacitance cable or alternatively, if the set-up permits, shortening of the cable provided.

The light 1.3kg platter has a strobe cut into the rim and illuminated from below, and the unit is belt driven from a small DC motor. This is electronically controlled for good speed stability, the electronics enabling conductive type touch switches for speed select and stop to be used. The main bearing was quite small in diameter but well toleranced and finished, demonstrating negligible play. The deck plate is mounted on springs possessing quite a low resonant frequency, helping to isolate it from the light resonant lid as well as from vibration transmitted to the plinth from below. The power supply comes in a separate box which is moulded onto the mains cable.

## Lab results

The motor exhibited sufficient torque to keep the speed variation under load to a moderate 0.3%. Start-up was average at 3.5 seconds, but in its favour, the drive showed a complete lack of

speed overshoot/dynamic wow effects (which is in marked contrast to the more costly '115 series, and indeed the '126).

Wow and flutter measured well, if a shade higher than for the earlier model, but unfortunately rumble was definitely worse, and averaged just 70dB DIN B (previously a 74dB averaged figure was obtained). Spectrum analysis revealed numerous modes around 100Hz plus a spurious 280Hz component.

The acoustic breakthrough results also showed imperfections, being quite good at lower frequencies but demonstrating a serious deterioration above 300Hz. Vibration isolation was good at around 150Hz, but below this frequency it proved less satisfactory as well as non-uniform. It was just possible to present the disc impulse transmission with X10 scaling, the result showing quite poor disc damping and a large low frequency resonance attributable to platter rocking at an estimated 10Hz; this is a rather low frequency and is indicative of poor rigidity.

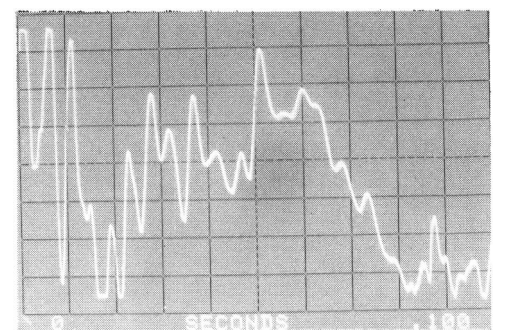
The moderate effective mass of 8g provided by the tonearm is suitable for medium compliance cartridges. A trace of play was evident in the bearings, but friction was low in both planes, bias correction was good, and downforce calibration satisfactory; cue operation was also fine. Audio band resonances were numerous, with evidence of 'chatter' or 'play', but in the main they were quite well controlled, displaying a relatively uniform energy trend. The counterweight resonated at 80Hz, the tube flexed at 200Hz, and a further severe mode is shown at 1.8kHz.

## Sound quality

Despite the 'improvements' the 105 did not gain more than an 'average' rating for sound quality. Some midrange coloration was present with a slightly aggressive upper range, for which the new mat was partially responsible. The bass was unexceptional with some 'softening' of impact, and the stereo imaging was neither particularly well-focused nor transparent.

## Conclusion

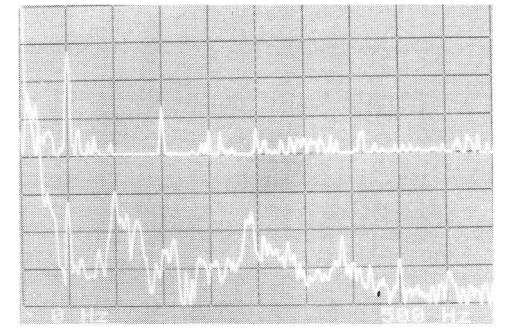
The TD105/104 players are reasonable enough, and sufficiently better than many other similarly priced models to merit recommendation.



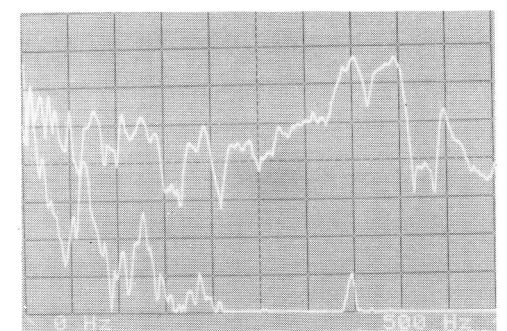
Disc impulse transmission, magnified X10.

## GENERAL DATA

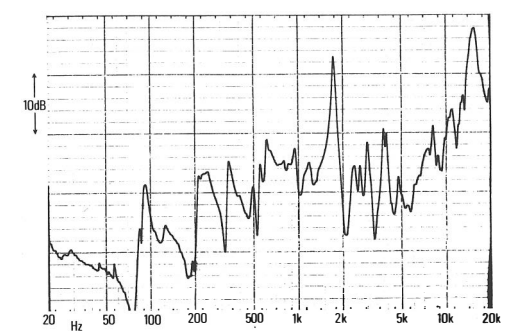
	Integrated Turntable
<b>Motor Section</b>	
Type.....	belt drive, auto return
Platter mass/damping.....	1.3kg/fairly good
Finish and engineering.....	very good/good
Type of mains lead/connecting leads	2 core, sep AC adaptor/phonos + earth
Speed options.....	33/45rpm (variable)
Wow and flutter (DIN peak wtd sigma 2).....	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz).....	0.1%/0.07%
Absolute speed error.....	variable
Speed drift 1 hour/load variation.....	-0.2%/-0.3%
Start up time to audible stabilisation.....	3.5secs
Rumble: DIN B wtd L/R av (see spectrum).....	-72/-68dB
<b>Arm Section</b>	
Approximate effective mass inc screws, excl cartridge.....	9g
Type/mass of headshell.....	fixed/plug in arm/N/A
Geometric accuracy.....	very good
Adjustments provided.....	overhang, lateral angle, tilt
Finish and engineering.....	good/good
Ease of assembly/setting up/use.....	good/fairly good/very good
Friction: typical lateral/vertical.....	less than 20mg/less than 20mg
Bias compensation method.....	spring
Bias force: rim/centre (set to 1.5g elliptical).....	160mg/180mg
Downforce calibration error: 1g/2g.....	-0.09g/-0.1g
Cue drift/8mm ascent/descent.....	negligible/1.0sec/1.5secs
Arm resonances.....	fairly good
Subjective sound quality.....	average
Lead capacitance/damping method	300pF/decoupled counterweight
<b>System as a whole</b>	
Size/clearance for lid rear.....	43.0(w) x 35.0(d) x 13.2(h)/4.5cm
Ease of use.....	good
Typical acoustic breakthrough and resonances.....	above average
Subjective sound quality of complete system.....	average
Hum level/acoustic feedback.....	good/above average
Vibration sensitivity/shock resistance.....	average/good
Estimated typical purchase price.....	£104 (104 II £87)



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



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



Structural arm resonances, audio band.

**RECOMMENDED**

# Thorens TD160C 111 *(re-assessed)*

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



## Features and design

This integrated model was already well established when it was reviewed in the first *Choice* edition to cover turntables and tonearms. It was subsequently withdrawn, but popular demand in the UK led to its reintroduction, and it now comes with an improved mat, whose flat areas offer some extra disc contact. For many years a leading low-cost integrated deck based on subchassis construction, the previous model was one of the earliest exponents of the low mass arm with detachable carrier, that now fitted is to the latest Thorens design.

The main bearing is substantial, with a 10mm shaft and a conical point contact on the hardened steel thrust washer. A die-cast double platter is used, belt driven from a two speed synchronous motor. The speed change and arm cueing are accomplished *via* convenient front-mounted controls which do not disturb the subchassis. Although levelling and set-up is not simple due to the concealed nuts, this model should have been pre-aligned at the factory in view of its integrated arm.

The arm itself is a quality model with a tight low-friction gimbal bearing array, and incorporates subtleties such as spring operated downforce and magnetic bias compensation. In addition to the usual lateral alignments, it is also adjustable for height and tilt, and has a bearing axis close to the stylus tip height for maximum tracking stability under heavy programme modulation, further assisted by the arm's dynamic balance. It proved to be a stable tracker in general, extracting a fine mechanical performance from most cartridges. The effective mass of 6g means that it is a genuinely low mass model suited to compliances in the 15-35cu range, which includes the more delicate moving-coils as well as the majority of high performance moving magnet types.

## Lab results

The combined wow and flutter result was excellent at 0.06%, though the wow alone was a little higher than average at 0.15%. The fairly heavy 2.5kg platter came to speed in a slow 4 seconds, despite the motor clutch which was supposed to accelerate matters (in the past this has never worked particularly well either). Speed was a trifle fast, and a moderate 0.3% slowing under load was encountered. The DIN B weighted rumble was very good, averaging -76.5dB; spectrum analysis showed little difference between the total rumble noise and that for electrical breakthrough alone, although the latter was higher than usual. X10 disc impulse scaling was just possible, but the new mat can be seen to possess rather poor absorption properties.

Well-adjusted, the arm returned very low friction levels, with the tabulated readings in fact dominated by a trace of residual bias compensation. The biasing force was slightly low, but worked well due to its negligible added friction, while the downforce calibration was accurate. The resonance graph showed a promisingly even energy trend, but with rather numerous and only partially controlled modes; the fine detail suggests some 'play' in either the counterweight or perhaps the carrier socket fixture.

The acoustic and vibration performances were well above average, but not quite on a par with more modern designs due to excess foam in the springs.

## Sound quality

We were struck by the generally complete and well ordered sound quality of this model, which was well ahead of other similarly priced commercial integrated players (barring perhaps the untested Rega combination). Bass was noticeably 'quick' and 'clean', with good definition and evenness; detail was well represented with

promising stereo depth, ambience, and image stability. The supplied mat emphasised the mild treble 'hardness' in the tonearm, which could also sound a little 'grainy' in the treble region, and substitution of an *Audio Ref* mat resulted in a notable smoothing as well as 'softening' here - a good match.

## Conclusion

We can congratulate Thorens and their importers on the reintroduction of this model, which is as good a purchase now as it ever was. At the price it is highly competitive in terms of sound quality, is foolproof to use, and relatively easy to set up. A strong recommendation is appropriate, particularly if used with a better mat.

## GENERAL DATA

### Motor Section

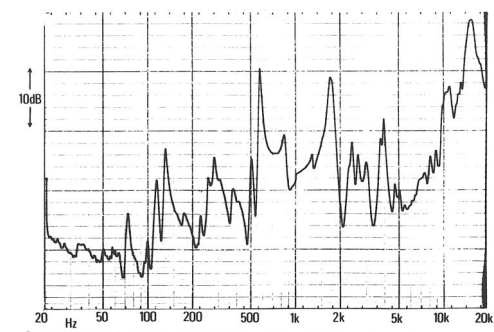
Type.....	belt drive, manual
Platter mass/damping.....	2.5kg/good
Finish and engineering.....	very good/very good
Type of mains lead/connecting leads.....	2 core/phonos + earth
Speed options.....	33/45rpm
Wow and flutter (DIN peak wtd sigma 2).....	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz).....	0.15%/0.09%
Absolute speed error.....	+0.6%
Speed drift 1 hour/load variation.....	synchronous/-0.3%
Start up time to audible stabilisation.....	approx 4secs
Rumble: DIN B wtd L/R av (see spectrum).....	-77/-76dB

### Arm Section

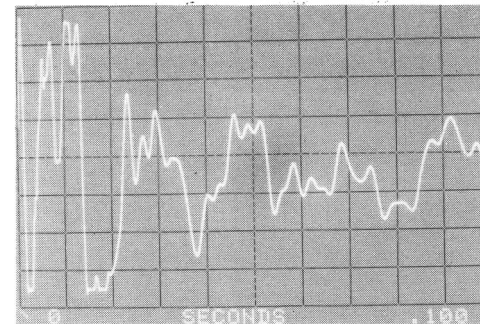
Approximate effective mass inc screws, excl cartridge.....	6.0g
Type/mass of headshell.....	plug in arm tube/N/A
Geometric accuracy.....	very good
Adjustments provided.....	overhang, lateral angle, height, tilt
Finish and engineering.....	very good/very good
Ease of assembly/setting up/use.....	good/fair/very good
Friction: typical lateral/vertical.....	25mg/25mg
Bias compensation method.....	magnetic
Bias force: rim/centre (set to 1.5g elliptical).....	140mg/140mg
Downforce calibration error: 1g/2g.....	+0.1g/0.00g
Cue drift/8mm ascent/descent.....	slight/0.6sec/2.5secs
Arm resonances.....	average +
Subjective sound quality.....	average +
Lead capacitance/damping method.....	180pF/none

### System as a whole

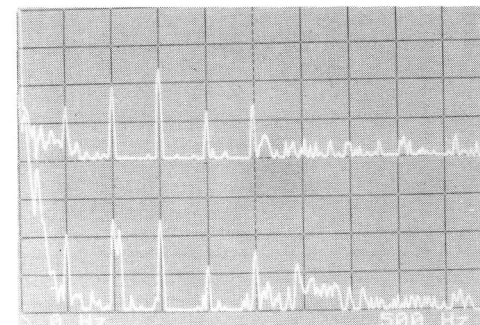
Size/clearance for lid rear.....	43.0(w) x 34.0(d) x 15.0(h)/8cm
Ease of use.....	very good
Typical acoustic breakthrough and resonances.....	good
Subjective sound quality of complete system.....	good
Hum level/acoustic feedback.....	very good/very good
Vibration sensitivity/shock resistance.....	good +/-fairly good
Estimated typical purchase price.....	£161



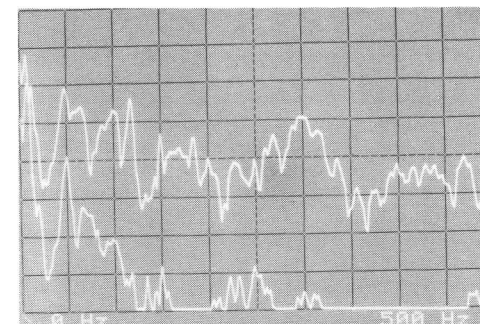
Structural arm resonances, audio band.



Disc impulse transmission, magnified X10.



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



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

RECOMMENDED

## Thorens TD160BC (revised and reprinted)

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



In the last edition, the *TD160* was reviewed in two versions: the standard basic Thorens model, and a German-modified version fitted with Hadcock or Mayware arms which was imported by some dealers: known as the *ATR*, this version is no longer available in the UK, and is in any case usurped by the new *'160S* (see review). In point of fact, the dealers who handle the *TD160* frequently offer their own similar modifications to the basic *'160* (mat change, removal of foam spring cores etc.) while carrying out the necessarily skilled and time consuming process of properly fitting an arm.

In mechanical terms, the *TD160BC* is a synchronous motor two speed belt drive turntable, with massive main bearing and a die cast balanced outer platter mounted on an effective, low working resonance, suspended sub-chassis. Engineering was to a high standard as the measured data confirmed, and even without the simple mat substitution it remains the best choice of motor unit at this as well as much higher price levels.

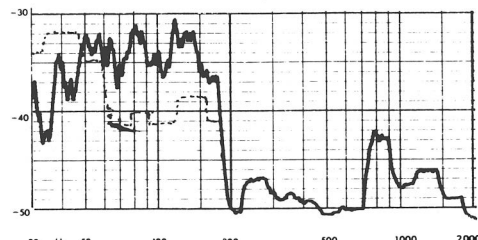
Rated as very good on both wow and rumble, slowing under load was acceptable; no overshoot was of course present due to the synchronous drive and dynamic wow was thus negligible. A reasonable 3 second start-up was demonstrated, but absolute speed proved a trifle fast at +0.6%. Acoustic breakthrough was however very good and improved further with *ATR*'s better mat and its removal of the foam cores from the springs.

Rated as good for the standard Thorens version and as very good with the *ATR* style modifications, the subjective performance attracted very little criticism. The mat change resulted in a significant

improvement in midrange detail and stereo depth, similar to the *LP12* in terms of neutrality, low frequency depth, evenness and ambience.

In both forms, very good value is offered, and a strong recommendation holds.

GENERAL DATA		Motor Unit
Type	..... belt drive	..... manual belt drive
Platter mass/damping	..... 2.5kg/good	..... 2.5kg/very good
Finish and engineering	..... very good	..... good/very good
Type of mains leads	..... 2 core	..... 2 core/N/A
Speed options/variable?	..... 33 $\frac{1}{3}$ ; 45rpm/no	..... 33 $\frac{1}{3}$ ; 45rpm
Wow and flutter (DIN pk wtd $\sigma$ 2)	..... 0.06%	..... 0.065%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	..... 0.11%/0.08%	..... 0.11%/<0.05%
Speed accuracy/drift/variation under load	..... +0.6%/none/-0.4%	..... +0.3%
Start up time to audible stabilisation	..... 3.5secs	..... synchronous/-0.25%
Rumble (av DIN B wtd L/R)	..... 73/74dB	..... 3.5secs
Size/rear clearance for lid	..... 43(w) x 34(d) x 15(h)/9.5cm	..... 78/79dB
Typical acoustic breakthrough and resonances	..... very good	..... 43.7(w) x 36.0(d) x 16.5(h)/7.5cm
Subjective sound quality of complete system	..... very good	..... ease of use
Hum level/Acoustic feedback	..... very good/very good	..... good
Vibration of shock sensitivity	..... very good	..... typical acoustic breakthrough and resonances
Ease of use	..... straight forward	..... very good
Estimated typical purchase price	..... £120	..... subjective sound quality of complete system



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

## (revised and reprinted) Thorens TD160S

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



### Features, facilities, setting up and use

Following the interest in the *ATR* version of the *'160*, as well as in other modifications both official and unofficial, an importer guaranteed version of the existing *TD160BC* has now been released. For those familiar with the existing standard *'160*, the improvements made for the *S* version were as follows. The platter balance and centration were to a closer tolerance, both components in die-cast zinc alloy, while the main bearing was of selected quality. The subchassis was acoustically damped by a bituminous laminate, the spring isolation efficiency was increased by removal of the foam cores, while a reinforced arm mount was also supplied. The plinth was much heavier in construction, manufactured from a wood composition with a massive bottom cover, and the lid was fitted with friction stop hinges. A flat rubber mat offering improved disc and platter damping was supplied, but in all other respects the two decks were identical, and comprised two speed synchronous motor designs, driven via a flat belt.

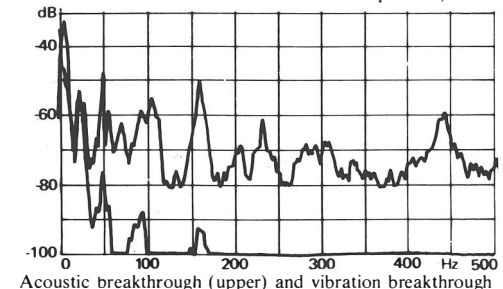
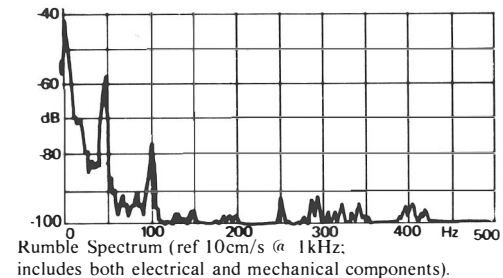
The measured performance showed a distinct improvement over the previously reviewed standard *160BC*, and strong gains were also apparent in acoustic terms. Wow and flutter was very good – particularly flutter (actually this was one of the best results for a quality belt drive motor that we measured). It ran slightly fast at a moderate +0.3%, but showed little slowing under load, while the fairly heavy 2.5kg platter reached speed in 3.5 seconds, and the rumble reading was also excellent at 78/79dB. The spectrogram was one of the cleanest in the report, particularly when the electrical nature of the 50 and 100Hz lines is taken into account. The mechanical resonance was satisfactorily low at 3.1Hz lateral and 6.3Hz vertical, although it was not very well balanced and

on our sample required careful adjustment. Despite a small peak at 160Hz, the acoustic breakthrough was very good, and vibration isolation was similarly rated, while feedback and hum were very good and shock resistance reasonably good.

Clearly in the top turntable group on our tests, we could make few criticisms of this model's sound quality.

Although it was not as well finished or as substantially engineered, the *TD160S* delivered comparable quality to the highly rated models up to £250 in my estimation. A recommendation is thus mandatory. The *160S* is clearly good value for money at its typical purchase price of around £170.

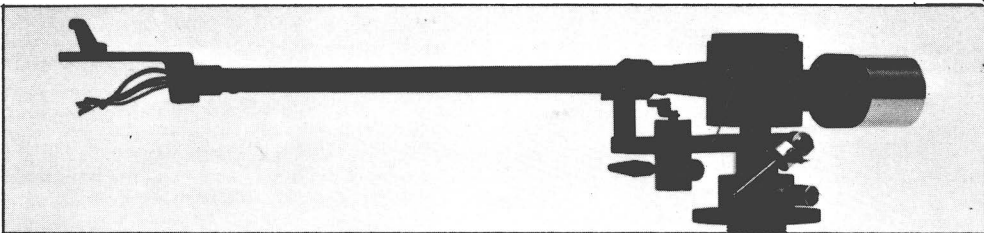
GENERAL DATA		Motor unit
Type	..... manual belt drive	..... manual belt drive
Platter mass/damping	..... 2.5kg/very good	..... 2.5kg/very good
Finish and engineering	..... good/very good	..... 2 core/N/A
Type of mains lead/connecting leads	..... 2 core/N/A	..... 33 $\frac{1}{3}$ ; 45rpm
Speed options	..... 33 $\frac{1}{3}$ ; 45rpm	..... +0.3%
Wow and flutter (DIN peak wtd sigma 2)	..... 0.065%	..... 0.11%/<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	..... 0.11%/<0.05%	..... 3.5secs
Absolute speed error	..... +0.3%	..... synchronous/-0.25%
Speed drift 1 hour/load variation	..... synchronous/-0.25%	..... 3.5secs
Start up time to audible stabilisation	..... 3.5secs	..... 78/79dB
Rumble: DIN B wtd L/R av (see spectrum)	..... 78/79dB	..... 43.7(w) x 36.0(d) x 16.5(h)/7.5cm
Size/clearance for lid rear	..... 43.7(w) x 36.0(d) x 16.5(h)/7.5cm	..... ease of use
Ease of use	..... good	..... typical acoustic breakthrough and resonances
Typical acoustic breakthrough and resonances	..... very good	..... very good
Subjective sound quality of complete system	..... very good	..... very good/very good
Hum level/acoustic feedback	..... very good/very good	..... very good/good
Vibration sensitivity/shock resistance	..... very good/good	..... £170
Estimated typical purchase price	..... £170	



RECOMMENDED

## Ultracraft AC30 (revised and reprinted)

J. Osawa & Co. Ltd., 10 Forge Court, Reading Road, Yateley, Camberley, Surrey GU17 7RX  
Tel (0252) 875919



### Features, facilities, setting up and use

At a price reduction of some 30%, Ultracraft have ingeniously produced the new AC-30 arm, which embodies the best of the '300 series while adding further improvements. Treading a middle path between the very low and very high mass '300 versions, the '30 was a rigid structure with the tube/stem and headshell properly and permanently fixed, offering a modest 9g effective mass. The arm is finished entirely in black, though the same pillar unit as on the '300 was used, including the variable damping unipivot. A rotating type calibrated counterweight was employed, and the arm was fitted with a good quality low capacitance cable measuring a total of 95pF. As with the '300, the same 15mm overhang geometry measurement was recommended instead of a sensible card protractor.

In general well engineered, we were slightly concerned over the lack of complete rigidity at the pivot, due to spring loading of the jewelled pin, presumably to prevent damage by shock; that on the AC-300 appeared firmer by comparison.

### Lab performance

This arm performed very well in the lab with fine geometrical accuracy and very low pivot frictions, offering effective damping as and when required. Effective mass was moderate at 9g – at the low end of the medium mass category – and in conjunction with damping was suitable for cartridge compliances in the 10–25cu range. Bias compensation was fine though the cue drifted a little on descent. A good rating was achieved for resonances, the arm exhibiting generally good control and a well maintained energy trend. The counterweight was apparent at 100Hz, but the break at 250Hz was not felt to be a true resonance – possibly it was movement at the pivot. The first flexural mode of the tube was masked, but probably lay at 500Hz.

### Sound quality

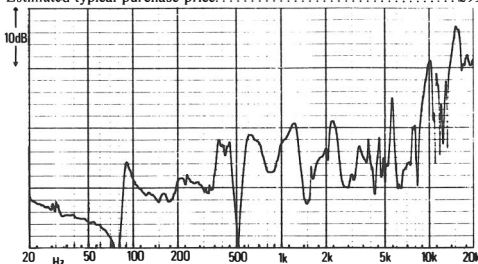
Felt to be of 'SME III' character, the AC30 sound was well balanced and neutral, showing a distinct lack of coloration and offering no emphasis of any spectral region. The sound was quite detailed and showed promising stereo depth and ambience, but the final degree of transient clarity and resolution of detail shown by the best arms was felt to be muted.

### Conclusion

Ultracraft have, in the AC30, produced a superior tonearm capable of almost universal application, especially in terms of its sensible effective mass and the variable damping facility. The value and the sound quality was good, and merits recommendation at the new reduced price.

### GENERAL DATA

	Tonearm
Approximate effective mass inc screws, excl cartridge	9.0g
Type/mass of headshell	fixed/N/A
Geometric accuracy	very good
Adjustments provided	tilt, overhang, lateral angle, height
Finish and engineering	excellent
Ease of assembly/setting up/use	good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	140mg/220mg
Downforce calibration error: 1g/2g	+0.05g/+0.07g
Cue drift/8mm ascent/descent	fairly good/1.5secs/2.5secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	95pF/variable via fluid well
Estimated typical purchase price	£99



Arm resonances

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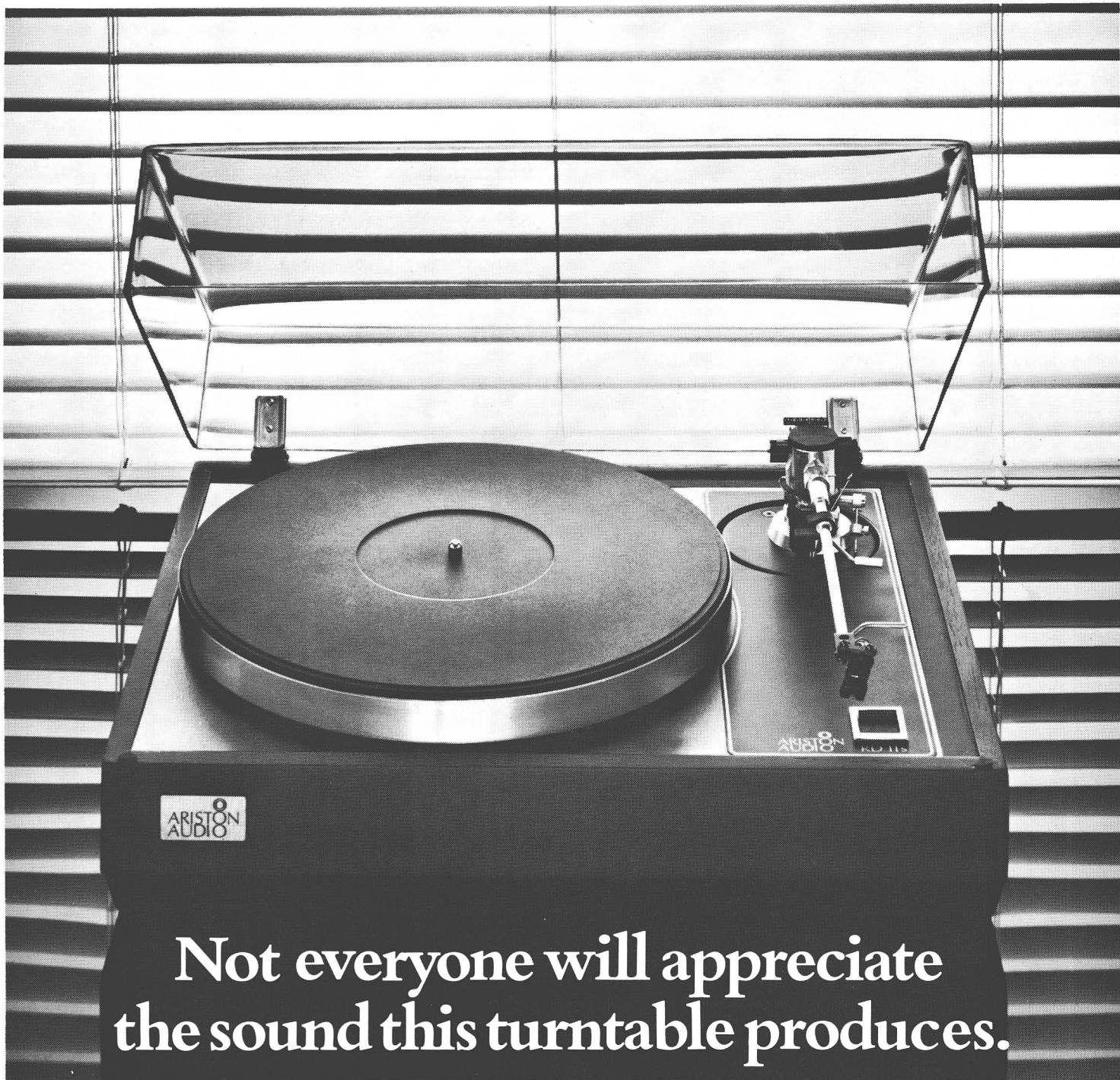
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Shown above: Ariston RD11S Turntable. The Ariston Mat. Ultracraft Tone Arm, Plinth is finished in Teak, Walnut or Black.

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QLM 32 tracks at 2 to 4 grams.

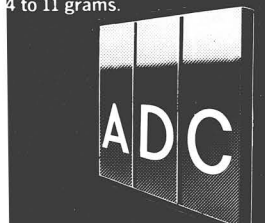
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Aberdeen: Telemach Audio Visual. Tel: 28817  
Ayr: Vennel Audio. Tel: 64124  
Edinburgh: Audio Aids (2 stores).  
Tel: 031-226 3979 and 031-667 2877  
Edinburgh: Hi-Fi Corner. Tel: 031-556 7901  
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# CARTRIDGES

The hi-fi cartridge is a miracle of micro-engineering yet it is the one component in the hi-fi chain that is most commonly taken for granted. So often are cartridges ill-matched electrically or mechanically to amplifiers and tone-arms, badly installed or just never maintained. It is even worth reminding readers of this introduction that a stylus is a disposable item and requires occasional replacement.

All cartridges work to convert the physical analogue of a musical event (the LP record) into an electrical signal by following the record groove with a stylus, and converting this movement through a generator assembly. Cartridges are, like dynamos, motors in reverse; they may operate by moving a magnet near a coil, by moving a piece of magnetic material near a fixed magnet near a coil (which amounts to the same thing), or by moving a coil near a magnet. The mechanism of the generator is used to describe the cartridge; in our example the first are magnetic cartridges, moving magnet and moving iron respectively, while the latter is a moving-coil. The electrical properties of the different generators will differ and this is covered under *Getting the Best from your Cartridge*.

It is important to get a feeling for the truly small world in which the cartridge operates before you can respect the device for the remarkable job it does. Hold your hands together and make a V-shape with your wrists touching, take this as a cross section through a record groove. The stylus that tracks such a groove would be a scale 4ft diameter and 10ft high. The cantilever to which the stylus is attached would be about 9ft in diameter and some 150ft away would be the generator mechanism!

## Design

Take the mechanical properties of the cartridge first. Obviously the cantilever needs to be hinged and suspended to allow it to trace the modulations of the record groove. This makes it a compliant system, say like a spring; the interaction of the mass of the cartridge on the other side of the cantilever suspension, coupled with the mass of the arm which the cartridge 'sees', creates a 'spring' which resonates at a specific frequency. This is the fundamental arm/cartridge resonance and is required to be down below the music bass signals on a record, say 20Hz, but above the frequency of warps in the vinyl, say about 3 to 6Hz, so that neither of these can 'excite' the system into resonance. Designers often go for a 12Hz resonance or thereabouts. This is defined by the mass of the

cartridge and the compliance of the cantilever suspension for a given arm mass. We have produced a graph that lets you work out what arms and cartridges work well together from this point of view.

The rigidity of the suspension also affects the ability of a cartridge to track small high frequency signals in the record; also the lower the mass of the moving parts the easier this job is. The catch here is that the smaller the parts, the more costly they are to produce; but this gives one indication of why some cartridges cost more than others.

The stereo signal is produced by two generator assemblies; these lie in the plane of the two walls of the stereo record groove, and are always at right angles to each other. The ability of a cartridge to keep the signal coming from the left wall separate from the signal from the right wall at all frequencies is known as its stereo separation. This is just one of the measurements made in our tests. The accuracy with which a cartridge is built and aligned by the manufacturer affects the separation figure. But just as important is that it is mounted in the tonearm square to the record to help it do its stereo scanning to the best of its ability.

A flat frequency response (or at least one with gentle trends) is a prime requirement for a hi-fi cartridge. The goodness of a cartridge's frequency response is a measure of the best compromise between the various mechanical and electrical design considerations.

## The stylus

The area of most rapid development in cartridge design over recent years has been in stylus profile. The basic problem here is that the cutter used to create the record groove is rather like a chisel; tracing this chisel-cut groove with anything other than another chisel must cause there to be lost information. Obviously you can't use a chisel-shaped replay stylus as records are designed to be played more than once - but you can get near to these conditions without jeopardising your vinyl treasures!

A true spherical tip has the one big advantage of being less than hypercritical about how it's set up in the first place but its big rounded contours will miss out and skip over some high frequency information. So designers produced what was called an elliptical stylus (more correctly known as a bi-radial tip). Here the radius that contacts the groove wall is reduced to enable higher frequencies to be scanned. But because the area where the tip contacts the wall has decreased, the track-

ing weight has to be reduced too; this set off a downward spiral of ever lower tracking weights and ever higher compliances.

The glimmerings of a solution came from an unlikely source - CD4 quadraphony. The Shibata profile stylus had been specifically designed to read off the supersonic 'quad' information frequencies from a CD4 disc and so had a much reduced minor radius but a much longer contact area down the groove wall to avoid the tracking weight problems. The catch was that the stylus tip could drag in the dirt at the bottom of the groove or even bottom out there and reduce fidelity because of increased noise.

Developments were soon made, and more and more specialised grinds became available, which retained the long thin contact area but swept the tip up away from the groove bottom. These 'line contact' tips are nowadays used on nearly all of the top designs and go under a variety of names *Aliptic* (ADC), *Fine Line* (Ortofon), *Vital* (Supex), *Hypereliptic* (Shure). The latest of these grinds is the *van den Hul* profile as used on the Goldring G900IGC cartridge.

## Electricity

All amplifier disc inputs have particular characteristics in the load they present to the cartridge - remember the cartridge acts like a dynamo and has to drive the input load. This load comprises a value of resistance, nominally 47kohm, plus some capacitance. The leads between the cartridges and amplifier themselves add some capacitance. The typical magnetic cartridge has not only a source resistance but an inductance brought about by the great lengths of thin wire coiled up in the generator which act like chokes. Put all this together and you get an electrical resonance rather like the mechanical resonance described earlier. This electrical resonance is found in the high frequency region, that part of the spectrum where a stylus/vinyl-spring mechanical resonance also occurs, rather than the very low frequency mass/compliance resonance.

Designers can use the electrical resonance of the cartridge/input interface either to minimise the mechanical HF resonance or to extend the flat response by counteracting suspension damping. While this was nearly always the case in the past, these resonant interactions can now be designed to occur in the cartridge's supersonic range - but as usual this costs.

But this leaves us with the problem that some cartridges are load sensitive and will change their frequency re-

sponse when faced with certain electrical loads at the disc input. Others are impervious to loading. A rough average optimum is an input impedance of about 47 kohms with capacitance of about 150pF to 250pF. Any cartridge mentioned as requiring different loading from this in the tests may well benefit from 'phono equalisers', which can be used to change the disc input loading to achieve a flatter response.

Moving-coil cartridges have very low inductances and so tend not to suffer from these loading problems. The catch with this kind of cartridge is that they produce a lower voltage output than magnetic types, and often require step-up devices. The moving-coil cartridge is an inherently flat device and can throw out supersonic signals far above the signals generated by a magnetic; this may mean that some pre-amps are in jeopardy of running out of headroom because they are having to handle these signals as well as audio frequencies.

Step-up or gain can either be achieved electronically with a head-amp or pre-amp or through a transformer (though the latter has problems handling frequency extremes). Mis-matched input impedance with moving-coils seems only to affect the output level rather than the quality or the frequency response, but this is a broad generalisation and source of endless hours of discussion amongst audiophiles.

### What to choose

The simplest advice to give here is on what not to choose! Check the mechanical compatibility of your arm and the cartridge you intend to buy. Massy arms can't cope with high compliance cartridges on even slightly warped records. The mechanical behaviour of a cartridge is affected by the amount of internal self-damping; note from our tests which cartridges need additional damping at the arm pivot. If you can't damp your arm don't choose a cartridge that needs arm damping.

Lower compliance designs, which tend to be synonymous with moving-coil cartridges, do create a lot of 'backchat' vibration, and really require a rigid, higher mass arm with good bearing quality to produce their best. A low compliance moving-coil in a flimsy low mass arm is unlikely to perform well.

While discussing moving-coils it is worth pointing out that the cost of a suitable step-up device may need to be taken into consideration from the outset, though many modern amplifiers now include these as part of the total package.

### Getting the best from your Cartridge

Cartridge alignment becomes easier to understand if you stop to think of the problems faced by the tonearm. To start with, records are cut by a cutting head that travels a path along a radius of the finished disc. A pivoted arm can only move the cartridge and stylus along an arc that approximates to the straight line radial path made by the cutter. Cartridge alignment is what gets that approximation as close as possible. With a correctly set up arm less than 0.6 per cent distortion (2nd harmonic) can be generated across the record from run-in to inner groove; an error of 1 mm or so in adjustment can triple that figure.

The end result should be minimum distortion across the whole playing surface of the record and this is not quite the same thing as minimum tracking error, errors at certain points being worse from the distortion point of view than the same error at another place on the disc. Mathematical theory can show that the least distortion is created over the greatest part of the record when the arc of the pivoted tonearm crosses the imaginary path of the cutter at two points where the distortion will be zero. Most protractors show only the inner point and don't offer such accuracy as a true two-point protractor with zero distortion points at 63.6 and 119.5mm from the centre of the record.

Not only should the stylus touch the radius at these two zero points but it should be aligned square to the radius. If the cartridge needs twisting to achieve this so be it – the cartridge should lie square to lines drawn parallel to and at right angles to the radius at these points. The headshell may not be parallel at this point if the arm designer hasn't got the arm geometry spot on – which happens more often than it should.

The cartridge can now be checked for square from the front aspect, which is done most conveniently with a mirrored surface, squaring the cartridge and its reflection.

The angle at which the stylus meets the disc (as viewed from the side) is correctly called the Vertical Tracking Angle. The differing depths of cartridge bodies means it is difficult to be certain of getting this angle right by adjusting the arm height (or packing the cartridge) until the arm comes parallel to the record surface. Far easier to check for the bottom and top of the cartridge being parallel to the record surface. Use ruled paper or graph paper behind the cartridge to check this. If adjustment is required lift or lower the arm pillar if this is possible, if not insert packing between the arm and cartridge but check the overhang measurement again afterwards and don't jeopardise a good bond between the arm and cartridge with flimsy packing pieces.

Tracking weight requirements for best tracking are covered in the individual reviews, but as a rule the best tracking is achieved toward the upper limit of the range quoted by the manufacturer. Arm bias can be set as *per* the manufacturer's instructions or with a test disc. If mistracking or breakup starts in the left channel then the arm is trying to swing outwards and the stylus is losing contact with the left (inner) wall of the record. This means that the arm is over-biased. Reduce the bias and check there is no mistracking at centre, inner and outer portions of the test disc. If right channel breakup is heard, increase the bias until the mistracking disappears completely (the bias is right), or is heard equally in both channels (the tracking weight can then be increased a little if it is not outside the manufacturer's range).

It is better to obtain secure tracking at a higher tracking weight than to use a lower tracking weight, mistakenly thinking that this may wear records less. Mistracking occurs when the stylus cannot follow the heavily modulated record groove and breaks away from

the groove wall to rattle catastrophically down the groove. Mistracking does more damage to records than an extra ½ gram downforce.

### Maintenance

Record cleaning devices proliferate and there are few I would have full confidence in recommending. The remark 'the best record cleaner is your stylus' is too often greeted with derisive laughter, but we are back to the problem of dimensions. Many record cleaners act as though you were trying to get the moss out of a row of gutters with a bunch of telegraph poles! (Not easy!) The stylus will remove micro dust from the grooves and requires periodic brushing to keep it clean. Lubricants present on records (metallic soaps) and vinyl itself can build up on the stylus tip – the stiff bristle Discwasher brush and cleaning fluid with vinyl solvents can be recommended for the paranoic or audiophile. Other users could make a cheap domestic alternative with a trimmed camel hair brush and a little bottle of vodka.

Periodic electrical maintenance can be recommended too. Once a year or so the pickup connections should be pulled apart and remade to ensure an electrically sound contact through mechanical wiping. This applies particularly to low output moving-coil set ups.

### Stylus life

By the time you hear it you're too late! Microscopic examination by an experienced eye can detect the first signs of wear, but this help is hard to find. For the hyper-critical listener using a quality elliptical tip, 400 hours would be the time to check for tip wear. Line-contact styli seem to keep better. Moderate use at the rate of 6 albums a week suggests a life of 18 months. Do budget for stylus replacement.

### OTHER MODELS WORTH CONSIDERING

The **ADC ZLM Imp** (£60) was found to set a high standard though stereo separation could have been better. This model hasn't been included in the *Best Buy Guide* as in value for money terms it is overshadowed by the cheaper **XLM**. Low mass arms with damping are recommended.

The **Fidelity Research FR1 II** (£65, step up needed) can be recommended for its fine stereo imaging, trackability and neutral character. Low to medium mass arms seem best suited. The cartridge will be exchanged when a new stylus is required at a percentage of the new cartridge price.

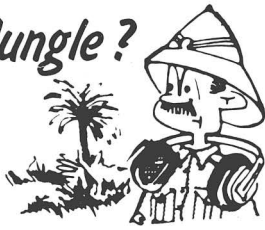
The **Ortofon FF15E II** has not been included as this model should soon be replaced on the market by the **VMS5** and **VMS10** designs.

The **Ortofon M20FL Super**, though effectively replaced by the newer **VMS30** design, is included because it will still be available in the shops at what may be a considerable saving. Similarly the **Signet TK3E** and **MkIII** models may still be found in dealers though they are no longer imported. Favourite past recommendations like the **Grado FTE+1** and the **Ultimo LOX** have been replaced (by the **GTE** and **LOX2** models respectively) and are therefore not included.

## Lost in the Hi Fi Jungle?

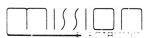
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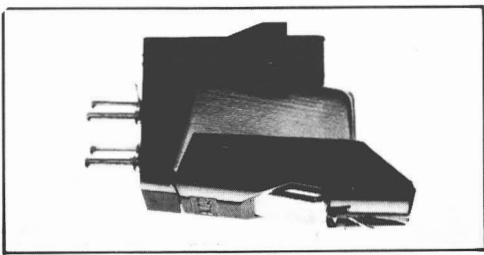
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**BEST BUY**

### ADC QLM34 III (revised and reprinted)

BSR Limited, Powke Lane, Cradley Heath, Warley, West Midlands B645QH  
Tel (0384) 65191



This relatively inexpensive cartridge performed well on all tests and was also placed high during auditioning. It proved relatively uncritical of loading, and 300pf gave the best result with a notably flat midrange. The compliance was low at 9cu, which is a logical value in view of its price, as it will go well with detachable headshell arms on less expensive turntables. The larger than usual 8µm tracing radius allowed a sensible 2.2g downforce without undue record wear, and this left some tracking margin for all but the most demanding of passages.

The excellently flat midrange has already been commented on, while the bass rise is due to the low mass test arm and would not apply with our recommended arm mass. The premature rolloff at 15kHz or so did not prove subjectively important, while up to 10kHz the channel balance and separation were good. Trackability was satisfactory at the test downforce, but the 300Hz 'Supertrack' was beyond its capabilities. Lateral 300Hz distortion was on the high side although generally speaking all other distortions were under good control and the sample demonstrated fine HF waveform quality. The squarewave showed excellent damping and confirmed the frequency response characteristic.

Ranked as 'good' — in other words above average — the '34 was described as a little dull in the extreme treble, lending a richer quality which helped to keep surface noise pleasantly low. The midrange was classed as quite 'open' with good rendition of detail and generally fine stereo image placement and depth. Heavy choral passages resulted in some muddling and coarsening, but the overall results were favoured by the panel.

This elliptical stylus consisted of a bonded diamond on a 280µm steel shank, the diamond being of good shape and close to specification, possessing fine alignment and polish. The cone angle was a sensible 50°.

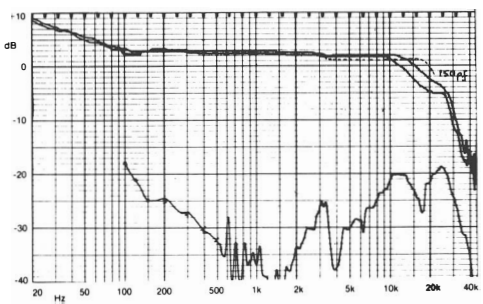
This design offers generally good performance,

possessing useful compatibility with medium to high mass arms, plus a pleasantly musical and open sound with fine stereo — at an extremely reasonable price.

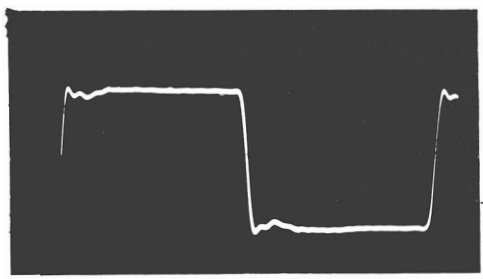
#### GENERAL DATA

Cartridge type and mass	.....	Induced magnet, 5.8g
Estimated dynamic compliance at 10Hz	.....	9cu (X10 <sup>-6</sup> cm/dyne)
Specified downforce: range 1g to 3g	.....	tested at 2.2g
LF resonance in test arm (SME 111, 6g me + cart)	.....	+10dB at 15Hz
Sensitivity at 1kHz	.....	1.2mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	.....	+1.5dB
Subjective sound quality	.....	Good
Recommended loading	.....	47Kohms plus 200-400pf
Recommended arm mass and damping	.....	15 to 30g, moderate
Cartridge coil resistance/inductance	.....	820ohms, 580mH
Induced hum level	.....	Very good
Stylus type and spec	.....	detach, shank elliptical, 8 X 18µm
Finish and alignment	.....	good, good
Tip geometry	.....	8 X 15µm
HF resonance (tip mass/vinyl)	.....	indicated at 22kHz
Frequency response 20Hz-20kHz	.....	±0.5dB*
Frequency response 100Hz-5kHz	.....	±0.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	.....	18dB, 35dB, 20dB
Channel difference at 1kHz, 10kHz	.....	0.7dB, 0.8dB
Trackability 300Hz lateral +15dB, +18dB ('Supertrack')	.....	1.8g, not possible at <2.5g
Trackability 300Hz vertical +12dB	.....	1.2g
Distortion 300Hz lateral +9dB	.....	1.1%
Distortion 300Hz vertical +6dB	.....	3.4%
High frequency waveform quality	.....	Good
Mid band intermodulation (1kHz + 1.5kHz)	.....	4.0%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	.....	0.22%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	.....	2.8%, 5.6%, 5.6%
Typical selling price inc VAT	.....	£12
Stylus replacement cost inc VAT	.....	£10

\* See text



Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec) (solid 400pf, dotted 150pf)

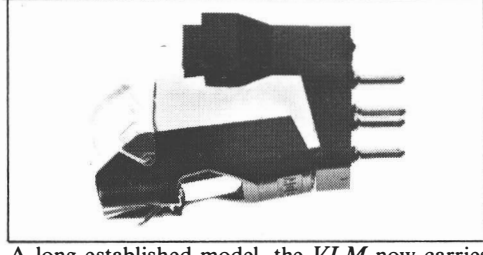


1 kHz squarewave

**BEST BUY**

### ADC VLM III imp

BSR Limited, Powke Lane, Cradley Heath, Warley, West Midlands B64 5QH  
Tel (0384) 65191



A long established model, the *VLM* now carries the appellation 'improved', which indicates revisions to the cantilever hinge and the mounting brackets. These changes were sufficiently radical to warrant a re-examination, but unfortunately we found that in some respects the new model was inferior to the old. The usefully moderate compliance of its predecessor has now been increased to 35cu, which restricts its recommended use to low mass arms. I can see no logical reason for this change, since the trackability was already very good and has been little improved with the new version.

In our opinion the stylus quality was also inferior. The stone was a Diasa diamond chip (brazed onto a sapphire rod), and thus shank mounted, with both it and the cantilever inaccurately set. The surface finish was disappointing and the grind was of pseudo-elliptical form, whereby the stylus surface actually in groove contact remains at the original major radius instead of the finer elliptical radius intended. Effectively therefore this is a spherical stylus, so far as the groove is concerned.

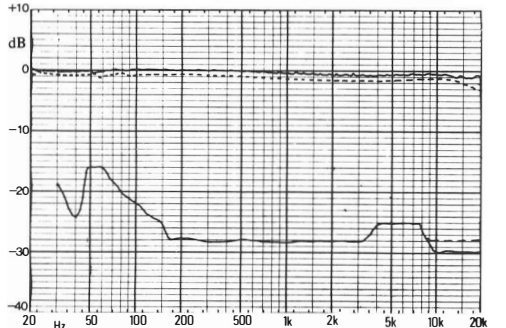
However other test results were to a good standard, with the characteristic flat ADC response using optimum capacitance (250pF seemed best loading with this sample), and well maintained stereo separation. The essentially clean squarewave performance confirmed the neutral and well-damped nature of this design, while distortions were well balanced and under good control, with the fine midband trackability indicated by the good result on the relevant intermodulation test.

On audition the original 'very good' rating was downgraded a stage to 'good', but this still remains a fine result at the price. It was described as possessing a good if slightly 'overwide' stereo image with promising depth and clarity, while in general the sound balance was quite neutral and open, with no obvious emphasis or loss. A degree of harshness and muddle was noted on high level

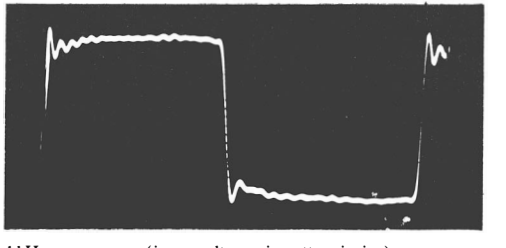
transients — notably percussion — and also on brass and violin tone.

Still worthy of recommendation, unfortunately the *VLM's* quality was marred by unnecessarily high compliance as well as its disappointing stylus quality and alignment.

Cartridge type/mass	.....	induced magnet, 5.75g
Estimated dynamic compliance at 10Hz	.....	35cu (X10 <sup>-6</sup> cm/dyne)
Specified downforce: range 0.9g to 1.5g	.....	tested at 1.4g
LF resonance in test arm (SME 111, 6g me + cart)	.....	+12dB at 8.2kHz
Sensitivity at 1kHz	.....	0.9mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	.....	-1dB
Subjective sound quality	.....	good
Recommended loading	.....	47k ohms plus (160-300) 250pF
Recommended arm mass	.....	3-7g
Recommended arm damping	.....	moderate
Cartridge coil resistance/inductance	.....	820 ohms, 580mH
Induced hum level	.....	very good
Stylus type	.....	detachable diasia shank elliptical, spec 8 X 18µm
Finish and alignment	.....	just adequate polish, fair alignment
Tip geometry	.....	pseudo elliptical, effective contact 18 X 18µm
HF resonance (tip mass/vinyl)	.....	est at 26kHz
Frequency response 30Hz-20kHz	.....	±1.5dB
Frequency response 100Hz-5kHz	.....	±0.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	.....	22dB, 28dB, 28dB
Channel difference at 1kHz, 10kHz	.....	1dB, 0.7dB
Trackability 300Hz lateral ±15dB	.....	0.6g
Trackability 300Hz vertical ±12dB	.....	0.8g
Trackability 300Hz lateral +18dB ('Supertrack')	.....	1.25g
Distortion 300Hz lateral +9dB	.....	0.37%
Distortion 300Hz vertical +6dB	.....	2.6%
High frequency waveform quality	.....	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	.....	1.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	.....	0.33%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	.....	0.3%, 0.7%, 3.6%
Typical selling price inc VAT	.....	£27



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

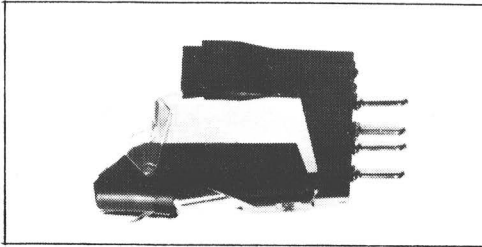


1 kHz squarewave (ignore ultrasonic cutter ringing)

## ADC XLM III imp

BSR Limited, Powke Lane, Cradley Heath, Warley, West Midlands B64 5QH  
Tel (0384) 65191

**BEST BUY**



Like the other 'Improved' models from ADC, the changes again relate largely to a strengthened 'full circle' mounting bracket and to 'micro machining' of the armature at the hinge point, where it was previously crimped. As most of the ADC samples showed some rotation of the cantilever, however, the micro machining does not appear to have had much beneficial effect.

Historically the *XLM* has proved to be a fine mid-priced performer, and the latest version upholds this reputation. The compliance was little changed at 25cu – a value rather more sensible than that found on the *VLM* or *QLM36* – and while arm damping is helpful it is not essential. Low to medium mass arms can be employed, with 250pF of loading giving the optimum frequency response; higher values result in premature treble rolloff. The cantilever was slightly skew or rotated, but the stylus – a low mass 1/2-chip oriented stone – was much better than those found on earlier versions, possessing an excellent polish and setting. The grind symmetry was very good, with a true swept elliptical profile of effective radii  $8 \times 18\mu\text{m}$ ; as is so often the case, the minor radius was a trifle larger than claimed.

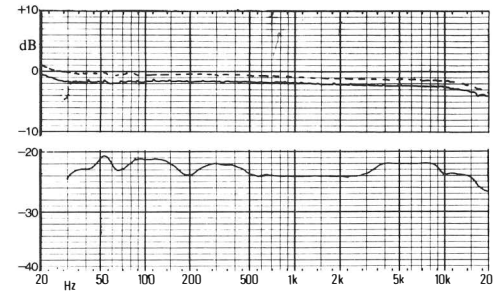
On measured performance this *XLM* was not as good as before in terms of its separation, although this result did not appear to influence the listening test results significantly. Distortion was generally good and trackability high, though the midrange intermodulation band was on the verge of distress.

The cartridge attained a 'very good' subjective rating, which is excellent for the price. The listening panel found the sound to be both neutral and free of vices. Instrumental detail was well presented, with precise frontal stereo imaging and moderate subjective depth. Tracking was fine, and although a slight coarsening was noted on the more difficult high level passages, on the whole the sound was well controlled with very little splutter and moderate surface noise.

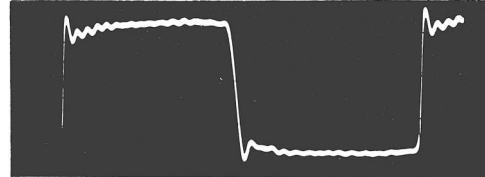
In conclusion the *XLM* retains its strong

recommendation, the design offering a well balanced performance as well as a fine stylus and good arm compatibility, all at a modest price. Slight reservations remain concerning stereo separation and cantilever stability and alignment. The *Integra III* is an integral-headshell version of the *XLM*, offering full alignment adjustment and possessing a modest 10g mass, and meriting similar recommendation.

Cartridge type/mass	induced magnet, 5.75g
Estimated dynamic compliance at 10Hz	25cu ( $\times 10^{-4}\text{cm/dyne}$ )
Specified downforce: range 0.75 to 1.5g	tested at 1.3g
LF resonance in test arm (SME 111, 6g me + cart)	+11dB at 9.4kHz
Sensitivity at 1kHz	0.85mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1.5dB
Subjective sound quality	very good
Recommended loading	47k ohms plus (150-300) 270pF
Recommended arm mass	3-10g
Recommended arm damping	moderate
Cartridge coil resistance/inductance	820 ohms, 520mH
Induced hum level	very good
Stylus type	detachable naked elliptical, spec $5 \times 18\mu\text{m}$
Finish and alignment	excellent polish/setting, slightly skew cantilever
Tip geometry	true swept elliptical, effective contact $8 \times 18\mu\text{m}$
HF resonance (tip mass/vinyl)	est 28kHz
Frequency response 30Hz-20kHz	+0.5, -2.5dB
Frequency response 100Hz-5kHz	+0.5, -0.2dB
Stereo separation, 100Hz, 1kHz, 10kHz	21dB, 24dB, 24dB
Channel difference at 1kHz, 10kHz	1.1dB, 1.0dB
Trackability 300Hz lateral $\pm 15\text{dB}$	1.2g
Trackability 300Hz vertical $\pm 12\text{dB}$	1.0g
Trackability 300Hz lateral +18dB ('Supertrack')	1.4g
Distortion 300Hz lateral +9dB	0.7%
Distortion 300Hz vertical +6dB	3.0%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	2.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.45%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.3%, 0.45%, 2.5%
Typical selling price inc VAT	£41



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

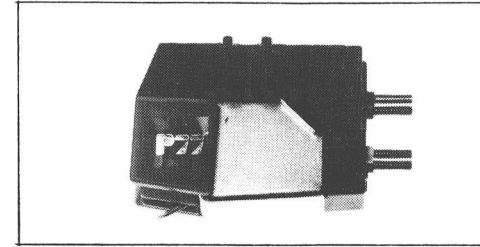


1kHz squarewave (ignore ultrasonic cutter ringing)

## A&R P77

A&R (Cambridge) Ltd., Denny End Industrial Centre, Waterbeach, Cambridge CB5 9PB  
Tel (0223) 861550

**RECOMMENDED**



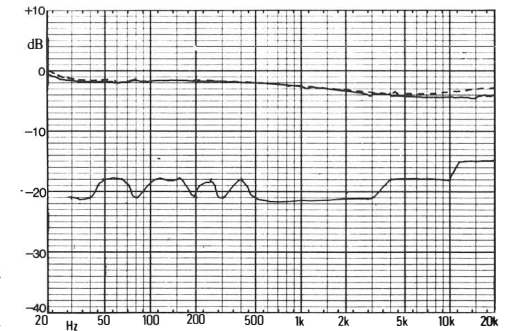
This Japanese made cartridge is one of three models specified and commissioned by A&R of Cambridge. The modest mass and equally modest compliance of 23cu, together with a marginal need for damping, should provide compatibility with a useful range of effective arm masses ranging from 3 to 12g. An unusually good 'Paroc' stylus was fitted, comprising a low mass, four-faceted line contact type, with fine shape, correct radii, excellent alignment and finish.

The frequency response was commendably flat, showing a mild droop at higher frequencies; 300-400pF loading was found to give a good result. Although uniform over the frequency range, the channel separation was nonetheless disquieting, measuring only 21dB in the midband. However distortions were well controlled, except for the mid intermodulation section where mistracking was beginning. The Supertrack itself required a 2.8g downforce, and one could expect that the '77 would occasionally be caught out on programme at the usual setting of 1.8g. The squarewave response was quite clean, with only a mild overshoot and rounding.

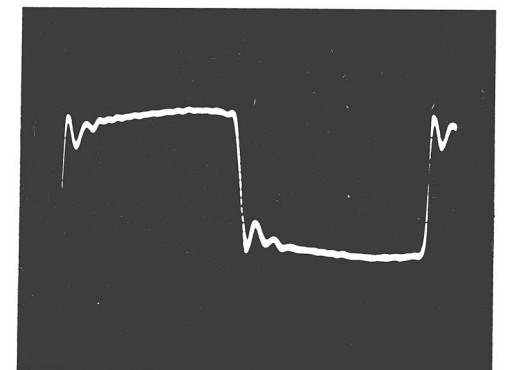
Ranked as good on overall sound quality, the '77 was described as possessing a slightly dull and smooth character. Surface noise and disc distortions were kindly handled, and the reproduction was quite detailed, but the stereo presentation was noticeably two dimensional, with depth comparatively restricted.

In conclusion this model represented quite good value, with a pleasant overall character. A well-balanced lab and subjective performance and very fine stylus tip as well as a sensible compliance and electrical matching requirement should enable it to be matched to a wide range of amplifier/turntable combinations. Examined overall, the price is favourable and this design can thus be recommended. Incidentally there were indications from the tests that the '77 was to be preferred to the more expensive '78.

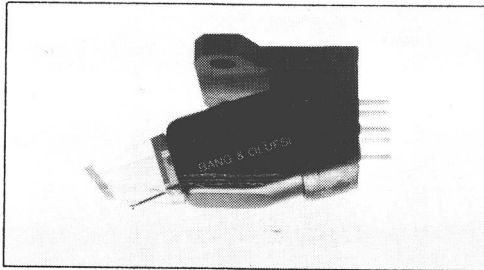
Cartridge type/mass	moving magnet, 6g
Estimated dynamic compliance at 10Hz	23cu ( $\times 10^{-4}\text{cm/dyne}$ )
Specified downforce: range 1.5g to 2.0g	tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 10Hz
Sensitivity at 1kHz	0.75mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-2.5dB
Subjective sound quality	good
Recommended loading	47k ohms plus 300-400pF
Recommended arm mass	3-12g
Recommended arm damping	optional
Induced hum level	very good
Stylus type	detachable naked oriented 'Paroc', spec $6-8 \times 50\mu\text{m}$
Finish and alignment	both excellent
Tip geometry	essentially of stereohedron form, $8 \times \text{line } \mu\text{m}$
HF resonance (tip mass/vinyl)	above 30kHz
Frequency response 30Hz-20kHz	+1, -1.5dB
Frequency response 100Hz-5kHz	$\pm 1.0\text{dB}$
Stereo separation, 100Hz, 1kHz, 10kHz	18dB, 21dB, 18dB
Channel difference at 1kHz, 10kHz	0dB, 0.7dB
Trackability 300Hz lateral $\pm 15\text{dB}$	1.5g
Trackability 300Hz vertical $\pm 12\text{dB}$	1.2g
Trackability 300Hz lateral +18dB ('Supertrack')	2.8g
Distortion 300Hz lateral +9dB	0.4%
Distortion 300Hz vertical +6dB	2.6%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	3.2%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.3%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.36%, 0.6%, 3.2%
Typical selling price inc VAT	£40



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



From a new range of four 'MMC' cartridges these models plug directly into the B & O arms of their integrated players, and are supplied with a universal fixing adaptor bracket for conventional arms. The '20E' reviewed here also has a spherically tipped brother available at a reduced cost, and as with all B & O designs, the complete body unit must be exchanged for stylus replacement. A medium compliance model, the '20E' would be suitable for medium mass arms around the 10g mark, and as some cantilever damping is provided, arm damping becomes optional.

Output was at the nominal 1mV/cm/sec level, with fair but consistent channel balance and very good channel separation. The response showed a gentle fall in the higher frequency range but without any peak to disturb the subjective balance; overall, the response was wide, with the well-controlled and even characteristic confirmed by good squarewave results. In general trackability was fine although the 10kHz pulsed distortion seemed a trifle high. Tip mass proved to be quite low for this class of cartridge.

Ranked as above average in the 'good' class, the sound quality was considered a little dull although 'open' enough to give good rendition of detail. Stereo image precision and depth were also fine, although occasionally some surface noise and disc distortion intruded, and complex passages resulted in a degree of added hardness and coarseness. A trace of 'sheen' was also apparent on strings, but sibilants were traced quite well.

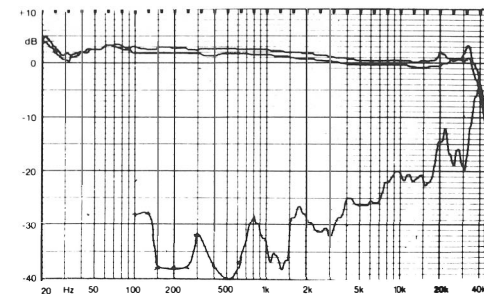
The shank-mounted diamond was of very good quality, with well formed radii to specification, a sensible 55° cone angle, and fine alignment and polish. The quality of this diamond was far superior to that found in the last issue for a previous equivalent B & O cartridge sample.

The MMC 20E was realistically priced in view of its overall performance. The stylus was of good

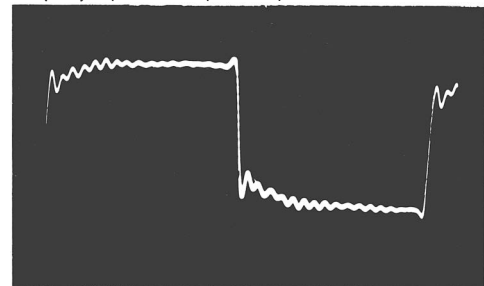
quality, and the lower than average compliance allows the use of medium mass arms. This design is therefore worthy of recommendation, but a tighter channel balance on future production would be welcome.

**GENERAL DATA**

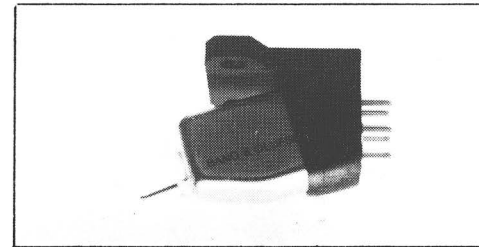
Cartridge type and mass	Induced magnet micro cross, 5.5g
Estimated dynamic compliance at 10Hz	18cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce: range-g to 1.5g	tested at 1.5g
LF resonance in test arm (SME 111, 6g me + cart)	+11dB at 10.6Hz
Sensitivity at 1kHz	1mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	0dB
Subjective sound quality	above average
Recommended loading	47k ohms plus 150 to 300pF
Recommended arm mass and damping	5 to 14g, moderate
Cartridge coil resistance/inductance	700ohms, nom 200mH at 1kHz
Induced hum level	Very good
Stylus type and spec	replaceable body, shank mounted elliptical, 5 × 15µm
Finish and alignment	Very good, very good
Tip geometry	6 × 18µm
HF resonance (tip mass/vinyl)	22kHz
Frequency response 20Hz-20kHz	+2.5, -2.5dB
Frequency response 100Hz-5kHz	+0.5, -2dB
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 33dB, 20dB
Channel difference at 1kHz, 10kHz	1.1dB, 1.0dB
Trackability 300Hz lateral + 15dB, + 18dB ('Supertrack')	0.8g, 1.1g
Trackability 300Hz vertical + 12dB	0.8g
Distortion 300Hz lateral + 9dB	0.5%
Distortion 300Hz vertical + 6dB	2.7%
High frequency waveform quality	Good
Mid band intermodulation (1kHz + 1.5kHz)	3.3%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	0.6%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	2%, 5.5%, 8%
Typical selling price inc VAT	£28
Stylus replacement cost inc VAT	£25



Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec).



1kHz squarewave.



At a 30% premium over the '20E', the 'EN' is equipped with a naked elliptical stylus of reduced tip mass, together with a perhaps less welcome increase in compliance; a low mass arm is thus essential for the best results. As with all the B & O models, easy cueing was facilitated by the 'exposed' stylus in its transparent stylus guard. The cartridge appeared to be quite tolerant of electrical loading, giving an output only fractionally below the nominal level. The 'EN' came complete with accessories, calibration and 1/2-inch adaptor bracket, but 'replacements' are less lavishly presented in economy bubble packs, and lack any documentation.

The response curve showed a strong similarity to that of the '20E', with the same 2dB presence droop, but a greater ultrasonic extension, albeit with a mild hump around 20kHz. Channel balance was very good, and separation excellent, particularly from 100Hz-7kHz, where it was generally in excess of 35dB. Trackability was fine, although strangely enough a little inferior to the lower compliance '20E', and excepting an only 'fair' result on the 300Hz lateral band, all measured distortions were under control.

Ranked as 'good' on sound quality this was a fine result in view of the below average price. Considered a significant improvement over the '20E', the stereo imaging showed good precision and depth, but while detail was well conveyed, the frequency balance was slightly flat and 'distant', due primarily to the mild presence recess. A touch of mild sibilance and surface noise effects were also apparent on occasion, but generally speaking disc distortion sounded low, with a clean rendition of the programme. The treble range was liked despite the mild HF lift.

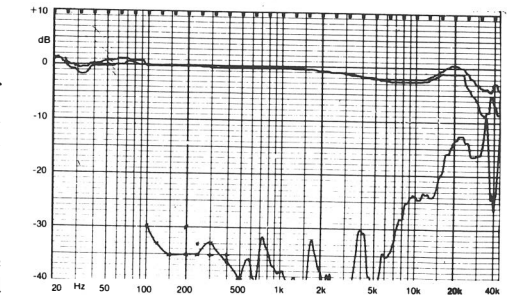
The stylus fitted was a low mass 150µm square shaft stone with well shaped radii to specification and with a 55° cone angle. The polish and alignment were good, although not quite up to the 20E

standard in these respects.

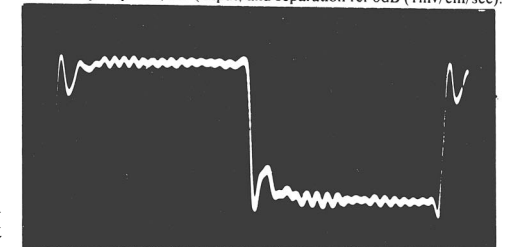
On subjective grounds alone the MMC 20EN would qualify for a recommendation at the price, and the fine overall standard of technical performance and stylus quality only serve to reinforce this decision. Note that a low mass arm must be used for the best results.

**GENERAL DATA**

Cartridge type and mass	Induced Magnet 'micro cross', 5.5g
Estimated dynamic compliance at 10Hz	26cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce: range-g to 1.2g	tested at 1.2g
LF resonance in test arm (SME 111, 6g me + cart)	+11.5dB at 9Hz
Sensitivity at 1kHz	0.88mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1.2dB
Subjective sound quality	good
Recommended loading	47k ohms plus 150 to 300pF
Recommended arm mass and damping	3 to 8g, moderate
Cartridge coil resistance/inductance	700 ohms nom 200mH at 1kHz
Induced hum level	Very good
Stylus type and spec	replaceable body, naked elliptical, 5 × 17µm
Finish and alignment	good, good
Tip geometry	6 × 20µm
HF resonance (tip mass/vinyl)	indicated at 38kHz
Frequency response 20Hz-20kHz	+1, -2dB
Frequency response 100Hz-5kHz	+0, -2dB
Stereo separation, 100Hz, 1kHz, 10kHz	30dB, 38dB, 22dB
Channel difference at 1kHz, 10kHz	0.1dB, 0.6dB
Trackability 300Hz lateral + 15dB, + 18dB ('Supertrack')	0.7g, 1.25g
Trackability 300Hz vertical + 12dB	0.9g
Distortion 300Hz lateral + 9dB	0.7%
Distortion 300Hz vertical + 6dB	2%
High frequency waveform quality	Good
Mid band intermodulation (1kHz + 1.5kHz)	4%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	0.5%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	3.3%, 6.5%, 9%
Typical selling price inc VAT	£38
Stylus replacement cost inc VAT	£30



Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec).



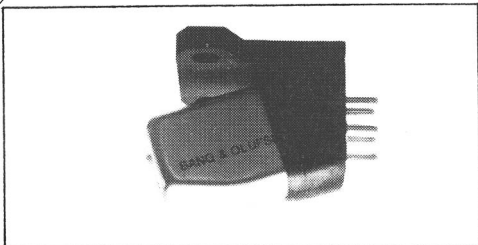
1kHz squarewave, note ultrasonic cutter 'ringing'



RECOMMENDED

## B & O MMC 20CL (extensively re-assessed)

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



B & O's *MMC20CL* represents their most costly cartridge to date, and for the present will only be supplied in fully calibrated form. The implication is that the need for a new 'CL' stylus will mean a completely new cartridge. A lowish mass arm perhaps with a little damping is to be preferred in view of the measured compliance of 26cu. Incidentally those B & O users who have the earlier grey universal mounting bracket should note that the newer black one, made of stronger moulded material, has also been improved in other respects, notably by giving a tighter fit (although still not tight enough we feel!)

The specified downforce was rather lower than average and the results to some degree will reflect this — for example, it is to be expected that the noise intermod distortion will be somewhat increased; despite this the overall results were good and highly consistent throughout the frequency range. The response was marginally more uniform than for the 'EN' with a better maintained presence band, and a surprisingly uniform extension to 45kHz. Stereo separation was outstanding, typically 35dB from 150Hz-6kHz, and still 20dB at 20kHz. Trackability was very good, and the squarewave photo showed a fine result

The 'CL' proved to be easy on the ear, apparently minimising subjective disc noise and distortions. Sibilants were accurately reproduced, the sound was highly neutral if slightly 'distant', and the stereo imaging was stable, wide and presented with very good depth. The treble range was considered notably 'transparent', with the usual traces of 'grit' and 'sizzle' virtually absent, while showing more temperature dependence than we would have liked.

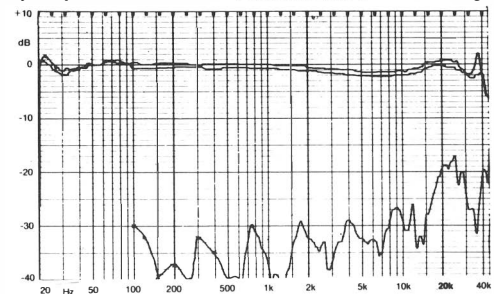
The stylus consultant noted a very well shaped naked line/elliptical stone on a 200µm square rod stock, with correct 50° cone angle and a very good polish and setting.

The *MMC20CL* represents a high class cartridge

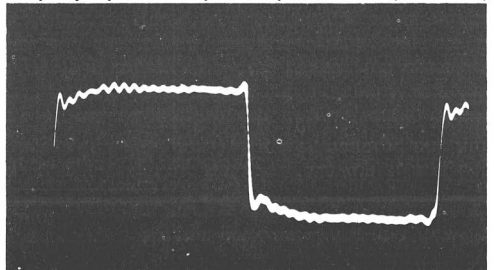
at a realistic price and is thus recommended. Some of the credit must go to B & O's own form of line stylus, which does not appear to suffer from some of the ill effects noted on many other models with this type of tip, and also presumably the new single crystal sapphire cantilever.

### GENERAL DATA

Cartridge type and mass	Induced magnet 'micro cross', 5.5g
Estimated dynamic compliance at 10Hz	23cu (X10 <sup>-8</sup> cm/dyne)
Specified downforce: range -g to 1g	tested at 1g
LF resonance in test arm (SME 111, 6g me + cart)	+11.5dB at 9Hz
Sensitivity at 1kHz	0.85mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1.5dB
Subjective sound quality	good
Recommended loading	47k ohms plus 150 to 300pF
Recommended arm mass and damping	3 to 8g, moderate
Cartridge coil resistance/inductance	700 ohms nom 200mH at 1kHz
Induced hum level	Very good
Stylus type and spec	replaceable body, naked line contact
Finish and alignment	Very good, very good
Tip geometry	7.6 X line µm
HF resonance (tip mass/vinyl)	indicated at 38kHz
Frequency response 20Hz-20kHz	+1, -1.5dB
Frequency response 100Hz-5kHz	+0, -1.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	30dB, 38dB, 29dB
Channel difference at 1kHz, 10kHz	0.8dB, 0.9dB
Trackability 300Hz lateral +15dB, +18dB ('Supertrack')	0.8g, 1.2g
Trackability 300Hz vertical +12dB	0.6g
Distortion 300Hz lateral +9dB	0.38%
Distortion 300Hz vertical +6dB	3.3%
High frequency waveform quality	Good
Mid band intermodulation (1kHz + 1.5kHz)	4%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	0.4%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	3%, 6%, 10%
Typical selling price inc VAT	£85
Stylus replacement cost inc VAT	new cartridge



Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec).

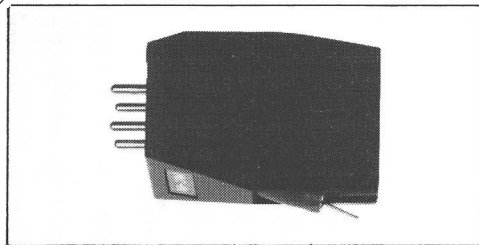


1kHz squarewave, note ultrasonic cutter 'ringing'

RECOMMENDED

## Coral MC81

Videotone, 98 Crofton Park Road, London SE4  
Tel 01-690 1914



Available at a comparatively low price due to direct importer sale (with attendant distribution limitations), the *MC81* is Coral's top line model, fitted with a line contact stylus and a special cantilever believed to be made from boron. It possessed a low output for which a special input or step up device is essential, but did not prove particularly critical of load impedance. The moderate compliance will allow low to medium mass arms to be accommodated, and damping is not really necessary except with the heaviest arm combinations. Unusually good hum immunity was demonstrated for a moving-coil device. A fine stylus was employed, namely a low mass stone, well fitted and of excellent polish. It provided a line contact from a well formed Shibata grind, if perhaps a touch 'deep' in terms of groove fit.

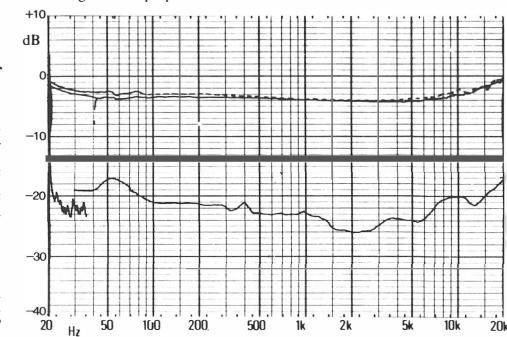
The ubiquitous mid suckout was well controlled but the high frequency range rose gradually by an average of +3.5dB at 20kHz. However the supersonic resonance was well-damped as the squarewave photo and clean high frequency separation shows, and while the separation was poorer than the specified 30dB midband, a second sample gave an improvement to 33dB. The design exhibited reasonable trackability, requiring 2.8g for the 'Supertrack', and although the intermodulation bands at a 2g downforce mistracked, this was not too severe. Vertical modulation distortion was low, but lateral distortion was higher than average.

Rated at a promising 'good' on the listening tests, the brightish treble balance did not go unnoticed by the panel, who described a corresponding change in tonal quality. Bass was firm, the stereo presentation stable and to a good standard, while much musical detail was in evidence.

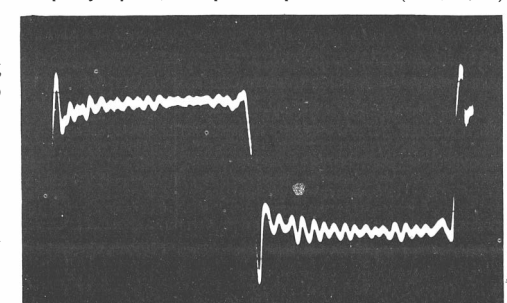
This cartridge clearly possessed good characteristics and could well suit some systems with an appropriate compensatory 'rich' speaker balance. In moving-coil terms it offers quite good value, although the extra for a step up device may need to be considered. It is usefully uncritical of matching

tonearms, and could partner many detachable headshell models.

Cartridge type/mass	low output moving coil, 5g
Estimated dynamic compliance at 10Hz	17cu (X10 <sup>-8</sup> cm/dyne)
Specified downforce: range 1.8g to 2.3g	tested at 2.0g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 11.5Hz
Sensitivity at 1kHz	(0.045mV alone) 0.9mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(alone -25dB) -1dB*
Subjective sound quality	good
Recommended loading	30-100 ohms plus uncritical pF
Recommended arm mass	6-12g
Recommended arm damping	moderate could be helpful
Cartridge coil resistance/inductance	6 ohms, -mH
Induced hum level	very good
Stylus type	fixed, naked, line
Finish and alignment	excellent, very good
Tip geometry	shibata, extended point, 8 X line µm
HF resonance (tip mass/vinyl)	estimated at 40kHz
Frequency response 30Hz-20kHz	-0.5, +3.5dB
Frequency response 100Hz-5kHz	±0.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	21dB, 23/33 2nd sample/DB
Channel difference at 1kHz, 10kHz	0dB, 0.8dB
Trackability 300Hz lateral ±15dB	1.7g
Trackability 300Hz vertical ±12dB	1.2g
Trackability 300Hz lateral +18dB ('Supertrack')	2.8g
Distortion 300Hz lateral +9dB	0.6%
Distortion 300Hz vertical +6dB	1.5%
High frequency waveform quality	fair
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	2.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.5%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.4%, 0.8%, 2.0%
Typical selling price inc VAT	£50
*assuming 26dB step up	



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

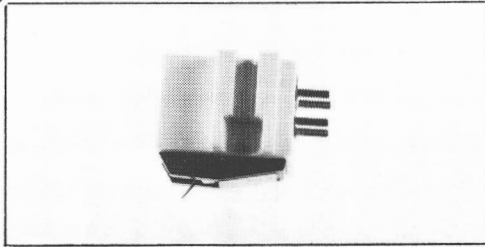


1kHz squarewave (ignore ultrasonic cutter ringing)

RECOMMENDED

## Denon 303

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



The 303 is a notable member of a new and costly group of moving-coil cartridges. A relatively low mass model at 5.8g, it has unnecessarily high compliance of 44cu, resulting in a recommendation for use with low mass damped arms only.

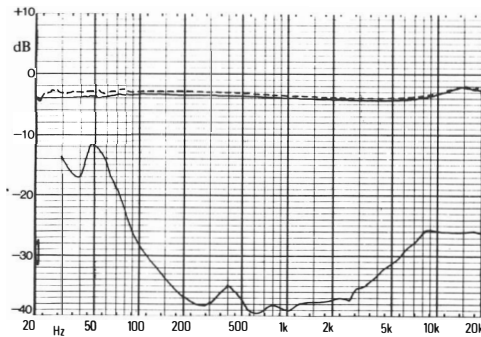
However it did produce a healthy output for a moving-coil, though still requiring a step up device, while hum rejection was not particularly good. Tested at the recommended downforce – rather low for a m-c design – it provided exceptional trackability and distortion results on all tests, while the frequency response was virtually flat with excellent channel balance and fine geometric symmetry. The HF resonance was well out of band at 40kHz, allowing harmless display of the recorded cutter ringing on the good squarewave response. The special stylus turned out to be an excellently finished and well-mounted 1/2-chip oriented stone with well-swept radii of line contact form.

On sound quality it just achieved the 'very good' category, and was liked for its exceptional stereo imaging and tracking ability, while both surface noise and distortion were kindly handled. Most panelists agreed on its virtues, but for reasons not entirely understood and possibly to do with the high compliance in combination with our test arm, they did express mild reservations concerning a touch of 'vagueness' and occasional lack of firmness and definition, coupled with a tonal balance which seemed a trifle recessed in the lower treble, but slightly forward higher up.

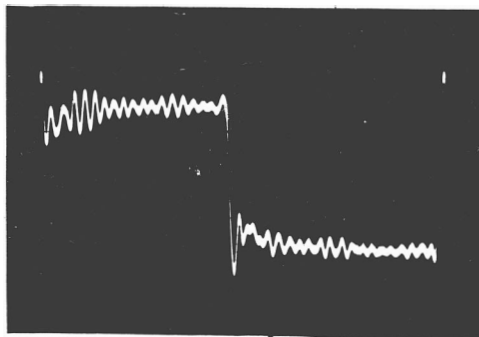
This good but costly cartridge was fussy about the choice of arm, needs a higher than average step-up impedance, and when all is said and done cannot be regarded as very good value. It will however be kind to your record collection, and does set a generally high performance standard.

Cartridge type/mass	low output moving coil, 5.8g
Estimated dynamic compliance at 10Hz	44cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.0g to 1.4g	tested at 1.3g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 7.6Hz
Sensitivity at 1kHz	(0.064mV alone) 1.3mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(-24dB alone) +2dB*
Subjective sound quality	very good
Recommended loading	100-150 ohms plus uncritical pF
Recommended arm mass	less than 5g
Recommended arm damping	moderate damping essential
Cartridge coil resistance/inductance	40 ohms, negligible mH
Induced hum level	fairly good
Stylus type	fixed, naked, oriented special elliptical line
Finish and alignment	excellent finish, fine alignment
Tip geometry	properly swept radii line contact, $8 \times$ line um
HF resonance (tip mass/vinyl)	+8dB at 40kHz
Frequency response 30Hz-20kHz	-0.5, +1.5dB
Frequency response 100Hz-5kHz	$\pm 0.5$ dB
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 39dB, 26dB
Channel difference at 1kHz, 10kHz	0.3dB, 0.2dB
Trackability 300Hz lateral $\pm 15$ dB	0.85g
Trackability 300Hz vertical $\pm 12$ dB	0.6g
Trackability 300Hz lateral +18dB ('Supertrack')	1.2g
Distortion 300Hz lateral +9dB	0.25%
Distortion 300Hz vertical +6dB	1.45%
High frequency waveform quality	fair
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.4%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.15%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.4%, 0.8%, 1.5%
Typical selling price inc VAT	£170

\*assuming 26dB step up



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

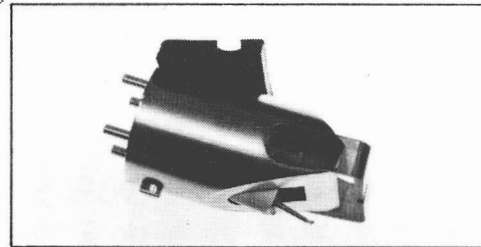


1kHz squarewave (ignore ultrasonic cutter ringing)

RECOMMENDED

## Dynavector 20A II

Dynavector Systems UK Ltd., 52 Park Rd, Kingston KT2 6AU. Tel 01-546 1434



Replacement for the famous 20A, this mark two version sports a lower mass reinforced plastic body with an elliptical rather than Shibata tip. Output has been increased to a remarkable (for a moving-coil) 0.9mV, and no matching problems should occur with any preamplifier. Compliance is however high, and although damping is not required, low to medium mass arms are, 10g being the ideal maximum. The naked diamond stylus was well polished and aligned, possessing a pseudo-elliptical grind but with sufficient over-polishing to provide blended elliptical radii of  $8 \times 20$ um.

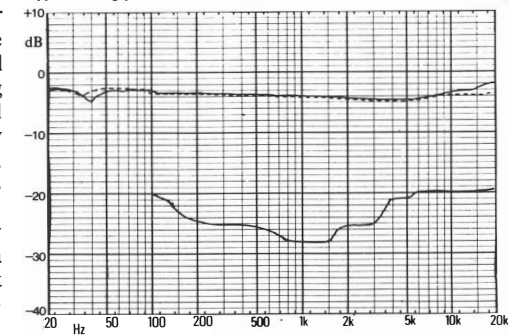
The well-damped overshoot and flat-topped squarewave confirmed the good transient behaviour and essentially flat frequency response (ignore the cutter ringing). Separation was fairly good and channel balance fine, while at close to the test 1.8g downforce it tracked almost everything bar the mid intermodulation section, which was significantly broken up. The distortion results were also good, with the exception of the lateral value which was high at 1%.

A commendable 'very good' was achieved by this cartridge after all the panel's listening test data had been analysed. Sounding almost as flat as it had measured, the reproduction was well integrated. Generally quite stable, the stereo presentation was precise with reasonable depth, and the sound was generally transparent with a good presentation of detail. Occasionally a slight sharpness was evident – on strings for example – but it proved quite kind to surface noise and disc distortion, much more so than its predecessor. Only very rarely was it caught out on tracking.

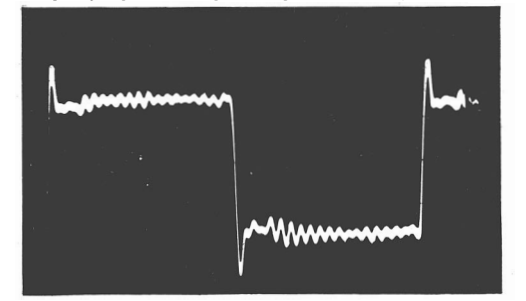
The 20AII is sufficiently advanced over the original 20A to maintain its market position, despite the higher standards dictated by the improved level of performance of the new generation of cartridges. A versatile moving-coil design, it merits recommendation and should work well with many systems, without the added complication of a high gain input or head amplifier. Incidentally the

20BII is similar but fitted with a beryllium cantilever, and in our listening tests it ranked a little below the 20AII.

Cartridge type/mass	high output moving coil, 5.3g
Estimated dynamic compliance at 10Hz	27cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.6g to 2.3g	tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart)	+7dB at 9.5Hz
Sensitivity at 1kHz	0.9mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1dB
Subjective sound quality	very good
Recommended loading	47k ohms plus uncritical pF
Recommended arm mass	4-10g
Recommended arm damping	not needed
Cartridge coil resistance/inductance	510 ohms, 1mH
Induced hum level	very good
Stylus type	fixed, naked, oriented, elliptical, spec $8 \times 18$ um
Finish and alignment	both very good
Tip geometry	blended pseudo-elliptical, effective contact $8 \times 20$ um
HF resonance (tip mass/vinyl)	approx +3dB at 28kHz
Frequency response 30Hz-20kHz	$\pm 1.0$ dB
Frequency response 100Hz-5kHz	$\pm 0.6$ dB
Stereo separation, 100Hz, 1kHz, 10kHz	20dB, 26dB, 20dB
Channel difference at 1kHz, 10kHz	0.3dB, 0.2dB
Trackability 300Hz lateral $\pm 15$ dB	1.6g
Trackability 300Hz vertical $\pm 12$ dB	1.2g
Trackability 300Hz lateral +18dB ('Supertrack')	2.0g
Distortion 300Hz lateral +9dB	1.0%
Distortion 300Hz vertical +6dB	2.0%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	4%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.25%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.35%, 0.5%, 2.6%
Typical selling price inc VAT	£84



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

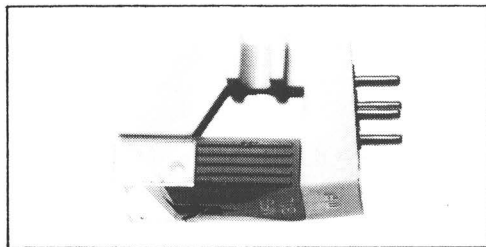


1kHz squarewave (ignore ultrasonic cutter ringing)

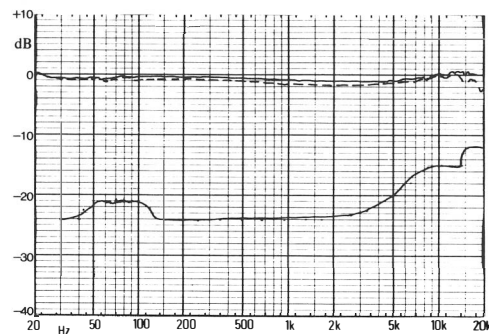
## Glanz MFG 31L

Profi, 8 Harford Street, Norwich  
Tel (0603) 616221

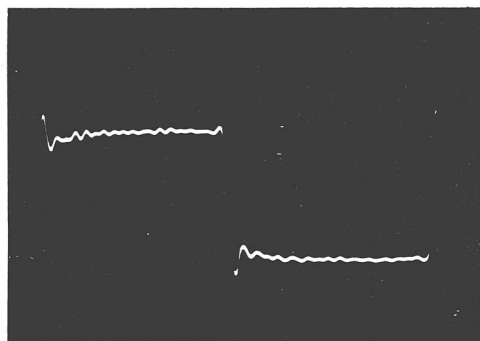
RECOMMENDED



Cartridge type/mass	..... moving magnet, 5.5g
Estimated dynamic compliance at 10Hz	..... 35cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.25g to 1.75g	..... tested at 1.5g
LF resonance in test arm (SME 111, 6g me + cart)	..... +10.5dB at 8.2Hz
Sensitivity at 1kHz	..... 0.85mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	..... -1.4dB
Subjective sound quality	..... above average
Recommended loading	..... 47k ohms plus 50-200pF
Recommended arm mass	..... 4-6g
Recommended arm damping	..... moderate
Cartridge coil resistance/inductance	..... 1.4k ohms, 120mH
Induced hum level	..... fairly good
Stylus type	..... detachable naked 'line'
Finish and alignment	..... both good
Tip geometry	..... well-shaped Shibata, contact $8 \times$ line um
HF resonance (tip mass/vinyl)	..... -2dB at 28kHz
Frequency response 30Hz-20kHz	..... +1, -1.5dB
Frequency response 100Hz-5kHz	..... 0.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	..... 21dB, 24dB, 15dB
Channel difference at 1kHz, 10kHz	..... 0.8dB, 0.2dB
Trackability 300Hz lateral $\pm 15$ dB	..... 1.25g
Trackability 300Hz vertical $\pm 12$ dB	..... 0.7g
Trackability 300Hz lateral +18dB ('Supertrack')	..... 1.5g
Distortion 300Hz lateral +9dB	..... 0.22%
Distortion 300Hz vertical +6dB	..... 3%
High frequency waveform quality	..... good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	..... 1.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	..... 0.5%, 1.2%, 2.5%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	..... 1.5%, 3.4%, 7.5%
Typical selling price inc VAT	..... £33



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Low mass arms are the best choice for use with this medium price design, considering its rather high compliance, but damping is not strictly necessary except where the heaviest arms are concerned. As with the *MFG71E*, the load impedance was uncritical, but hum rejection was not particularly good. This model was fitted with a good quality Shibata tip (it is also available with an elliptical tip as the *31E*). The stylus consultant commented that the cone angle of the tip was larger than usual at  $58^\circ$ , which in conjunction with the Shibata grind, allowed the radii to be more extensively swept than usual giving an improved line contact area.

As noted with the *71*, the measured frequency response was very uniform with generally good balance. Taken from the second sample tried, the separation was only fair, with the first failing the manufacturer's own spec. at 23dB, 1kHz. Vertical tracking angle was also rather high at an estimated  $35^\circ$ . In general trackability was good with 'Supertrack' passed at the test downforce, but the high frequency intermodulation results were unsatisfactory. Confirming the uniform frequency response, the squarewave illustrated a clean characteristic, with marginal overshoot or aberration.

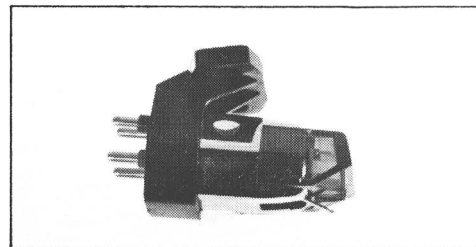
Ranked above average on the listening tests - a fair result at the price - the panel noted a pleasant with marginal overshoot of aberration. and neutral balance. However there was an occasional indication of tracking problems and accentuated surface noise, though the general impression was of a 'blandness' which appeared to dull transients. The midrange also sounded slightly muddy and rich, lacking real definition, while the stereo presentation seemed overwide and lacking in depth.

The *31L* is *in toto* a reasonably priced and well-balanced performer, with its major weakness undoubtedly its stereo separation. Uncritical of electrical loading, low mass arms are to be preferred.

## Goldring G900 IGC

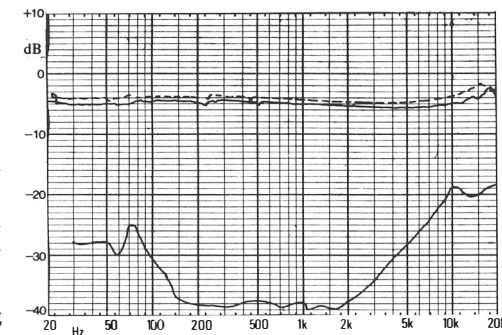
Goldring Products Ltd., Anglian Lane, Bury St Edmunds, IP32 6SS  
Tel (0284) 64011

RECOMMENDED

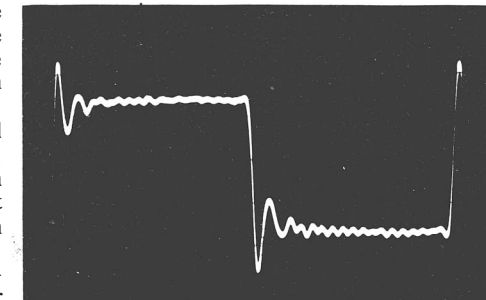


*IGC* is capable of good results, and can be recommended with some reservations at the price.

Cartridge type/mass	..... moving magnet, 4g
Estimated dynamic compliance at 10Hz	..... 42cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 0.75g to 1.5g	..... tested at 1.25g
LF resonance in test arm (SME 111, 6g me + cart)	..... +15dB at 7.8Hz
Sensitivity at 1kHz	..... 0.56mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	..... -4.5dB
Subjective sound quality	..... good
Recommended loading	..... 47k ohms plus (80-160) 120pF
Recommended arm mass	..... 3-6g
Recommended arm damping	..... yes, moderate
Cartridge coil resistance/inductance	..... 700 ohms, 570mH
Induced hum level	..... good
Stylus type	..... detachable naked line, spec $4.5 \times 80$ um
Finish and alignment	..... very good, good
Tip geometry	..... well formed pure line contact, $7 \times$ line um
HF resonance (tip mass/vinyl)	..... -2.25kHz
Frequency response 30Hz-20kHz	..... -0.5, +3dB
Frequency response 100Hz-5kHz	..... $\pm 0.6$ dB
Stereo separation, 100Hz, 1kHz, 10kHz	..... 31dB, 38dB, 14dB
Channel difference at 1kHz, 10kHz	..... 0.8dB, 1.0dB
Trackability 300Hz lateral $\pm 15$ dB	..... 0.75g
Trackability 300Hz vertical $\pm 12$ dB	..... 0.6g
Trackability 300Hz lateral +18dB ('Supertrack')	..... 1.0g
Distortion 300Hz lateral +9dB	..... 0.22%
Distortion 300Hz vertical +6dB	..... 2.2%
High frequency waveform quality	..... good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	..... 3.2%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	..... 0.7%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	..... 0.5%, 0.7%, 1.8%
Typical selling price inc VAT	..... £60



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Developed from the *G900SEII*, the *IGC* carries a special true line contact stylus designed by A. Van den Hul of Holland. A low body mass model, the compliance was excessively high at 42cu and requires a low mass arm with damping, as well as a low load capacitance of around 120pF. The latter is in fact difficult to realise with many current turntable/amplifier combinations. The stylus examination revealed a top class stone of true extended line contact profile, though with a minor contact radius broader than claimed. The grind was not perfectly symmetrical, but it exhibited good mounting and alignment.

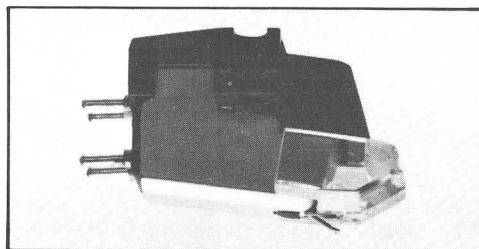
The frequency response was notably flat in the midrange, rising to +3dB towards the tip resonance beyond 25kHz. The exceptional midband separation degraded to a just satisfactory 14dB towards the high frequency range, and while the basic trackability was quite good (1.0g sufficed for the 'Supertrack'), the intermodulation sections were poorly handled at 1.25g, despite the high compliance. A notable strength was the very clean result on the pink noise high frequency tracks, attributable to the refined stylus tip.

Rated at a promising 'good' on the listening tests, two main areas were criticised. At times the stereo image was well developed with promising depth, but phases of insecurity and vagueness were also apparent, possibly due to the excessive compliance, while complex midband sections were subject to slight coarsening. Conversely the high frequency range, though a trifle light even 'brittle', was noticeably transparent, with the general character open and detailed.

One sample tried showed a tendency to bottom on the record surface, a problem which is not unknown with '900 series Goldrings. The high compliance proved to be a handicap, but a *Discracker* or similar device could help to stabilise matters. Provided that the purchaser can offer the right electrical loading and arm matching, the

(revised and reprinted) **JVC Z2E**

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



This cartridge's predecessor, the Z-1, was tested in the first issue and produced a competent if undistinguished performance using a Shibata tip optimised for CD4. In contrast the Z-2E has been directed at stereo listeners, and uses an elliptical tip which is fitted to a low mass alloy cantilever; a single-point tensioned suspension has been used to closely define the vibrational axis. A moving magnet design, the element was of samarium-cobalt with laminated generator poles.

Lab testing revealed a well designed cartridge, and although tested at 1.8g (the mean of the manufacturer's recommended range), it showed such a tracking margin that the lower limit of 1.5g could safely be adopted. The frequency response was wide and quite uniform, rising slightly on 100pf to +1dB at 28kHz, which indicates the tip mass resonance. Channel balance was good, separation excellent throughout the range, and distortion levels were well ordered and at the lower limit defined by the test records. The high frequency waveform was clean and the fine squarewave taken with 100pf loading reflected this overall characteristic; with 150-200pf the overshoot practically disappeared.

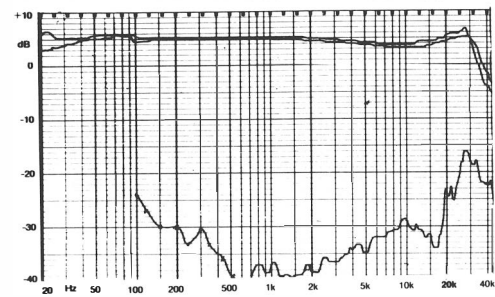
Listening tests ranked the Z-2E as 'very good' overall an excellent result for the price. Stereo presentation was fine with good depth rendition and the overall sound was neutral and clear, with quiet surfaces and little distortion. A hint of edge and hardness was noted on the occasional heavy complex passages, while strings could sound a little 'sharp'.

The stylus report noted a low mass naked elliptical diamond ground from 200µm square rod, with very well-shaped 6 × 18µm radii, the former a bit smaller than specified. Alignment and polish were both good, and the cone angle was a satisfactory 50°.

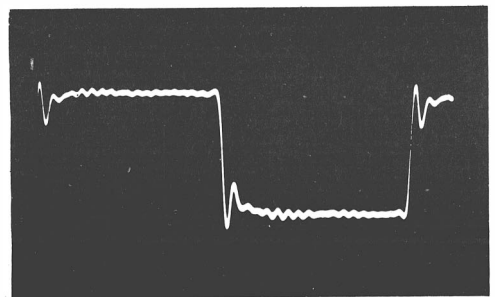
It is apparent that the Z-2E was a fine all rounder, and as such certainly deserves recommen-

dation. A low mass damped arm is however required to exploit it to the full and produce its top class imaging, neutral balance, and very good tracking at a 1.5g downforce.

Cartridge type and mass	..... Moving magnet, 5.5g
Estimated dynamic compliance at 10Hz	..... 25cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce: range 1.5g to 2.0g	..... tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart)	..... +13 at 9.6Hz
Sensitivity at 1kHz	..... 1.65mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	..... +4dB
Subjective sound quality	..... Very good
Recommended loading	..... 47K ohms plus 200pf
Recommended arm mass and damping	..... 4 to 8g, moderate
Cartridge coil resistance/inductance	..... 510ohms, approx 350mH
Induced hum level	..... Very good
Stylus type and spec	..... detach, naked elliptical, 8 × 18µm
Finish and alignment	..... Both good
Tip geometry	..... 6 × 18µm
HF resonance (tip mass/vinyl)	..... estimated at 28kHz
Frequency response 20Hz-20kHz	..... ±1.5dB
Frequency response 100Hz-5kHz	..... +0, -1dB
Stereo separation, 100Hz, 1kHz, 10kHz	..... 24dB, 37dB, 29dB
Channel difference at 1kHz, 10kHz	..... 0.3dB, 0.6dB
Trackability 300Hz lateral +15dB, +18dB ('Supertrack')	..... 0.9g, 1.3g
Trackability 300Hz vertical +12dB	..... 0.65g
Distortion 300Hz lateral +9dB	..... 0.3%
Distortion 300Hz vertical +6dB	..... 2.9%
High frequency waveform quality	..... Good
Mid band intermodulation (1kHz + 1.5kHz)	..... 3.2%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	..... 0.25%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	..... 2.5%, 4%, 8%
Typical selling price inc VAT	..... £44
Stylus replacement cost inc VAT	..... est £28



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



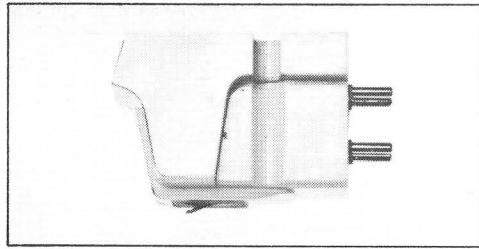
1kHz squarewave (ignore ultrasonic cutter ringing)

**BEST BUY**

**RECOMMENDED**

**JVC MCI**

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



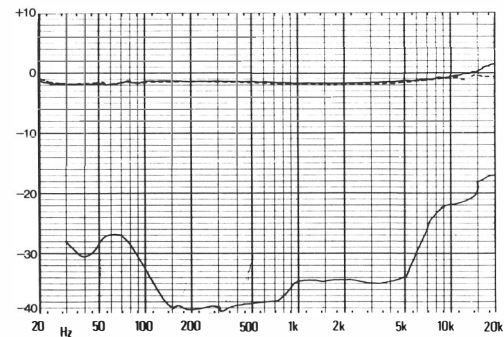
This very costly cartridge appears to have overcome the problems which beset the MC2E. A low output model with 'microchip' coils, it does not require damping, but needs a fairly low mass arm, and a low noise step up or input with 100 ohms or more of impedance. Quoted as a 'line', the excellent well-mounted stylus was of Shibata grind, with good symmetry and pretty good alignment.

The tip mass resonance at 28kHz was well-damped, as the signal overshoot on the squarewave showed, while the frequency response was exceptionally flat bar a 2-3dB rise at 20kHz. Separation was also very good and excellently maintained over the whole band, while the channel balance held to 0.1dB to 10kHz. It proved to be a good tracker, ably handling all bands at its 1.6g downforce, while distortions were also well controlled at all frequencies.

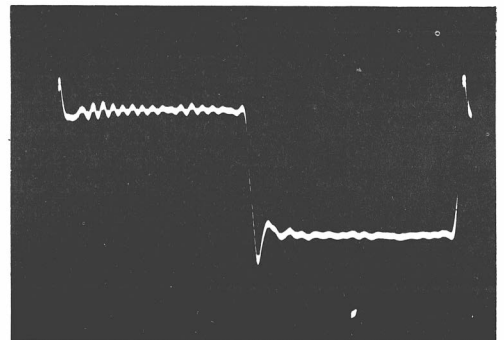
Rated in the top group on sound quality, and thus justifying its price, the MCI was ranked highly on image quality and depth as well as neutrality of balance, clarity and liveliness. Very slight edginess was occasionally present together with a trace of extra surface noise; a more refined stylus might provide an additional improvement here.

The MCI succeeds, albeit at a price, where the MC2E fails. This JVC moving-coil is a genuine 'superclass' model, offering a very well balanced technical performance coupled with excellent subjective quality, and in the right arm it can hardly fail to please.

Cartridge type/mass	..... low output moving-coil, 8.7g
Estimated dynamic compliance at 10Hz	..... 22cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce: range 1.3g to 1.65g	..... tested at 1.6g
LF resonance in test arm (SME 111, 6g me + cart)	..... +9dB at 9Hz
Sensitivity at 1kHz	..... (0.075mV alone) 0.75mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	..... (-22.2dB) -2.2dB*
Subjective sound quality	..... excellent
Recommended loading	..... 100 ohms plus not critical pF
Recommended arm mass	..... 3-8g
Recommended arm damping	..... not essential, could be helpful
Cartridge coil resistance/inductance	..... 30 ohms, negligible mH
Induced hum level	..... very good
Stylus type	..... fixed naked, Shibata 'line'
Finish and alignment	..... very good, good
Tip geometry	..... Shibata grind of good symmetry, contact 8 × line um
HF resonance (tip mass/vinyl)	..... +4dB at 28kHz
Frequency response 30Hz-20kHz	..... -0, +3dB
Frequency response 100Hz-5kHz	..... ±0.2dB
Stereo separation, 100Hz, 1kHz, 10kHz	..... 32dB, 34dB, 22dB
Channel difference at 1kHz, 10kHz	..... 0.1dB, 0.1dB
Trackability 300Hz lateral ±15dB	..... 1.3g
Trackability 300Hz vertical ±12dB	..... 0.9g
Trackability 300Hz lateral +18dB ('Supertrack')	..... 1.6g
Distortion 300Hz lateral +9dB	..... 0.3%
Distortion 300Hz vertical +6dB	..... 1.5%
High frequency waveform quality	..... fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	..... 1.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	..... 0.3%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	..... 0.5%, 1%, 2.8%
Typical selling price inc VAT	..... £190
*+20dB step up	



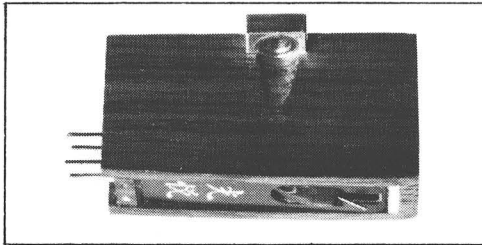
Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

## Koetsu

Absolute Sounds, 42 Parkside, London, SW19  
Tel 01-947 5047



Costing around £500, this wood-bodied cartridge proved to be a thorn in our flesh. For while it could often give a superb subjective performance, it was also possessed of certain problems, and the mix made review judgment a nightmare. Tested at a 2g downforce and producing a comparatively healthy hum-free output, it possessed a very low compliance and required surprisingly heavy arms of up to 30g, despite its own rather high body mass. Damping was not strictly necessary but could be helpful in moderation. A tiny high quality multi-faceted line contact stylus was fitted to the boron-deposited alloy cantilever, and while the wide bandwidth (50kHz+) clearly revealed the harmless disc cutter ringing on squarewave plots, the tip mass resonance was obviously well controlled.

With a gentle 1dB presence droop and a mild 3dB rise towards 20kHz, the response was fairly uniform, but the separation was phenomenal, with remarkable generator symmetry and orthogonality in all planes. In practice this design was quite a good tracker, despite the 3.5g needed for the 'Supertrack', since the more musically important mid and high frequency intermodulations were correctly handled at 2g, and the noise intermodulation was also particularly good.

Rated excellent on sound quality the Koetsu was judged as slightly dull in balance. Its midrange definition, solidity, depth and transient clarity were quite exceptionally good and the bass was extended in addition to being well differentiated if a little 'full'. The treble was also free of vices and had outstanding stereo accuracy. Although it was occasionally caught out on the highest level tracks, the mistracking was hardly noticeable.

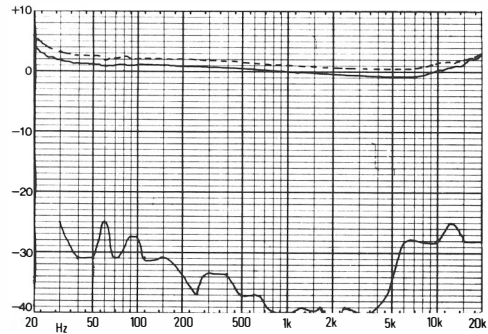
Personally I could not justify the expenditure much as I would like to own a Koetsu. Its 'rich' character makes audition with a specific system important, but those with well-lined pockets and experienced ears might find this cartridge difficult to resist.

Tests on a more recent sample showed a slightly

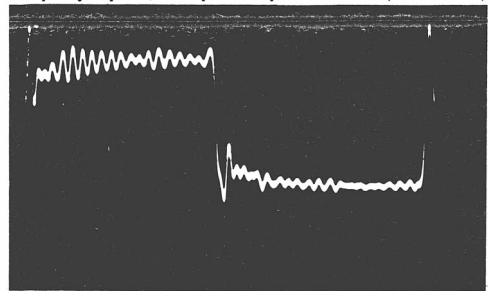
reduced separation (25, 35, 20) and increased compliance (12cu), though the sound quality showed little change.

Cartridge type/mass	medium output moving coil, 12g
Estimated dynamic compliance at 10 Hz	8.5cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce	tested at 2.0g
LF resonance in test arm (SME 111, 6g me + cart)	+11dB at 13Hz
Sensitivity at 1kHz	(alone 0.99mV) 0.9mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(alone -21dB) -1dB*
Subjective sound quality	very good
Recommended loading	30-200 ohms uncritical
Recommended arm mass	12-30g
Recommended arm damping	yes, moderate
Induced hum level	very good
Stylus type	fixed naked line contact (?)
Finish and alignment	both very good
Tip geometry	estimated 8 $\times$ line um
HF resonance (tip mass/vinyl)	+3dB at 30kHz
Frequency response 30Hz-20kHz	-1, +3dB
Frequency response 100Hz-5kHz	1.0dB
Stereo separation, 100Hz, 1kHz, 10kHz	27dB, 40dB, 28dB
Channel difference at 1kHz, 10kHz	1.0dB, 1.0dB
Trackability 300Hz lateral $\pm 15$ dB	2.5g
Trackability 300Hz vertical $\pm 12$ dB	1.5g
Trackability 300Hz lateral +18dB ('Supertrack')	(with heavy bias) 3.5g
Distortion 300Hz lateral +9dB	0.18%
Distortion 300Hz vertical +6dB	1.4%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.8%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.4%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.4%, 0.5%, 1.6%
Typical selling price inc VAT	£500

\*assuming 20dB step up



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

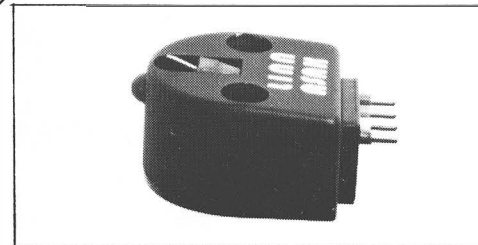


1kHz squarewave (ignore ultrasonic cutter ringing)

RECOMMENDED

## Linn Asak DC2100K

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



This cartridge has an excellent pedigree and comprises a model specially made by Supex to Linn's requirements, embodying much of the mechanics of the costly *SDX1000*, together with certain of those of the '900. Its moderate compliance is suited to medium-high mass arms, while its high body energy means that additional mass loading is recommended when used with delicate low mass tonearms. It produced a healthy hum-free output, was not particularly critical of electrical loading, and was fitted with a superlative true elliptical stylus whose alignment and profile were both very good.

Much flatter compared with previous Supex models we have measured, the presence droop was held to 1dB, though with a mild channel imbalance and response rise in the last octave. This anomaly was mirrored by the crosstalk response, the 8kHz point proving to be a perennial region of trouble for the Supex 900 and 1000 also. In other respects the separation was to a high standard. Again in common with the Supexes, trackability did not prove to be the Azak's strongest point. The 'Supertrack' was failed even at 3g, as was the mid intermodulation section at 2g; however, high frequency trackability was very fine, as were other measured distortions.

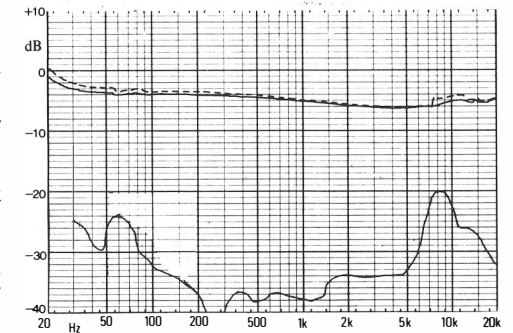
Rated 'very good' on the listening tests the sound was only let down by occasional coarsening, indicative of mistracking on high level complex passages, and a hint of 'edginess' or 'grit' in the upper treble. The stereo presentation was excellent with the bass clean and firm, and the midband highly neutral as well as transparent, exhibiting excellent transient detail.

This cartridge showed many of the good qualities of the more costly *Koetsu*, albeit lighter and 'sharper' in balance, a factor which may nonetheless work to its advantage with certain systems. The Linn *Asak* is probably Supex' best product to date, and it goes well with the exceptional Linn

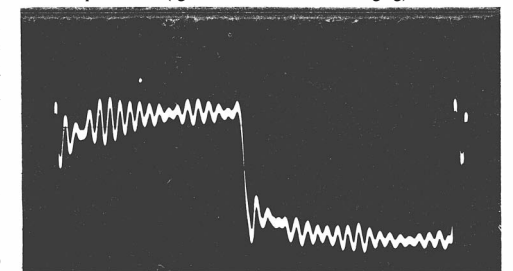
*Ittok* arm, but its body width can cause mounting problems in some headshells.

Cartridge type/mass	low output moving coil, 6g
Estimated dynamic compliance at 10Hz	14cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.8g to 2.2g	tested at 2.0g
LF resonance in test arm (SME 111, 6g me + cart)	+12dB at 13.5Hz
Sensitivity at 1kHz	(0.045mV alone) 9mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(-27dB alone) -1dB*
Subjective sound quality	very good
Recommended loading	30-500 ohms plus uncritical pF
Recommended arm mass	12-22g
Recommended arm damping	yes, moderate
Cartridge coil resistance/inductance	3.5 ohms, negligible mH
Induced hum level	very good
Stylus type	fixed, oriented, naked, elliptical, spec 5 $\times$ 18um
Finish and alignment	both very good
Tip geometry	true swept elliptical, 7 $\times$ 18um
HF resonance (tip mass/vinyl)	+9dB at 42kHz
Frequency response 30Hz-20kHz	+1.5, -1.3dB
Frequency response 100Hz-5kHz	1.1dB
Stereo separation, 100Hz, 1kHz, 10kHz	32dB, 38dB, 22dB
Channel difference at 1kHz, 10kHz	0.1dB, 0.6dB
Trackability 300Hz lateral $\pm 15$ dB	2.1g
Trackability 300Hz vertical $\pm 12$ dB	1.4g
Trackability 300Hz lateral +18dB ('Supertrack')	failed at 3g
Distortion 300Hz lateral +9dB	0.5%
Distortion 300Hz vertical +6dB	2.0%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.15%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.28%, 0.45%, 1.8%
Typical selling price	£185 when reviewed, now £207

\*assuming 26dB step up



1kHz squarewave (ignore ultrasonic cutter ringing)

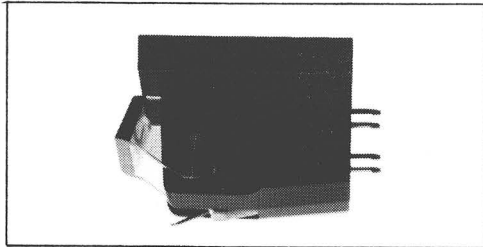


1kHz squarewave (ignore ultrasonic cutter ringing)

## Mayware MC3L

Mayware Ltd., PO Box 58, Edgware, Middlesex HA8 9UH  
Tel 01-958 9421

RECOMMENDED



This Japanese-made, relatively inexpensive, high output moving-coil possessed a moderate compliance, thus suiting it to low and medium mass tonearms; in most cases damping should be unnecessary. Almost by definition it is uncritical of electrical loading, and while its output was some 5dB below the nominal target of 1mV/cm/sec, the hum rejection was fortunately very good. Tracking at a 2g downforce, a line contact stylus was fitted which showed very good alignment and finish. The grind was Shibata with an 8µm estimated scanning radius, and an extended major contact radius.

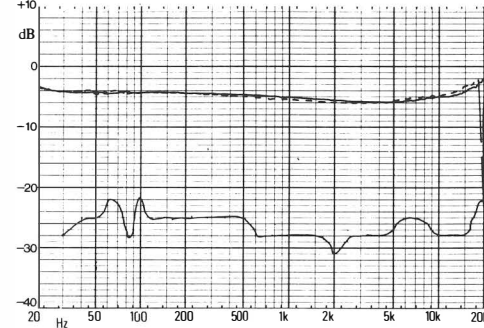
Poorly damped, the HF resonance lift was some 10dB at 38kHz, as the prolonged ringing on the squarewave response indicates, with a 3dB step at 20kHz in evidence. A small 1dB droop in the presence band also characterised the frequency response. The first sample we tried exhibited up to 4dB of channel imbalance depending on the modulation axis, but a second sample obtained with the importer's permission direct from a local dealer was fine. Channel separation was good, especially at high frequencies, and both trackability and distortion were generally satisfactory, though the mid intermodulation section did cause some difficulty, with marginally higher distortion as a result.

Rated as 'good' on the listening tests, the MC3L provided a generally neutral frequency balance if perhaps slightly dulled in the upper mid and occasionally bright or even slightly 'fizzy' in the upper treble. Stereo staging was stable and precise with fairly good depth, and the presentation of detail was also good, but with the sound marred somewhat by a coarsening on complex orchestrated passages. However, the muddy almost coloured effects common with some cartridges were essentially absent here.

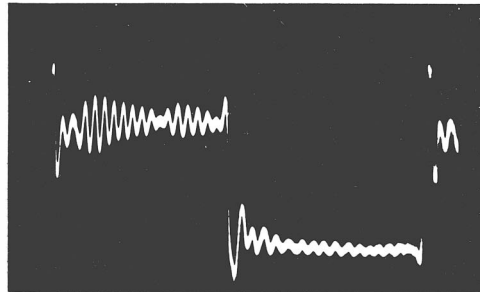
In view of its flexibility in terms of arm and amplifier matching as well as its lack of a step up requirement, its good quality stylus and generally good performance throughout the tests, the MC-

3L is worthy of recommendation, with the assumption that the first sample with poor channel balance was a 'rogue'.

Cartridge type/mass	high output moving coil, 6.9g
Estimated dynamic compliance at 10Hz	23cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce: range 1.8g to 2.2g	tested at 2g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 9.8Hz
Sensitivity at 1kHz	0.45mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-5dB
Subjective sound quality	good
Recommended loading	47k ohms plus uncritical pF
Recommended arm mass	3-12g
Recommended arm damping	marginal value
Cartridge coil resistance/inductance	115 ohms, negligible mH
Induced hum level	very good
Stylus type	fixed naked line contact
Finish and alignment	good polish, very good alignment
Tip geometry	well-shaped Shibata, effective contact 8 × line µm
HF resonance (tip mass/vinyl)	+10dB at 38kHz
Frequency response 30Hz-20kHz	-1, +3dB
Frequency response 100Hz-5kHz	±0.8dB
Stereo separation, 100Hz, 1kHz, 10kHz	22dB, 28dB, 28dB
Channel difference at 1kHz, 10kHz	0.1dB, 0.2dB (4dB 1st sample)
Trackability 300Hz lateral ±15dB	1.6g
Trackability 300Hz vertical ±12dB	1.2g
Trackability 300Hz lateral +18dB ('Supertrack')	2.1g
Distortion 300Hz lateral +9dB	(1.0 1st sample) 0.4%
Distortion 300Hz vertical +6dB	1.4%
High frequency waveform quality	fair
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	2.0%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.3%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.35%, 0.45%, 2.0%
Typical selling price	£49 (assessed at £60)



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

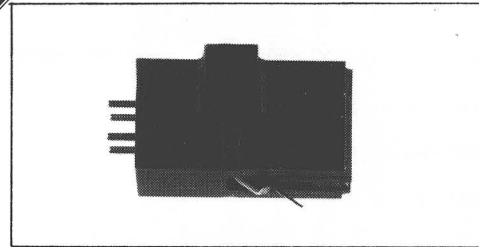


1kHz squarewave (ignore ultrasonic cutter ringing)

## Mission 773 (fully re-tested)

Mission Electronics, Unit 9A, George Street, Huntingdon, Cambridgeshire PE18 6BD  
Tel (0480) 57151

RECOMMENDED



Previously examined in prototype form, the 773 is now in full production. We were alarmed to discover a 40° odd tracking angle on unpacking, but were informed that this was deliberate since an hour or two of 'running in' promoted a reduction to 27° or so. Although this was still rather excessive it was nonetheless acceptable, since the compliance was very high at 45cu. The latter indicates the use of low mass arms without damping. A high output moving-coil, no step up device was required, nor did it prove load conscious. An excellent four-faceted line contact stylus was fitted, namely a Paroc, with a narrow 6µm scanning radius.

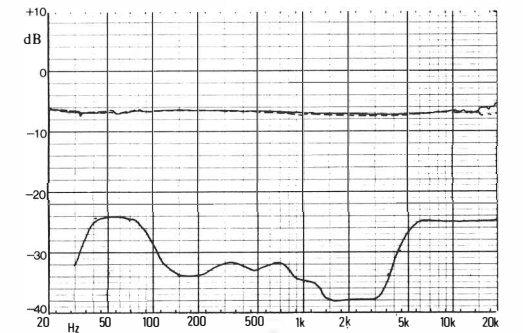
The very uniform response was mirrored by the flat topped squarewave, the well-controlled leading edge on overshoot corresponding to the well-damped tip mass resonance at 27kHz. Channel balance and separation were both very good. A small internal symmetry problem was apparent, since the distortion results differed markedly for left and right channels (not uncommon with cartridges!), and the results, although still reasonable, represent an average of the two readings. Low frequency trackability was very good, with the Supertrack accommodated within the test downforce of 1.7g, but both mid and high frequency intermodulation bands were mistracked and the noise intermodulation results were poorer than usual.

Rated as 'very good' on sound quality with little exaggeration of distortion, the 773 nevertheless sounded a trifle bright, even 'edgy' at times. The frequency balance was very open and detailed, with pleasing transparency and good stereo depth, but the image was not quite stable (perhaps a product of the high compliance?) Complex mid and high frequency passages also promoted a mild coarsening of the reproduction.

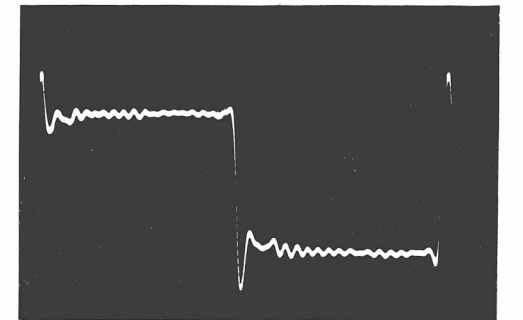
While it does not entirely convince me at the price, this fine cartridge needs no step up or arm damping, proved uncritical of electrical loading,

and was fitted with a high quality stylus. An audition is recommended.

Cartridge type/mass	high output moving coil, 5.2g
Estimated dynamic compliance at 10Hz	45cu (×10 <sup>-6</sup> cm/dyne)
Specified downforce	tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart)	+5dB at 7.2Hz
Sensitivity at 1kHz	0.45mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-7dB
Subjective sound quality	excellent
Recommended loading	22-47k ohms plus 50-500pF
Recommended arm mass	3-6g
Recommended arm damping	not required
Cartridge coil resistance/inductance	200 ohms, negligible
Induced hum level	very good
Stylus type	fixed, line contact 5 × line µm
Finish and alignment	both very good
Tip geometry	well-formed 4-faceted Paroc, effective contact 6 × line µm
HF resonance (tip mass/vinyl)	+4dB at 27kHz
Frequency response 30Hz-20kHz	-0.5, +1dB
Frequency response 100Hz-5kHz	±0.2dB
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 36dB, 25dB
Channel difference at 1kHz, 10kHz	0.2dB, 0.1dB
Trackability 300Hz lateral ±15dB	0.95g
Trackability 300Hz vertical ±12dB	1.25g
Trackability 300Hz lateral +18dB ('Supertrack')	1.55g
Distortion 300Hz lateral +9dB	0.6%
Distortion 300Hz vertical +6dB	3%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	1.2%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.8%, 1.2%, 3%
Typical selling price inc VAT	£160



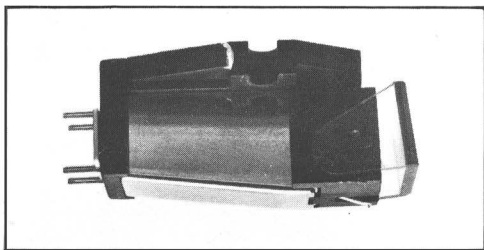
Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

**BEST BUY**

**Ortofon VMS20E II** (revised and reprinted)  
 Harman Audio (UK) Ltd., Mill Street, Slough, Berkshire SL2 5DD  
 Tel (0753) 76911



This model was also reviewed in Mark I version in the first issue, but did not achieve any particular distinction. The first '20E II' tried here offered good but not especial separation, the generator axes showing a lack of mutual alignment, but a second sample (not selected) provided the improvement shown by the dotted trace on the graph; accordingly this sample was used for all subsequent testing. Two frequency responses were also charted to explore the criticality of loading, with the optimum dotted 400pF curve clearly the best. Without too great elaboration the VMS with a naked elliptical tip may be regarded as an improved version of the FF15E.

Measurement showed the VMS compliance to be a little higher than the '15, at 28cu, but trackability was significantly increased, the Supertrack needing just 1g. Most distortions were similarly good except for the 1/3-octave results which were much better than for the '15, while an excellent frequency response and channel balance were both charted, plus very good separation throughout.

On audition the '20E II' appeared in the top group which is an excellent result for the price paralleling the achievement of the ADC XLM III in this respect. Considered very slightly nasal and dull in tonal colour it was nevertheless sufficiently neutral to achieve close tape copying. Stereo imaging was reproduced with precision and depth, and the treble range was clean and clear even on complex passages; overall a very musical and accurate sound with quite quiet surfaces.

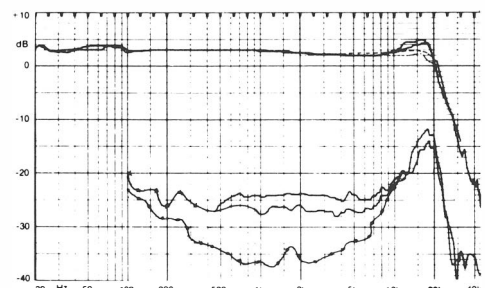
The stylus report showed a naked 220µm round stock elliptical diamond to specification, with a 50° cone angle and good shape. The alignment was fine but polish disappointingly poor.

In conclusion, the 400pf loaded VMS 20E II can be strongly recommended on the assumption that the second sample rather than the first was typical, but is best suited to low mass arms. In addition, a cartridge of this calibre should really have better

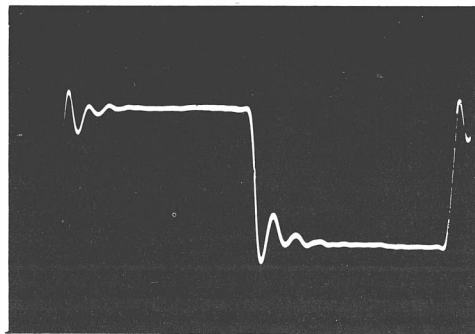
stylus polish, which would 'complete' the otherwise fine diamond fitted.

**GENERAL DATA**

Cartridge type and mass	Induced Magnet 'VMS', 5g
Estimated dynamic compliance at 10Hz	28cu (X10 <sup>-9</sup> cm/dyne)
Specified downforce: range 0.75g to 1.5g	tested at 1.3g
LF resonance in test arm (SME 111, 6g me + cart)	+11dB at 8.9Hz
Sensitivity at 1kHz	1.2mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	+2dB
Subjective sound quality	very good
Recommended loading	47k ohms plus 400pF
Recommended arm mass and damping	3 to 8g, moderate
Cartridge coil resistance/inductance	800ohms, 600mH
Induced hum level	Very good
Stylus type and spec	detach, naked elliptical, 8 X 18µm
Finish and alignment	Poor, good
Tip geometry	8 X 18 µm
HF resonance (tip mass/vinyl)	indicated at 18kHz
Frequency response 20Hz-20kHz	±1.3dB
Frequency response 100Hz-5kHz	+0, -1dB
Stereo separation, 100Hz, 1kHz, 10kHz	20dB, 35dB, 22dB
Channel difference at 1kHz, 10kHz	0dB, 0dB
Trackability 300Hz lateral +15dB, +18dB ('Supertrack')	0.8g, 1g
Trackability 300Hz vertical +12dB	0.4g
Distortion 300Hz lateral +9dB	0.7%
Distortion 300Hz vertical +6dB	2.8%
High frequency waveform quality	Good
Mid band intermodulation (1kHz + 1.5kHz)	3.8%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	0.2%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	3%, 6.4%, 6.6%
Typical selling price inc VAT	£27
Stylus replacement cost inc VAT	£24



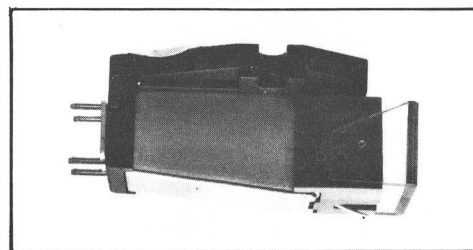
Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec) (dotted curve 400pf; separation see text).



1k Hz squarewave

**BEST BUY**

(revised and reprinted) **Ortofon M20FL Super**  
 Harman Audio (UK) Ltd., Mill Street, Slough, Berkshire SL2 5DD  
 Tel (0753) 76911



This top-of-the-line induced magnet cartridge was built to have a moderate compliance of 20cu, thus allowing the use of medium mass arms up to 10g, and subsonic damping is probably not essential. Although employing a different stylus assembly, the 'FL Super' had the same body resistance and inductance as the other Ortofon models in the report, and the obligatory 400pf of loading was therefore required, the output also proved surprisingly high. A standard alloy cantilever was fitted but with a line contact tip which allows tracking forces of up to 2g without accelerated wear.

On test 1.7g was in fact required to cope with Supertrack +18dB, so perhaps the permissible downforce range was just as well! Frequency response was as excellently controlled as with the cheaper VMS and balance was fairly good, with channel separation excellent throughout. Trackability at the test downforce (1.6g) was fine with all distortions held to very good levels; in fact, the usual rise in lateral distortion so often noted with line styli was avoided here altogether. The square-wave reflected the fine channel response, the single 'ring' simply deriving from the steep rolloff above 20kHz. High frequency waveforms were noticeably cleaner than average.

Auditioning ranked the 'FL Super' in the top class. Distortion was very low right to end of side, as well as on high level sections which often caught other models out. Stereo was fine with great musical clarity and depth plus an open, quite neutral balance, but surface noise was slightly obtrusive, and on occasion a marginally cold, steely quality was detected — something not noticed with the VMS20E II.

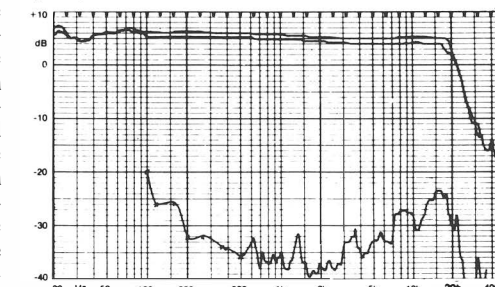
Stylus examination revealed a superb square stock naked line contact diamond with correct 8µm minor radius and a 50° cone angle. Polish and alignment were very good, though the shape neared a Shibata profile, extending a little deep.

Another fine Ortofon cartridge, the M20 FL

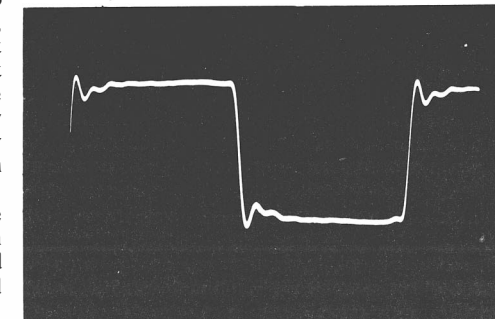
Super was obviously not such good value as the companion VMS, but nevertheless easily deserves recommendation. The lower compliance was a help in achieving a match with medium mass arms.

**GENERAL DATA**

Cartridge type and mass	Induced magnet 'VMS', 5g
Estimated dynamic compliance at 10Hz	20cu (X10 <sup>-9</sup> cm/dyne)
Specified downforce: range 1.25g to 1.75g	tested at 1.6g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 10.8Hz
Sensitivity at 1kHz	1.7mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	+4.5dB
Subjective sound quality	very good
Recommended loading	47k ohms plus 400pF
Recommended arm mass and damping	4 to 10g, moderate
Cartridge coil resistance/inductance	800ohms, 600mH
Induced hum level	Very good
Stylus type and spec	detach, naked line contact 8 X line µm
Finish and alignment	Both very good
Tip geometry	8 X line µm
HF resonance (tip mass/vinyl)	not clear, 30kHz
Frequency response 20Hz-20kHz	±1.6dB
Frequency response 100Hz-5kHz	+0.2, -1dB
Stereo separation, 100Hz, 1kHz, 10kHz	20dB, 36dB, 28dB
Channel difference at 1kHz, 10kHz	0.9dB, 1.0dB
Trackability 300Hz lateral +15dB, +18dB ('Supertrack')	1.2g, 1.7g
Trackability 300Hz vertical +12dB	0.8g
Distortion 300Hz lateral +9dB	0.3%
Distortion 300Hz vertical +6dB	2%
High frequency waveform quality	Very good
Mid band intermodulation (1kHz + 1.5kHz)	3.3%
H.F. intermodulation pulsed 10kHz, 24cm/sec peak	0.14%
Pink Noise intermodulation, 12kHz, 16kHz, 20kHz	1.7%, 5.8%, 4%
Typical selling price inc VAT	£40
Stylus replacement cost inc VAT	£33



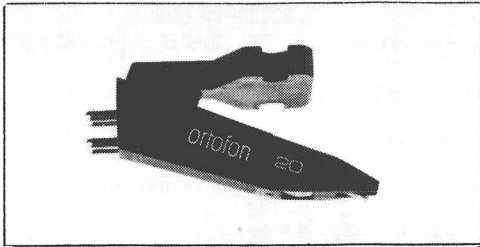
Frequency response, rel. output, and separation ref 0dB (1mV/cm/sec)



1k Hz squarewave

## Ortofon LM20 (& Concorde)

Harman Audio (UK) Ltd., Mill Street, Slough, Berkshire SL2 5DD  
Tel (0753) 76911



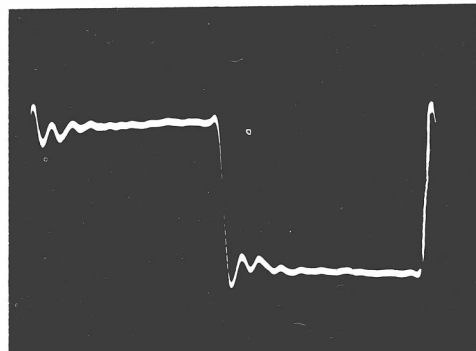
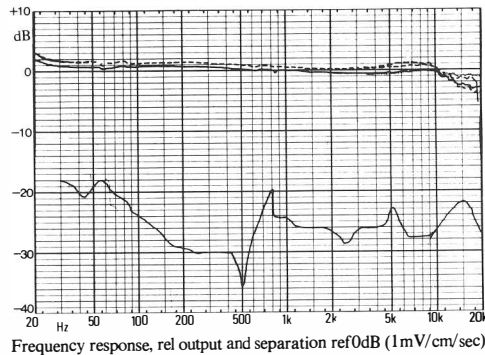
Cartridge type/mass	induced magnet 'VMS', 2.6g
Estimated dynamic compliance at 10Hz	(22cu) 33cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce	range 0.8g to 1.2g, tested at 1.1g
LF resonance in test arm (SME 111, 6g me + cart)	(+13dB at 12Hz) +14dB at 10Hz
Sensitivity at 1kHz	1.0mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	+0.2dB
Subjective sound quality	very good
Recommended loading	47k ohms plus 350-450pF
Recommended arm mass	4-9g
Recommended arm damping	yes, moderate
Cartridge coil resistance/inductance	600 ohms, 500mH
Induced hum level	good
Stylus type	diasa shank 'fine line'
Finish and alignment	good finish, shape, but just fair alignment
Tip geometry	4-faceted stereohedron type, 8 $\times$ line um
HF resonance (tip mass/vinyl)	suggested at +4dB at 23kHz
Frequency response 30Hz-20kHz	-1.5dB
Frequency response 100Hz-5kHz	-0.6dB
Stereo separation, 100Hz, 1kHz, 10kHz	24dB, 24dB, 26dB
Channel difference at 1kHz, 10kHz	0.7dB, 0.9dB
Trackability 300Hz lateral $\pm 15$ dB	0.7g
Trackability 300Hz vertical $\pm 12$ dB	0.7g
Trackability 300Hz lateral +18dB ('Supertrack')	1.2g
Distortion 300Hz lateral +9dB	0.4%
Distortion 300Hz vertical +6dB	2.5%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	3%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.6%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.5%, 1.5%, 4%
Typical selling price inc VAT	£36

Only 20 styli fit the versatile range of Ortofon '20' bodies, including the LM bracket type, and the Concorde headshell series, and various accessories are supplied to help mate these models to various arms. The two styli - the 20 and 20H - show how seriously Ortofon now take the question of matching, as the H is a high compliance model, while the other is suitable for greater mass arms of up to 15g. Damping would be helpful for both, and one would expect to run the 20 at a higher downforce than the 1.1g suggested for the 20H, the latter reviewed fully here. The Diasa-shanked diamond could have been better aligned, since this is a critical factor where such a four-faceted ground stone in line contact form is concerned.

The frequency response was dependent on loading, and while it showed a mild 2.5dB drop at 20kHz using 400pF, it was otherwise uniform. A hint of the resonance/crosstalk problem noted with the LM10 was present here also, but acceptably controlled, and while separation was fairly good, there was room for improvement. Trackability was generally fine, passing 'Supertrack' at just a 1.2g downforce, but the distortion levels were higher than usual; in this instance the stylus rake alignment was a possible cause. The standard 20 with its lower compliance and thus reduced cantilever deflection offered better alignment here.

Just scraping into the 'very good' class on the listening test, which is remarkable at the price, the panel awarded high marks for clarity, stereo presentation and a neutral frequency balance, free of edginess. However they also noted some groove contact failure including excessive clicks and surface noise, while it was especially noisy on the lacquer cuts.

Ortofon have clearly maintained their market position, for despite the stylus alignment error, the LM20(H) can be seen to have done well. The standard 20 is particularly recommended at a higher downforce (eg: 1.6g), while the various versions available will suit almost any tonearm.

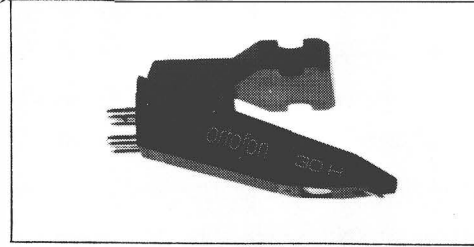


1kHz squarewave (ignore ultrasonic cutter ringing)

BEST BUY BEST BUY

## Ortofon LM30H (& Concorde)

Harman Audio (UK) Ltd., Mill Street, Slough, Berkshire SL2 5DD  
Tel (0753) 76911



Available in high and medium compliance versions, the 30 is Ortofon's top low mass (LM) model, and has also been incorporated in the SME III arm system to sell as a complete 'carrier' unit. The H version is fully reviewed here, while the standard 30 will suit arms of up to 15g mass at a 1.6g downforce. Due to their very low body mass certain models in the range need special counterweights with many arms, which Ortofon supply. Their low frequency resonance would benefit from some arm damping, with 400pF or so the optimal electrical loading value. The cartridge was fitted with a well finished, aligned and mounted line contact stone of Shibata grind. The stylus was low in mass and offered an 8um scanning radius, visual inspection suggesting that the tip was rather deep-pointed.

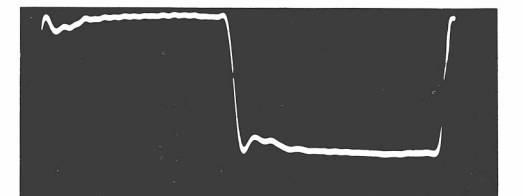
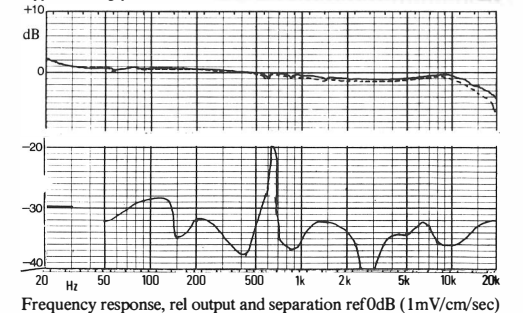
The essentially smooth frequency response had a 'rich' balance, possessing a mild presence droop and also a mild extreme treble rolloff, while the +/-1dB limits from 100Hz to 5kHz served to define a gently falling response. Balance was good and separation very good especially at high frequencies, but that mysterious 'LM' mid behaviour was still in evidence here at 700Hz or so, with a momentary separation reduction to 20dB. Distortion was well controlled throughout, with fine trackability, but at a 1.3g downforce the mid intermodulation section was on the verge of breakup; 1.5g produced a quite satisfactory result, however.

Rated 'very good' on the listening tests, the LM30 was undoubtedly possessed of a cleaner and more subtle sound quality than the LM20. It showed great clarity and retrieval of detail, and sounded quite open, but with a slight trace of treble 'edginess'. The stereo behaviour was complex; at times it was very good with fine depth, and yet occasionally it seemed to lose focus slightly in the midrange, possibly due to the mid separation anomaly noted previously. It was also marred slightly by a less kind handling than usual of

surface noise clicks and distortion, which could be a nuisance; the deep tip is perhaps responsible here?

The LM30 can be seen to be a very good performer on virtually all counts and at a realistic price. The matching versatility of the range is an important plus factor, and despite certain minor quirks of performance, a recommendation is clearly deserved.

Cartridge type/mass	induced magnet 'VMS', 2.6g
Estimated dynamic compliance at 10Hz	30cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce	tested at 1.3g
LF resonance in test arm (SME 111, 6g me + cart)	+12dB at 10.5Hz
Sensitivity at 1kHz	0.95mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-0.5dB
Subjective sound quality	very good
Recommended loading	47k ohms plus 350-450pF
Recommended arm mass	4-10g
Recommended arm damping	yes, moderate
Cartridge coil resistance/inductance	600 ohms, 500mH
Induced hum level	fairly good
Stylus type	'naked line'
Finish and alignment	both very good
Tip geometry	good quality, low mass Shibata, 8 $\times$ line um
HF resonance (tip mass/vinyl)	indeterminate
Frequency response 30Hz-20kHz	+1.5, -3dB
Frequency response 100Hz-5kHz	$\pm 1$ dB
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 35dB, 36dB
Channel difference at 1kHz, 10kHz	0.2dB, 0.6dB
Trackability 300Hz lateral $\pm 15$ dB	0.6g
Trackability 300Hz vertical $\pm 12$ dB	0.7g
Trackability 300Hz lateral +18dB ('Supertrack')	1.2g
Distortion 300Hz lateral +9dB	0.3%
Distortion 300Hz vertical +6dB	2.3%
High frequency waveform quality	very good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	3%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.3%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.3%, 0.8%, 2.9%
Typical selling price inc VAT	£50



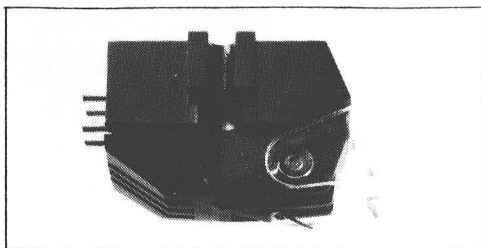
1kHz squarewave (ignore ultrasonic cutter ringing)



## Reference Spectre

Reference Products, Unit 18A, Botley Works, North Hinksey Lane, Oxford  
Tel (0865) 60844

RECOMMENDED



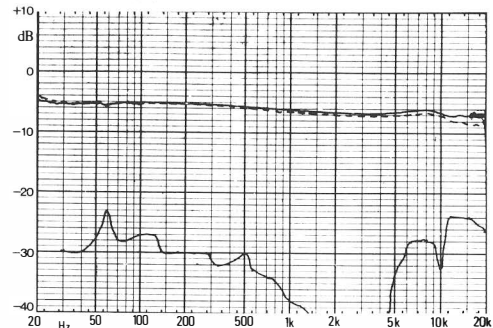
Cartridge type/mass	low output moving coil, 8.5g
Estimated dynamic compliance at 10Hz	26cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.5g to 2.0g	tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart)	+7dB at 8.4Hz
Sensitivity at 1kHz	(0.036mV alone) .72mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(-28dB alone) -2.8dB*
Subjective sound quality	good
Recommended loading	6-100 ohms plus uncritical pF
Recommended arm mass	3-10g
Recommended arm damping	not required
Cartridge coil resistance/inductance	2 ohms, negligible mH
Induced hum level	good
Stylus type	fixed, naked, oriented, elliptical, spec $8 \times 18\mu$
Finish and alignment	very good
Tip geometry	exemplary true elliptical, $8 \times 18\mu$
HF resonance (tip mass/vinyl)	40kHz
Frequency response 30Hz-20kHz	-1.0dB
Frequency response 100Hz-5kHz	-1.0dB
Stereo separation, 100Hz, 1kHz, 10kHz	27dB, 38dB, 26dB
Channel difference at 1kHz, 10kHz	0.2dB, 0.2dB
Trackability 300Hz lateral $\pm 15$ dB	-1.3g
Trackability 300Hz vertical $\pm 12$ dB	-1.0g
Trackability 300Hz lateral +9dB ('Supertrack')	2.6g
Distortion 300Hz vertical +6dB	0.3%
Distortion 300Hz vertical +6dB	1.5%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	2.3%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.27%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.4%, 0.7%, 3.2%
Typical selling price inc VAT	£69
*assuming 26dB step up	

Specially manufactured in Japan for the UK Reference Company, this low output moving-coil needed a high gain, low noise step up or input, and is likely to give less satisfactory results using a transformer. Of medium compliance, low to medium mass arms are recommended, and damping was unnecessary. A near-flawless and true elliptical diamond stylus was fitted, showing fine polish and very good alignment. The vertical tracking angle was a trifle high at  $30^\circ$ , but this did not appear to impair the results, and the tip mass resonance was well-damped as the squarewave response testifies.

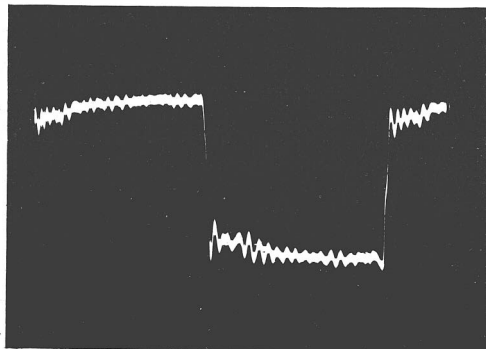
In the important middle region channel balance was well maintained, deteriorating somewhat above 10kHz, while the respectably uniform frequency response showed minimal presence droop and only the very mildest of ripples at high frequencies. Channel separation was very good overall. The cartridge proved to be a generally good tracker, but the highest levels of 'Supertrack' and the mid intermodulation test caused some trouble, as did the pink noise intermodulation sections. Otherwise distortions were very good.

Rated firmly in the 'good' category on sound quality, the *Spectre* offered a pleasing balance of qualities. The sound appeared open and lively with good rendition of detail, while the stereo was quite stable with good frontal precision and well developed depth. Very complex passages caused some hardening, while a hint of graininess or lack of sweetness was apparent in the treble, but surface noise and distortion were both handled well.

The *Spectre* can be seen to be a good allrounder, offering the fine stereo quality we have come to expect from good moving-coil designs. Considering its realistic price level it is certainly worthy of recommendation, despite the need for a step up device.



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

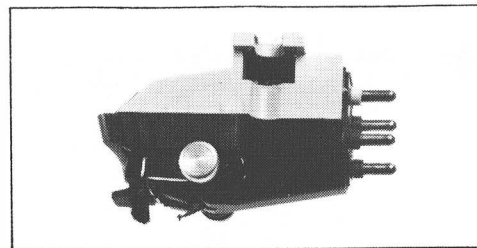


1kHz squarewave (ignore ultrasonic cutter ringing)

## Shure M97EJ

Shure Electronics Ltd., Eccleston Road, Maidstone ME15 6AU  
Tel (0622) 59881

BEST BUY



were only to increase the damping action, reduce the compliance and improve the tip, it could be even better!

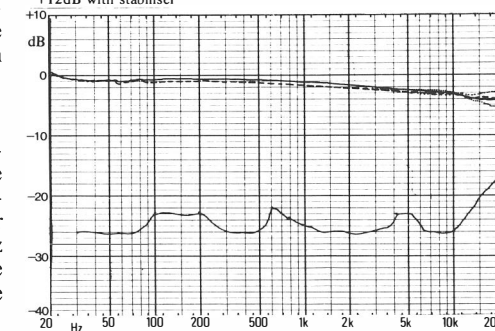
Cartridge type/mass	moving magnet, 6.4g
Estimated dynamic compliance at 10Hz	28cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.5g to 3g	tested at 2.0g
LF resonance in test arm (SME 111, 6g me + cart)	+15dB at 9Hz*
Sensitivity at 1kHz	0.85mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1.5dB
Subjective sound quality	good
Recommended loading	47k ohms plus 200-300pF
Recommended arm mass	3-10g
Recommended arm damping	some (cartridge damper less effective than HE)
Cartridge coil resistance/inductance	1550 ohms, 700mH
Induced hum level	very good
Stylus type	detachable, large shank mount elliptical, spec $10 \times 18\mu$
Finish and alignment	both only fair
Tip geometry	pseudo-elliptical, effective contact $18 \times 18\mu$
HF resonance (tip mass/vinyl)	indeterminate
Frequency response 30Hz-20kHz	+0.5, -2.5dB
Frequency response 100Hz-5kHz	+0.5, -1.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	23dB, 25dB, 26dB
Channel difference at 1kHz, 10kHz	0.8dB, 0.1dB
Trackability 300Hz lateral $\pm 5$ dB	0.9g
Trackability 300Hz vertical $\pm 12$ dB	0.7g
Trackability 300Hz lateral +9dB ('Supertrack')	1.3g
Distortion 300Hz lateral +6dB	0.7%
Distortion 300Hz vertical +6dB	2.7%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.8%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.37%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.3%, 0.55%, 3.3%
Typical selling price inc VAT	£24
*+12dB with stabiliser	

Having been disappointed last year with the performance of the *95EJ*, we were pleased to find this *97*-series model doing rather better this time. At the outset, however, certain problems are apparent: a moderately high compliance cartridge, it is unfortunately best suited to low-medium mass tonearms, which are likely to be out of its logical price-matching bracket. It also demonstrated a sharp resonance rise which was found to be little affected by the attached damper; it was fairly critical of electrical loading, with 250pF as the optimum value in our opinion. The output was however healthy, with good hum rejection. Despite its low price, the stylus could have been better, as examination showed it to be a relatively massive metal-shanked stone of just fair polish and alignment. Possessing a pseudo-elliptical grind, the contact region was virtually spherical at a 18um radius.

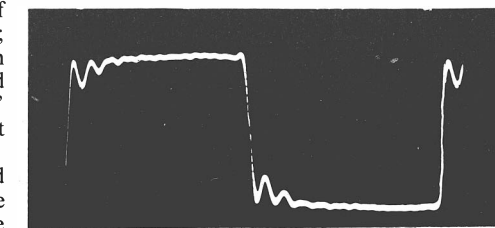
The frequency response was very smooth, falling gently with frequency to -2.5dB, 20kHz, while balance and separation were both reasonably good. At a 2g downforce there was a huge tracking reserve, and the compliance could therefore have been reduced to good effect, better suiting popular tonearms. The distortion at 300Hz lateral was a trifle high but the other results were all surprisingly good, considering the state of the stylus.

Rated a comfortable 'good' on the listening tests the sound was in fact exceptional for the price. Despite being on the dull and 'thick' side of neutrality, the cartridge nonetheless found favour; its tracking was secure, and stereo presentation reasonable, with clarity good and the overall sound unfatiguing. Detail loss over and above the 'rich' balance was apparent in the treble, but this was not too serious.

At the price the *97EJ* can be recommended without hesitation. Despite its low price, the correct arm and electrical matching should be observed to obtain the best results, and if Shure



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

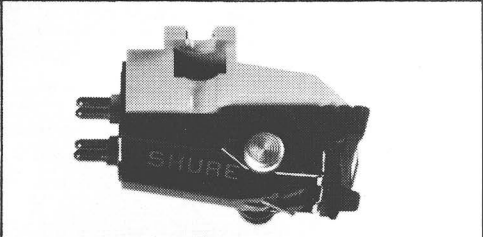


1kHz squarewave (ignore ultrasonic cutter ringing)

**BEST BUY**

## Shure M97HE

Shure Electronics Ltd., Eccleston Road, Maidstone ME15 6AU  
Tel (0622) 59881



Stereo separation was fine for a moving magnet design and would appear to correlate with the good stereo image depth we observed. Shure's price-v-performance equations are currently producing good results, and the 97HE can be recommended.

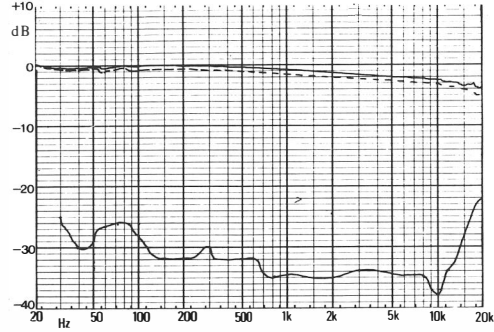
Cartridge type/mass	moving magnet, 6.4g
Estimated dynamic compliance at 10Hz	35cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 0.75g to 1.5g	tested at 1.25g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 7.9Hz*
Sensitivity at 1kHz	0.9mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-1.0dB
Subjective sound quality	very good
Recommended loading	47k ohms plus 200-300pF
Recommended arm mass	3-12g
Recommended arm damping	cartridge damper fitted (recommended)
Cartridge coil resistance/inductance	1550 ohms, 700mH
Induced hum level	very good
Stylus type	detachable, Shure hyper-elliptic, naked, spec 5 x line um
Finish and alignment	good finish, fairly good mounting
Tip geometry	essentially a well-formed elliptical, contact 8 x 18 um
HF resonance (tip mass/vinyl)	indeterminate
Frequency response 30Hz-20kHz	+1, -2.3dB
Frequency response 100Hz-5kHz	$\pm 1$ dB
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 34dB, 35(av)dB
Channel difference at 1kHz, 10kHz	0.8dB, 0.8dB
Trackability 300Hz lateral $\pm 15$ dB	0.9g
Trackability 300Hz vertical $\pm 12$ dB	0.8g
Trackability 300Hz lateral +18dB ('Supertrack')	1.25g
Distortion 300Hz lateral +9dB	0.5%
Distortion 300Hz vertical +6dB	2.9%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.25%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.3%, 0.4%, 1.5%
Typical selling price inc VAT	£42
*6dB @ 9Hz with damper	

To some degree the models in the M97 series may be regarded as versions of the V15IV but without the high frequency anti-resonance damper in the cantilever assembly. The SC39 'professional' cartridge is also closely related, but has a stylus guard system substituted for the 97's damper brush. The version reviewed here carries the HE suffix, which in Shure's terminology denotes a 'hyper-elliptical' stylus, the specification defining a form of line contact. As with the V15IIIHE, the naked rondel stylus proved to be of good quality and finish with essentially elliptical radii 8 x 18um, although some sweeping of the major radius provided a little contact extension. The stone was however a little offset in its mounting on the cantilever, though the grind symmetry was better than for the V15 sample. Critical of electrical loading, 350pF was preferred. Bearing in mind the high compliance, low mass arms would be a necessity without the effective damper brush, but its inclusion fortunately extends the cartridge's compatibility into the medium mass range.

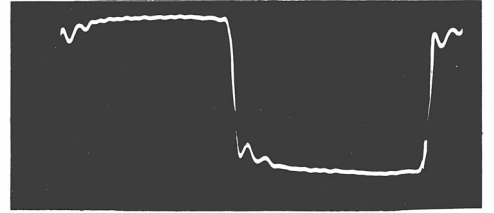
The frequency response was very smooth if slightly 'rich' in balance and the good uniformity and high frequency control was shown by the well-damped squarewave response. Stereo separation was to a very good standard at all frequencies, while distortions were well-controlled and tracking exemplary on all bands.

Rated 'very good' on sound quality, this was a fine result for the price and probably the best yet for a Shure cartridge in this publication. Criticised for a slightly dulled 'dead' frequency balance and a suspicion of hardness on string tone, the sound grew on many panelists during the sessions. It exhibited a generally clear and even performance with relaxed tracking, and coherent and precise stereo imaging, with good depth.

At this price level the damper was felt to be a worthwhile accessory in terms of arm compatibility, and the overall performance - both on technical and subjective grounds - was very good.



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

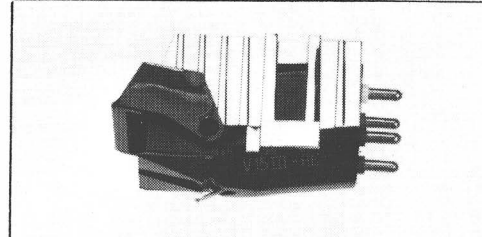


1kHz squarewave (ignore ultrasonic cutter ringing)

**RECOMMENDED**

## Shure V15III HE

Shure Electronics Ltd., Eccleston Road, Maidstone ME15 6AU  
Tel (0622) 59881



that the IIIHE gives the IV something to think about.

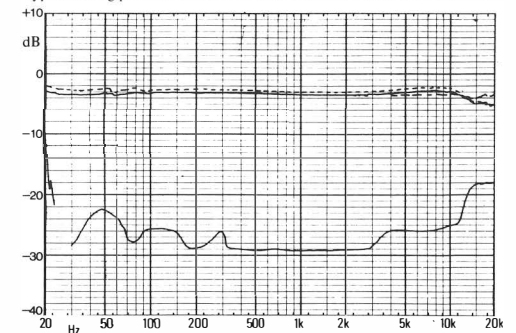
Cartridge type/mass	moving magnet, 6g
Estimated dynamic compliance at 10Hz	53cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 0.75g to 1.5g	tested at 1.25g
LF resonance in test arm (SME 111, 6g me + cart)	+7dB at 6.8Hz
Sensitivity at 1kHz	0.7mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-3.2dB
Subjective sound quality	very good
Recommended loading	47k ohms plus (300-400) 350pF
Recommended arm mass	3-6g
Recommended arm damping	helpful with higher mass arms
Cartridge coil resistance/inductance	1550 ohms, 650mH
Induced hum level	very good
Stylus type	detachable naked hyper-elliptic, spec 5 x line um
Finish and alignment	good finish and alignment but asymmetric grind
Tip geometry	essentially a good swept elliptical, effective contact 8 x 20um
HF resonance (tip mass/vinyl)	indeterminate
Frequency response 30Hz-20kHz	$\pm 0.5$ dB
Frequency response 100Hz-5kHz	+0.25dB
Stereo separation, 100Hz, 1kHz, 10kHz	25dB, 29dB, 25dB
Channel difference at 1kHz, 10kHz	0.4dB, 0.7dB
Trackability 300Hz lateral $\pm 15$ dB	0.9g
Trackability 300Hz vertical $\pm 12$ dB	0.8g
Trackability 300Hz lateral +18dB ('Supertrack')	1.1g
Distortion 300Hz lateral +9dB	0.5%
Distortion 300Hz vertical +6dB	2.0%
High frequency waveform quality	good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.6%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.12%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.8%, 0.8%, 3.0%
Typical selling price inc VAT	£58

Effectively a new cartridge with the inclusion of a true elliptical stylus, this 'old warhorse' appears to have taken on a new lease of life, and is worthy of reassessment. Possessing an unacceptably high compliance, the best results will only be obtained using low mass tonearms, and slight damping could also prove useful to help stabilise the inevitably low LF resonant frequency. On test 350pF gave a fair loading compromise, the exact value in fact proving fairly critical in terms of frequency balance. The stylus profile was essentially a true swept-radius elliptical of effective contact 8 x 20um, rather than the specified '5 x line'. The finish and alignment were good, though the grind was significantly off-centre.

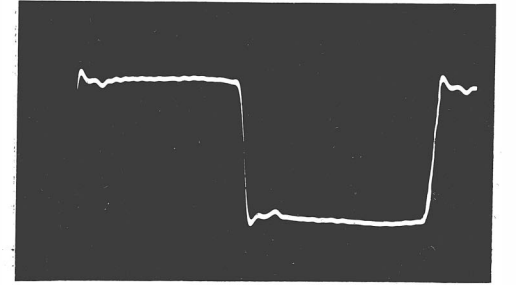
Tight frequency response limits were met, together with good separation and channel balance. Predictably enough, the trackability was excellent, all tests being passed with aplomb at a 1.25g downforce. The high noise intermodulation figures were possibly due to the larger scanning radius, but the other distortions were all well-controlled.

On the listening tests this new V15 variant stood up well to the recent competition and scored a 'very good' rating. It was liked for its open and neutral frequency balance, its exemplary security of tracking and consistently good rendition of detail throughout the band. Stereo imaging also showed quite good focus, though with some flattening of perspective. The main criticism, albeit mild, was of a thickening or hardening effect in the midrange, coupled with a touch of nasal coloration, this incidentally also noted in the review of the original 'standard' V15III.

The III has not increased significantly in price over the years, and this revised stylus has provided sufficient enhancement to allow for a recommendation. This is of course also true of the stylus alone, and it should be possible to fit it and upgrade existing IIIs. Despite a high compliance which rules it out for all but a handful of arms, we believe



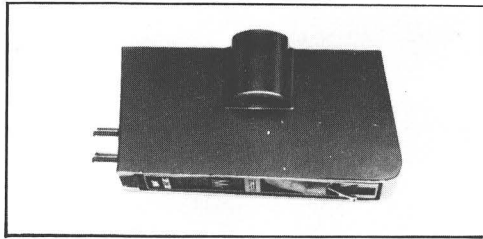
Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

(fully re-tested) **Supex SD901S**

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



The 901 is reviewed here in its latest form with the 'vital' stylus. Although in the past it has been regarded as the 'weaker brother' of the range, the results from the tests on our latest samples suggest that its performance now surpasses that of the 900. Representing the high output version of the 900, the expression 'high output' relates only to moving-coil designs, and a fairly sensitive preamplifier (minimum 2mV sensitivity) will be required for full amplification. The moderately low compliance suits this cartridge to medium mass arms, and the need for damping was marginal, and it also proved singularly uncritical of loading.

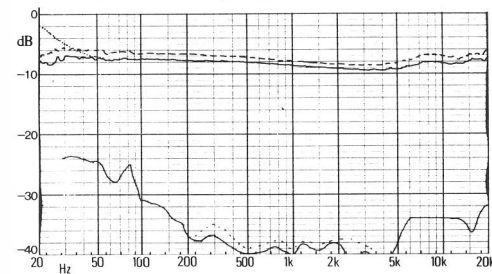
The stylus achieved the same exemplary standard as the other Supexes, while the frequency response dip was held to just 1 dB, and the treble lift to +2dB. A well-damped tip mass resonance is indicated by the minimal leading edge ringing on the squarewave, the clearly displayed cutter ringing merely demonstrating the cartridge's wide bandwidth. Stereo separation was outstanding and free of the 7kHz problem associated with low output Supexes, and at a recommended 2g downforce it almost managed the 'Supertrack', and held on throughout all the other tests, although the mid intermodulation was not far from failure. Distortion was low throughout and the results obtained were better than those for the 900.

Rated 'very good' on the listening tests, family similarities with the 900 were clear - the rich down-tilted balance lending a 'weighty' impression (see also Koetsu). Stereo imaging was notably transparent with fine depth and precision, and despite the 'laid back' balance, detail was well presented with surface noise and clicks subdued. A hint of coarseness was however apparent on difficult end-of-side passages, and the extreme treble could sound a little thin and wispy.

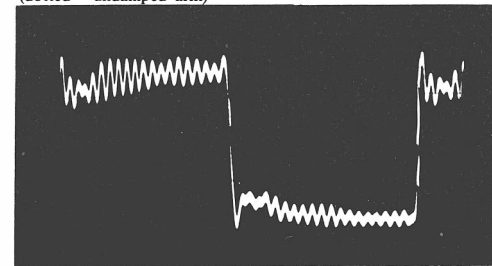
The first sample of the 901 received exhibited poor channel balance - not an uncommon fault with the high output moving-coil models - and was rejected accordingly. But despite its relatively high

price, and on the assumption that good 901s achieve the standards set by the second sample tested above, the cartridge is clearly worthy of recommendation; its versatile electrical and physical compatibility represent strong points in its favour.

Cartridge type/mass	high output moving coil, 9.5g
Estimated dynamic compliance at 10Hz	12cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 2.0g to 2.5g	tested at 2.2g
LF resonance in test arm (SME 111, 6g me + cart)	+11dB at 12.5Hz
Sensitivity at 1kHz	0.33mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	-8.5dB
Subjective sound quality	very good
Recommended loading	47k ohms plus uncritical pF
Recommended arm mass	12-20g
Recommended arm damping	marginal
Cartridge coil resistance/inductance	80 ohms, negligible mH
Induced hum level	very good
Stylus type	fixed, naked, oriented, 'super elliptical', spec 8 $\times$ 20um
Finish and alignment	both excellent
Tip geometry	exemplary true swept elliptical, 7 $\times$ 20um
HF resonance (tip mass/vinyl)	above 40kHz
Frequency response 30Hz-20kHz	+2, -1dB
Frequency response 100Hz-5kHz	$\pm$ 1dB
Stereo separation, 100Hz, 1kHz, 10kHz	31dB, 40dB, 34dB
Channel difference at 1kHz, 10kHz	0.8dB, 0.95dB
Trackability 300Hz lateral $\pm$ 15dB	1.8g
Trackability 300Hz vertical $\pm$ 12dB	1.2g
Trackability 300Hz lateral +18dB ('Supertrack')	2.5g
Distortion 300Hz lateral +9dB	0.4%
Distortion 300Hz vertical +6dB	1.8%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.4%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.22%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.4%, 0.6%, 2.7%
Typical selling price inc VAT	£125



Frequency response, rel output and separation ref 0dB (1mV/cm/sec) (dotted - undamped arm)



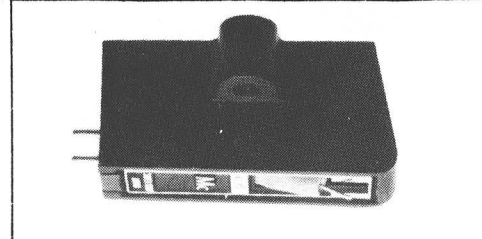
1kHz squarewave (ignore ultrasonic cutter ringing)

RECOMMENDED

RECOMMENDED

**Supex SD900E Super** (fully re-tested)

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



It now seems likely that the Supex designs may have gone through a 'sticky patch' some time a year or so back, accounting for the problems *Choice* encountered in reviewing both the 900 and 901. Happily these difficulties appear to have been overcome, as the quality of the 900 models submitted this time was comparable with the superior performance of the original 'classic' sample of several years ago. A low compliance moving-coil design, the 900E is suited to medium-high mass arms, and slight damping could be beneficial. A superb naked oriented elliptical diamond was fitted, comprising a true swept-radius stone of effective contact 7  $\times$  20um, the latter not unrealistic at a typical 2g downforce.

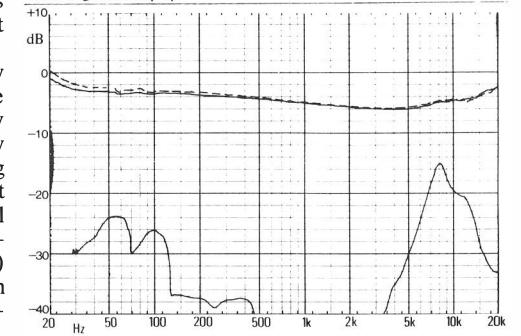
The very low effective tip mass was reflected by the HF resonance, which was estimated to lie above 45kHz. The midrange droop in frequency response was some 1.5dB, with the subjectively 'rich' balance corresponding to the gently rising response below 1kHz. The inevitable rise at 20kHz was held to +2.5dB, with fine channel balance, and with the exception of the 'glitch' at 7-8kHz (characteristic of low output Supex designs) the separation was very good. In common with many other cartridges, the 'Supertrack' and mid-band intermodulation sections both gave trouble, but at the 2g downforce all other tracking and distortion tests were well accommodated.

On the revised rating system the SD900 scored 'very good' on sound quality (in relative terms this does represent a slight downgrading from the previous 'excellent'). While still showing its firm, stable character with very good stereo imaging and attendant depth, the balance tended to an 'over-rich' quality which enhanced the bass at the expense of the mid/treble detail, and occasionally 'fizzy' effects were also noted in the extreme treble. However it was kind to surface noise, and did not mistrack too often.

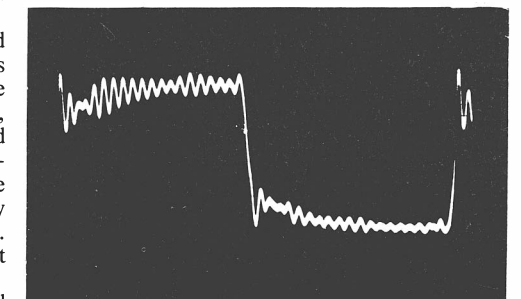
The costly 900, for so long a reference standard amongst moving-coils, continues to be a top flight

cartridge, but is now somewhat eclipsed at relatively little extra cost by its close relative the *Asak*.

Cartridge type/mass	low output moving coil, 9g
Estimated dynamic compliance at 10Hz	11cu ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 2g to 2.5g	tested at 2g
LF resonance in test arm (SME 111, 6g me + cart)	+12dB at 13Hz
Sensitivity at 1kHz	(0.06mV alone) 1.2mV/cm/sec*
Relative output (0dB = 1mV/cm/sec)	(-24.5 alone) +2dB*
Subjective sound quality	very good
Recommended loading	20-500 ohms plus uncritical pF
Recommended arm mass	12-20g
Recommended arm damping	marginal
Cartridge coil resistance/inductance	3.5 ohms, negligible mH
Induced hum level	fairly good
Stylus type	fixed, naked, oriented, elliptical, spec 8 $\times$ 20um
Finish and alignment	both excellent
Tip geometry	exemplary true elliptical, 7 $\times$ 20um
HF resonance (tip mass/vinyl)	+12dB at 745kHz
Frequency response 30Hz-20kHz	-1.5, +2.5dB
Frequency response 100Hz-5kHz	$\pm$ 1.5dB
Stereo separation, 100Hz, 1kHz, 10kHz	26dB, >40dB, 20dB
Channel difference at 1kHz, 10kHz	0.1dB, 0.1dB
Trackability 300Hz lateral $\pm$ 15dB	1.8g
Trackability 300Hz vertical $\pm$ 12dB	1.0g
Trackability 300Hz lateral +18dB ('Supertrack')	2.6g
Distortion 300Hz lateral +9dB	0.6%
Distortion 300Hz vertical +6dB	2.0%
High frequency waveform quality	fair
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	3.7%
HF intermodulation, pulsed 10kHz, 24cm/sec peak	0.33%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.45%, 0.7%, 3.7%
Typical selling price inc VAT	£145



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

**BEST BUY**

## Technics EPC205 III L

Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berkshire SL1 3DR  
Tel (0753) 34522

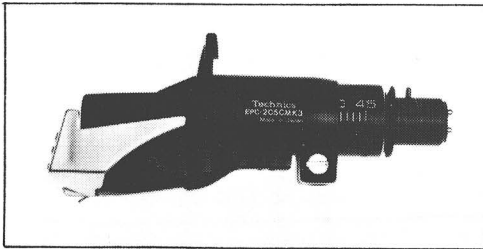


photo: integrated headshell version

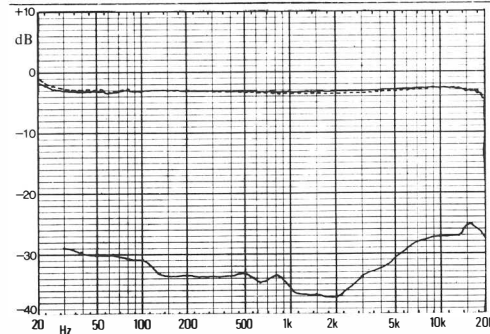
Successor to the *EPC205* reviewed in the first issue, Technics have devoted considerable attention to refining their moving magnet cartridges. Available in headshell and universal forms, this design incorporated a hollow boron cantilever of very low tip mass, while the internal poles were precision aligned and manufactured from tape lead ferrite. The cartridge proved especially insensitive to variations in both temperature and electrical loading, and its moderate compliance with adequate low damping means that a variety of low to medium mass arms will be compatible. A superb true swept elliptical stylus was fitted offering fine  $6 \times 20\mu\text{m}$  radii, while both polish and alignment were excellent.

The high frequency resonance was well controlled at 33kHz, and disregarding the cutter ringing the squarewave response was a textbook example of phase and frequency accuracy. This fully backed the measured frequency response which was remarkably uniform, while both channel balance and stereo separation were also very good. All distortions were low and trackability excellent at a 1.3g downforce – another textbook performance.

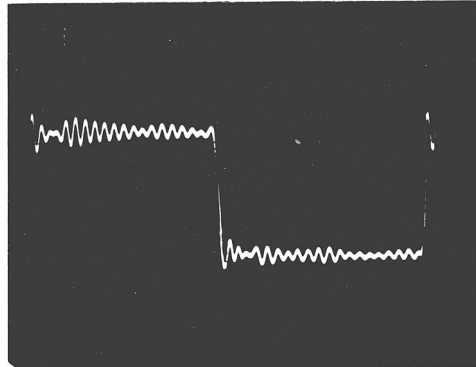
Rated excellent on sound quality grounds, the *205* represented an almost ideal balance of qualities. Stereo presentation was stable and precise with good depth, the frequency balance sounded smooth and open, minimal coloration was noted, and the rendition of fine detail proved exceptional. Surfaces were well handled, and the model was never caught out on tracking.

A clear winner, this cartridge offered an almost ideal balance. Possessing a top class subjective performance, it sounded very neutral and was unaffected by loading or temperature. It also proved relatively unfussy about the choice of arm, and at the price is virtually a 'steal'.

Cartridge type/mass	moving magnet, 6.5g
Estimated dynamic compliance at 10Hz	23cu ( $\times 10^{-6}\text{cm/dyne}$ )
Specified downforce: range 1.0g to 1.5g	tested at 1.25g
LF resonance in test arm (SME 111, 6g me + cart)	+10dB at 10Hz
Sensitivity at 1kHz	0.54mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	(alone -5.5dB)
Subjective sound quality	excellent
Recommended loading	47k ohms plus uncritical pF
Recommended arm mass	4-12g
Recommended arm damping	optional, moderate
Cartridge coil resistance/inductance	500 ohms, 240mH
Induced hum level	very good
Stylus type	detachable, naked, elliptical, spec $6 \times 18\mu\text{m}$
Finish and alignment	both very good
Tip geometry	exemplary true swept elliptical, $7 \times 20\mu\text{m}$
HF resonance (tip mass/vinyl)	+3dB at 33kHz
Frequency response 30Hz-20kHz	$\pm 1.0\text{dB}$
Frequency response 100Hz-5kHz	$\pm 0.25\text{dB}$
Stereo separation, 100Hz, 1kHz, 10kHz	28dB, 38dB, 28dB
Channel difference at 1kHz, 10kHz	0.7dB, 0.4dB
Trackability 300Hz lateral $\pm 15\text{dB}$	0.7g
Trackability 300Hz vertical $\pm 12\text{dB}$	0.55g
Trackability 300Hz lateral +18dB ('Supertrack')	1.3g
Distortion 300Hz lateral +9dB	0.35%
Distortion 300Hz vertical +6dB	2.5%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.5%
H F intermodulation, pulsed 10kHz, 24cm/sec peak	0.35%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.3%, 0.4%, 1.7%
Typical selling price inc VAT	£65



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

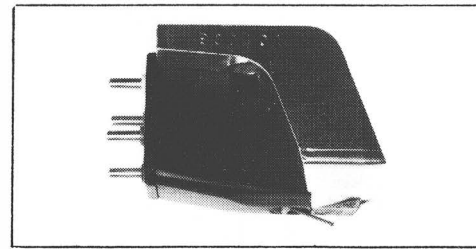


1kHz squarewave (ignore ultrasonic cutter ringing)

**RECOMMENDED**

## Technics EPC305MC

Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berkshire SL1 3DR  
Tel (0753) 34522



This is Technics' latest moving-coil cartridge, whose offset coil generator system is reminiscent of the *Signet MK111E*. A low output type, the impedance was higher than usual and needs some consideration in electrical matching; however the compliance was sensible, and arms in the medium-low mass range are appropriate, with damping probably helpful. This and the companion *205* moving magnet models both have very low temperature sensitivity suspensions and may thus be a wise choice in certain climates. The fine quality stylus fitted had very good finish and alignment, the grind based on a pseudo-elliptical form but with some over-polishing to achieve an estimated  $10 \times 20\mu\text{m}$  scanning radius.

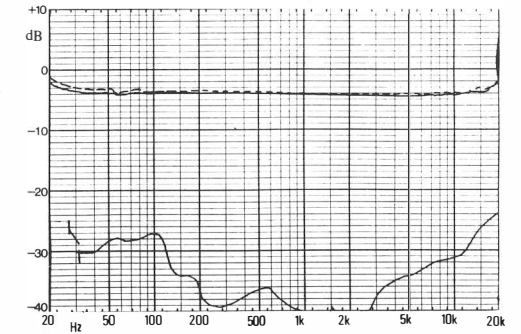
The tip mass resonance was poorly damped but comfortably ultrasonic at above 40kHz, this peak resulting in the highly magnified presentation of the cutter ringing present on the squarewave test disc. The fundamental frequency response was perfectly aligned and virtually ruler-flat, except for the slight rise at 20kHz. Channel balance and stereo separation were both excellent and distortions were very well controlled, although both the high frequency intermodulation and pink noise sections were noticeably worse than average, the broad tracing radius or the lively resonance considered possible causes.

Rated as 'good' on the listening tests, a result commensurate with the price, the comments made by the panelists were in fact somewhat contradictory. While the sound was undoubtedly 'open' and clear, with good stereo staging and well developed depth, and the quality was uniform throughout the frequency range, somehow it just did not reach the top class. The reasons were partly to do with a mild 'blurring' of complex textures in the reproduction, together with some loss of integration and precision on sharp transients.

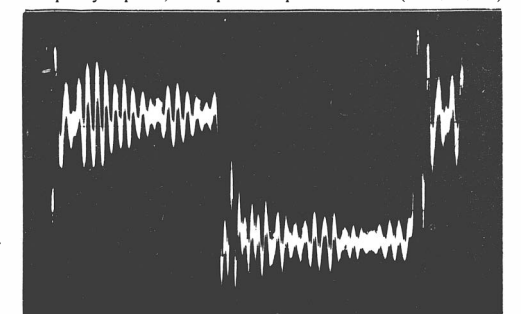
Overall the performance justifies recommendation, with the immunity to temperature and arm

matching flexibility further plus points; however it is worth bearing in mind the step up requirements.

Cartridge type/mass	low output moving coil, 6.7g
Estimated dynamic compliance at 10Hz	20cu ( $\times 10^{-6}\text{cm/dyne}$ )
Specified downforce: range 1.3g to 1.7g	tested at 1.6g
LF resonance in test arm (SME 111, 6g me + cart)	+12dB at 11Hz
Sensitivity at 1kHz	1.12mV/cm/sec
Relative output (0dB = 1mV/cm/sec)	(alone -25dB) +1dB
Subjective sound quality	good
Recommended loading	100-500 ohms plus uncritical pF
Recommended arm mass	4-12g
Recommended arm damping	could be helpful
Cartridge coil resistance/inductance	30 ohms, negligible mH
Induced hum level	good
Stylus type	fixed naked oriented elliptical, spec $5 \times 18\mu\text{m}$
Finish and alignment	both very good
Tip geometry	polished pseudo-elliptical, effective contact $10 \times 20\mu\text{m}$
HF resonance (tip mass/vinyl)	+13dB at above 40kHz
Frequency response 30Hz-20kHz	-0.25, +2.0dB
Frequency response 100Hz-5kHz	0.25dB
Stereo separation, 100Hz, 1kHz, 10kHz	27dB, 40dB, 31dB
Channel difference at 1kHz, 10kHz	0.1dB, 0.2dB
Trackability 300Hz lateral $\pm 15\text{dB}$	1.0g
Trackability 300Hz vertical $\pm 12\text{dB}$	0.85g
Trackability 300Hz lateral +18dB ('Supertrack')	1.5g
Distortion 300Hz lateral +9dB	0.5%
Distortion 300Hz vertical +6dB	1.4%
High frequency waveform quality	fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)	1.6%
H F intermodulation, pulsed 10kHz, 24cm/sec peak	0.45%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz	0.6%, 0.9%, 4%
Typical selling price inc VAT	£70



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)

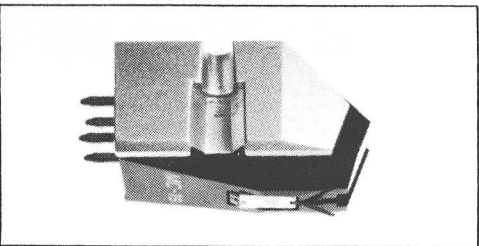


1kHz squarewave (ignore ultrasonic cutter ringing)

**RECOMMENDED**

## Yamaha MC1S

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex  
Tel 01-863 8622



Cartridge type/mass.....	low output moving coil, 7.5g
Estimated dynamic compliance at 10Hz.....	24 $\mu$ ( $\times 10^{-6}$ cm/dyne)
Specified downforce: range 1.6g to 2.0g.....	tested at 1.8g
LF resonance in test arm (SME 111, 6g me + cart).....	+5dB at 9.0Hz
Sensitivity at 1kHz.....	(0.045 alone) .9mV/cm/sec*
Relative output (0dB = 1mV/cm/sec).....	(-27dB alone) -1dB*
Subjective sound quality.....	good
Recommended loading.....	100-500 ohms plus uncritical pF
Recommended arm mass.....	3-10g
Recommended arm damping.....	not required
Cartridge coil resistance/inductance.....	30 ohms, negligible mH
Induced hum level.....	fairly good
Stylus type.....	fixed, naked, super elliptical, spec 8 $\times$ 40 $\mu$ m
Finish and alignment.....	both excellent
Tip geometry.....	excellent semi-line elliptical, 7 $\times$ 18 $\mu$ m
HF resonance (tip mass/vinyl).....	+8dB indicated at 40kHz
Frequency response 30Hz-20kHz.....	-0.25, +3dB $\pm$
Frequency response 100Hz-5kHz.....	$\pm$ 0.5dB
Stereo separation, 100Hz, 1kHz, 10kHz.....	30dB, 37dB, 30dB
Channel difference at 1kHz, 10kHz.....	0.1dB, 2.0dB
Trackability 300Hz lateral $\pm$ 15dB.....	1.4g
Trackability 300Hz vertical $\pm$ 12dB.....	1.2g
Trackability 300Hz lateral +18dB ('Supertrack').....	1.7g
Distortion 300Hz lateral +9dB.....	0.6%
Distortion 300Hz vertical +6dB.....	1.5%
High frequency waveform quality.....	fairly good
Mid band intermodulation (1 kHz + 1.5 kHz 24cm/sec).....	4.0%
HF intermodulation, pulsed 10kHz, 24cm/sec peak.....	0.22%
Pink noise intermodulation, 12kHz, 16kHz, 20kHz.....	0.3%, 0.5%, 2.0%
Typical selling price inc VAT.....	£70
* assuming 26dB step up.....	† see text

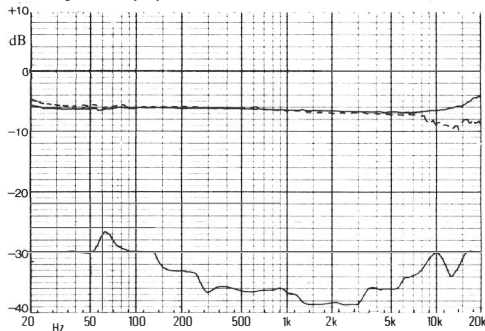
Employing micro-circuit coils like the JVC models, Yamaha have chosen to place these more conventionally at the pivot position. A low output model, the fairly high coil impedance means that it will need careful electrical matching, though the medium compliance and very well damped low frequency resonance will allow its use with low to medium mass arms.

The stylus was specified as a super elliptical line form with 8  $\times$  40 $\mu$ m contact. Expert examination revealed excellent mounting and finish with an extended contact elliptical grind, the effective contact radii estimated at 7  $\times$  18 $\mu$ m.

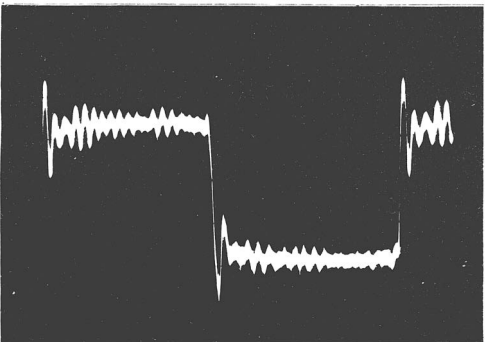
Tip mass resonance was indicated at the comfortably high frequency of 40kHz, and was reasonably damped, while the squarewave can be seen to be 'square' (ignoring the reproduced cutter ringing) with a quickly damped leading overshoot. The first sample gave the poorer high frequency channel balance charted, but a second sample (used for auditioning) held to within 1dB, 10kHz, and 2dB, 20kHz. Essentially uniform, the response tended to rise towards the higher frequencies, while very good channel separation was demonstrated throughout. Tested at 1.8g, the cartridge sailed through all the tracking tests except the mid intermodulation which it did not like; distortion was low on all other tests.

Rated 'good' on audition, it failed to get into the top grade due to certain anomalies. While not entirely transparent, the sound also showed a mild thin and 'brittle' quality together with some 'edginess' and 'fizz' in the upper registers; rather surprisingly, transients sounded a little 'dead'. Conversely stereo imaging was to a good standard, and the overall frequency balance was quite neutral.

One of the better moving-coils, the MC1S more or less justifies its price, and its achievement is sufficient to merit recommendation.



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

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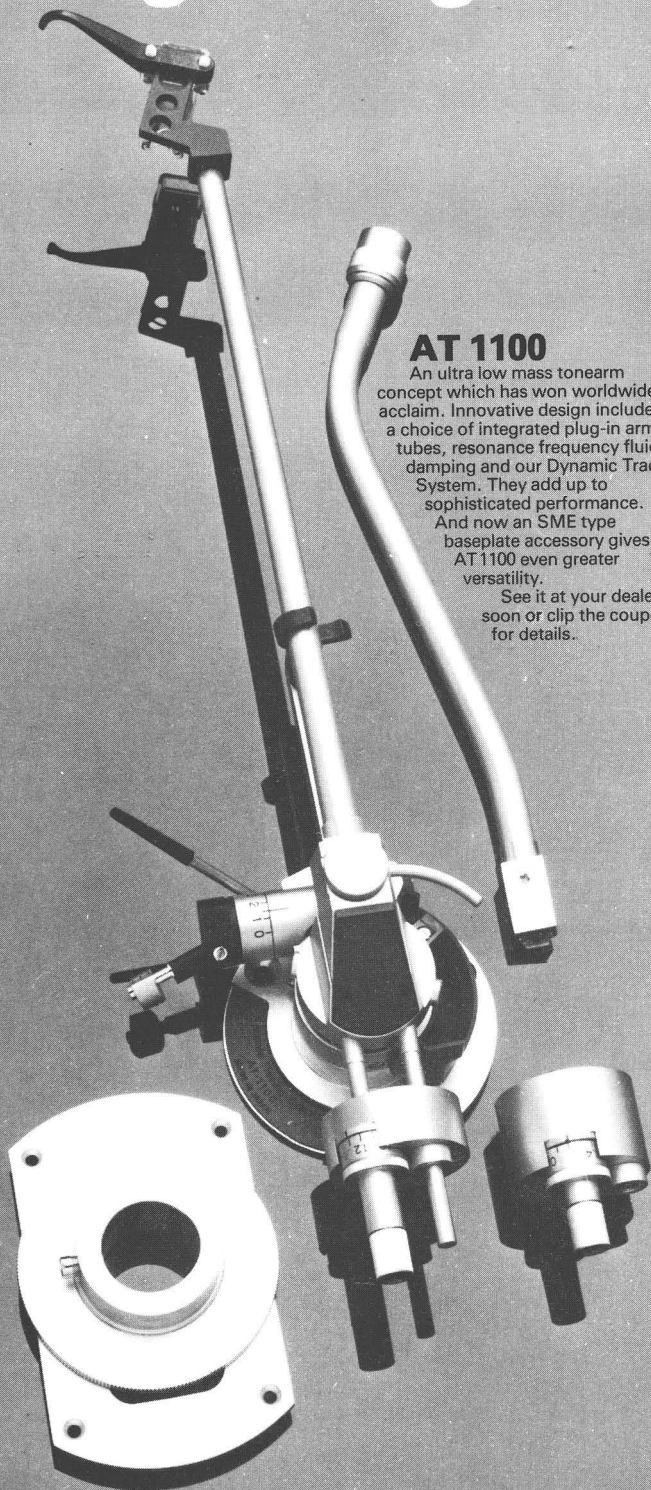
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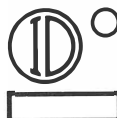
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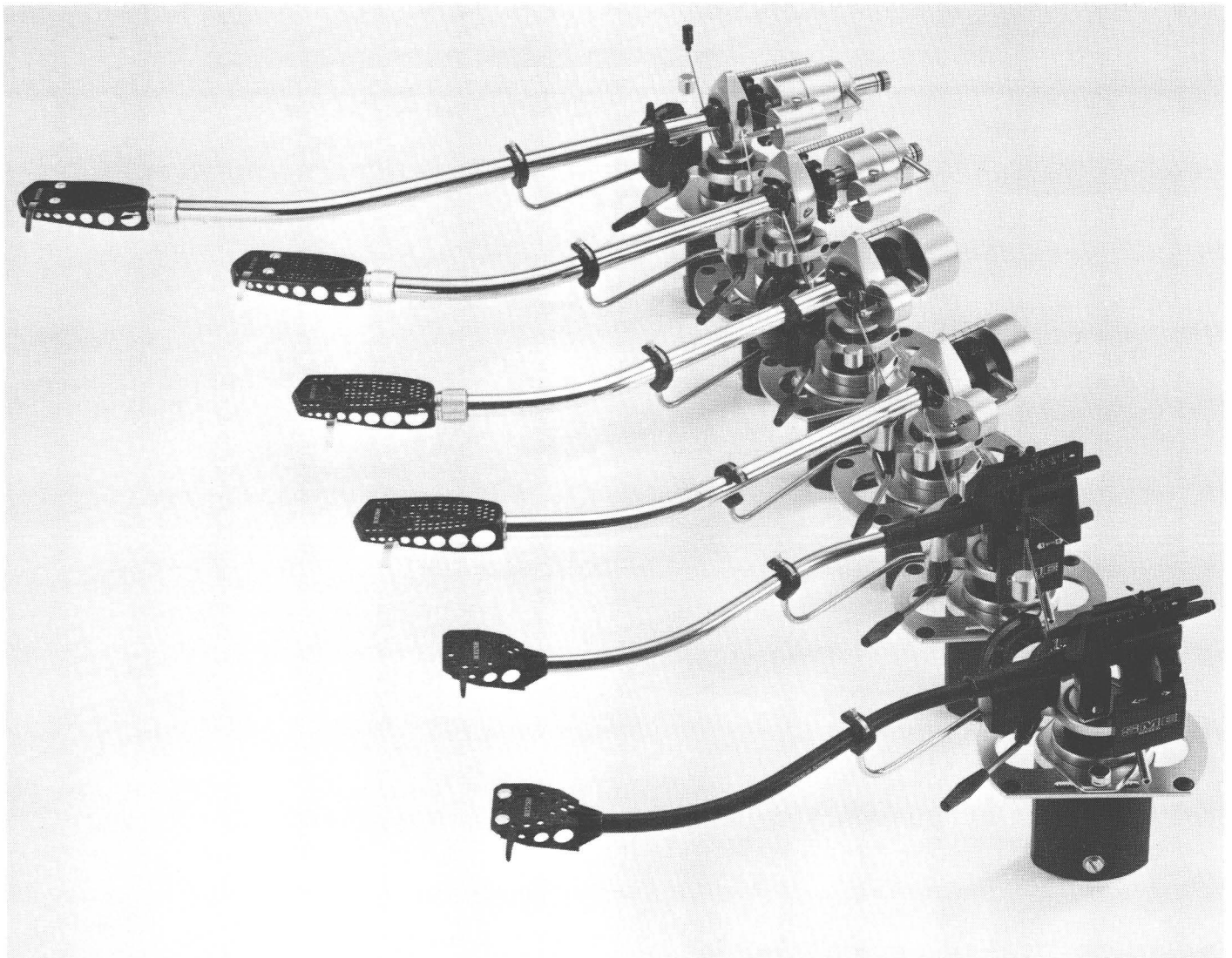
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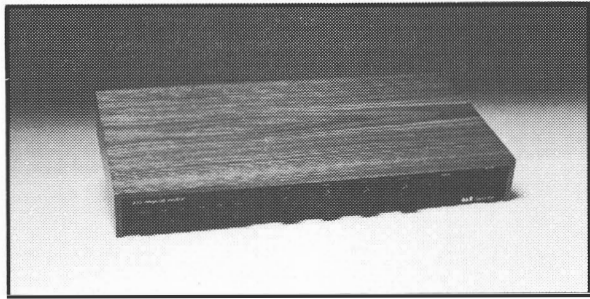
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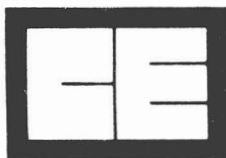
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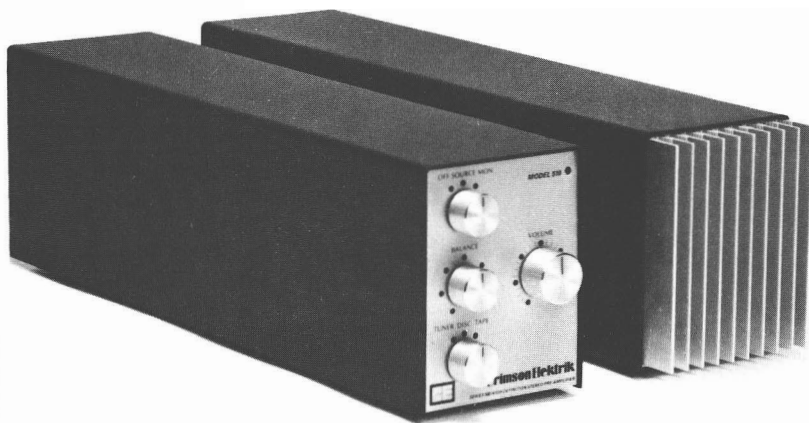
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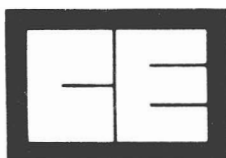
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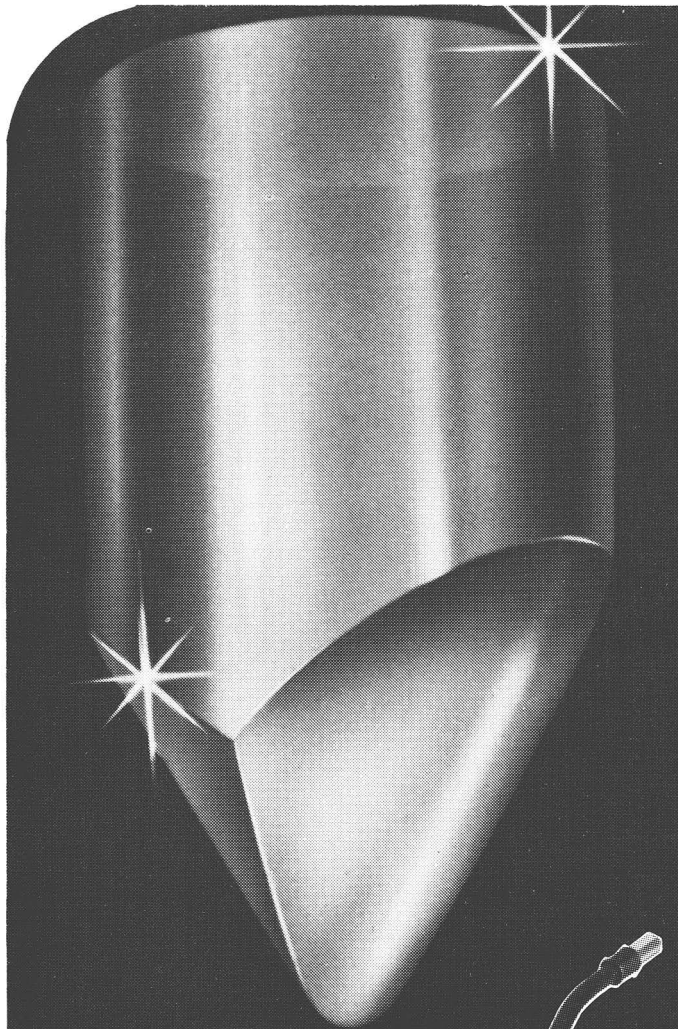
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One of the best-selling pickups ever! Performance second only to the V15 Type IV – but at a more modest price.

## M97HE

Top-of-the-line features and excellent performance at an intermediate price. Features Dynamic Stabilizer and SIDE-GUARD stylus protector.

## M97HE-AH The Headliner™

All the design and performance of the M97HE plus the simplicity of plug-in connection. Allows instant attachment to the tone arm of most turntables.

## M95HE

Features high trackability, flat frequency response, low-loss/high output magnetic pole piece, at a modest price.

## M75HE Type 2

NEW!

The first time HE stylus offered in such a low price range! High trackability, and excellent performance.

## M75HE-J Type 2

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Designed to deliver the best performance from heavier tracking tone arms. Exceptionally modest price.

## V15LT & M97LT (Linear Tracking Models)

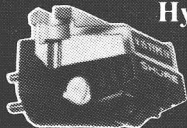
NEW!

Get the most from advanced technology linear tracking turntables! Performance comparable to V15 Type IV and M97HE (respectively).

## MV30HE

Sleek, integral pickup/carrier arm combination for use with SME Series III and SME Series IIIS tone arms. Performance similar to V15 Type IV.

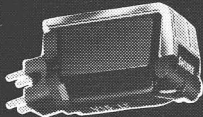
### The HE Family: Hyperelliptical-Equipped



V15 Type IV  
3/4-1 1/4 grams



MV30HE  
3/4-1 1/4 grams



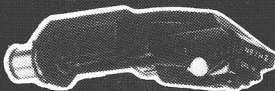
V15 LT  
1 1/4 grams



V15 Type III-HE  
3/4-1 1/4 grams



M97HE  
3/4-1 1/2 grams



M97HE-AH  
(with attached headshell)  
3/4-1 1/2 grams



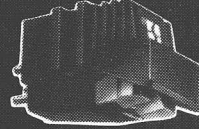
M97 LT  
1 1/4 grams



M95HE  
3/4-1 1/2 grams



M75HE Type 2  
3/4-1 1/2 grams



M75HE-J Type 2  
1 1/4-2 1/2 grams

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# AMPLIFIERS & RECEIVERS

The mass production of consumer electronics, amplifiers in particular, only became feasible some 20 years ago when the transistor took over from the thermionic valve and shook off its own teething troubles. At first germanium transistors were costly and slow acting, but soon transistor technology was racing ahead, and today the power amplification stages of an amplifier (that five years ago would have consisted of perhaps a hundred discreet components) can now be produced as one large integrated circuit. In relative terms amplifiers have never been cheaper, seemingly offering more watts and less distortion yearly.

An amplifier is the core of the hi-fi system, both brain and heart. Brain, because it deals with signals and re-routes them, and heart, because it pumps electricity to the loudspeakers. A rough and ready analogy perhaps but one which serves to demonstrate the basic functions of the essential amplifier. An amplifier can be conveniently divided into three areas or stages. The pre-amplifier stage comprises the inputs and the circuits which immediately buffer or modify those inputs, equalisation or filter networks and of course the volume and balance controls. The pre-amp is also a switch box and can be arranged to connect up tape recorders for duplication and recording. Next section is the power amplifier. This receives its signal from the pre-amp, its job is to multiply this signal from the level supplied by the pre-amp to a sufficient level to drive the loudspeakers. The pre-amp will always deliver a common signal whatever the level of its input.

The third stage of the amplifier is the power supply which may be distributed throughout the pre- and power amplifiers circuits (though in some designs it is discreet circuitry in separate boxes): its job is to supply an unyielding source of electricity to the right places in the amplifier at the right time.

## Pre-amp basics

Some pre-amplifiers lead a separate existence from their power amp while others are contained in a one-box design. Whichever, they can be expected to accept a range of different electrical signals and to process and switch these to produce the one output suitable for amplification by the power amplifier.

## Cartridge (phono) input

The phono input is tailored to the level of signal it will receive from a stereo cartridge. The most common cartridge being the moving magnet type which commonly produces 1 mV on a standard velocity signal recorded on disc. Most cartridges come close to this figure – the cartridge reviews earlier in this guide show their relative outputs. To economise on space and to overcome

surface noise problems, discs are pressed with a signal which has been carefully 'distorted' to have reduced bass and increased treble. The pre-amplifier needs to produce an overall flat frequency response from this cut-bass/boosted-treble signal, so it applies an inverse amplification to boost the bass and cut the treble. This is done to an internationally accepted standard and is known as RIAA equalisation. Our amplifier reviews check how accurately this process is carried out.

To confuse the picture further there is another type of cartridge, the moving-coil type, which does not produce the level of signal that a magnetic model does, and requires a quite different electrical load. Some amplifiers contain circuitry to deal with these cartridges, providing about 20dB more gain, but sadly many of these input circuits are afterthoughts, and a separate step-up device (pre- pre-amp or transformer) can often give better results, as it is designed to interface the moving-coil cartridge with the magnetic phono input.

The electrical load shown by some phono inputs can affect the magnetic cartridge's ability to produce a flat response, and this aspect is commented upon in the amplifier reviews.

## Tape input/output

Tape recorders need two-way contact with the pre-amp to be able to replay their signal through them and to be able to access any other input to record it. The big problem is that there are two international standards for tape connections which are of course incompatible. The DIN standard is of German devising and is incorporated into many European machines while Japanese, American and other manufacturers use the 'RCA phono' plug and socket, but to confuse matters further many amplifiers have DIN sockets fitted that require phono levels and matching impedances.

As most tape machines are best used through their phono sockets if they have them, and most amps have phono sockets, the best advice is that for phono standard signals they prefer to travel from one impedance to a similar or larger impedance (anything up to 100 times bigger), while the sensitivity of the input should be similar or a little less than the output.

The rule therefore is to use phono-to-phono or DIN-to-DIN connections except where DIN is disguised phono and then the rule is to avoid connecting phono outputs to DIN inputs and DIN outputs to phono inputs. Many tape decks have a level control facility to help with these matching problems.

The tape selector switch on the pre-amplifier is almost always a different switch from the main input selector, to allow off-tape monitoring with the more sophisticated cassette decks.

## Additional sockets

Most amplifiers have sockets for the connection of a tuner and an auxiliary input both of which have the same level requirements as the tape inputs and can be interchanged. TV sockets are Aux sockets by another name, and will enable a suitably equipped TV to be connected through the hi-fi system to reproduce television sound (which is, incidentally, high quality FM mono). Duplicate tape sockets enable signal processing devices like graphic equalisers or noise reduction units to be coupled into the system.

## Volume control

The rotary control of fair size is ergonomically unsurpassed for the simple task of adjusting volume level. Many people think they can judge how powerful an amplifier is by how far round they turn the volume control. Other people subscribe to the idea that volume controls should never be anywhere other than half way on. Neither is true. The ideal volume control should give satisfying increments in volume without jumping or bunching. A muting switch can be used to extend the range of the volume control.

## Balance control

This adjusts the balance between the two channels of information passing through the stereo pre-amp. It can be used to make some kind of allowance for sitting closer to one speaker than another or for the asymmetrical positioning of speakers in a room, not to mention compensating for a volume control which doesn't track the two channels it controls that well.

Again a balance control if properly designed should silence one channel when pushed or rotated to its extreme position. Moving the control from one extreme to the other should result in an even shift of signal from one speaker to the other again without bunching near the centre and jumping near the end of travel.

## Stereo/mono switching

I would consider this switch a basic and essential feature as it enables troubleshooting the system to be done far more easily and can be used to reduce broadcast hiss, noise from old mono records (in particularly low frequency out of phase grumblings), or even to check the balance control to get a dead centre mono image.

## Other inputs /outputs and features

A few amplifiers, noticeably those used in rack systems, are fitted with a microphone mixing socket for use both in conjunction with a tape recorder or just to talk over the system's loudspeakers.

Tone controls are one of the most requested and least used features on modern amplifiers. They offer cut and

boost over a wide part of the audio spectrum and some feature switchable turnover points (the frequency at which the cut or boost begins to act). Some amps have mid controls in addition to treble and bass.

What real use are the common tone controls? They are said to be fitted to enable the user to help compensate for room/speaker interactions, to overcome frequency imbalances in other equipment, or to compensate for badly balanced recordings or broadcasts. The treble control may be able to help in some small way with treble reflection/absorption problems with rooms and speaker but acts over rather too wide a range. The bass control is utterly inadequate to compensate for low frequency room/speaker interactions.

It is not difficult to buy inexpensive equipment today which has a flat charted response. If a cartridge's response is out, far better to compensate for this by altering the pre-amp loading; cassette decks too are best used with the tape for which they are aligned and kept well cleaned and demagnetised rather than an attempt be made to get a flat response with the tone controls.

Few people realise how crude tone controls are. Tonal imbalance of the type which could be corrected by the application of treble or bass cut or lift is rarely encountered as a 'fault' on records or broadcasts.

The ears' sensitivity changes with level and frequency. That is to say that as the level of a flat signal is reduced it will appear to lose treble and bass frequencies to the listener who would try to boost top and bottom to keep the signal 'flat' at low levels. Some amplifiers have a *loudness* or *contour* control to compensate for this subjective loss of treble and bass at low levels but so often the curve chosen is one which can be easily had as a fixed value of the tone control circuits rather than one which takes the psychoacoustic curve into consideration. If the loudness control works inversely with the volume control, the chances are that the designer has given it some thought and it may just work well.

Rumble and scratch filters (otherwise called high pass and low pass filters respectively) show the same problems as do the tone controls. Their slopes are too shallow and their turnover frequencies often inappropriately chosen to enable them to remove low frequency rumble from disc or hiss from non-Dolby tape or FM stereo. If the filters have variable rates of attenuation or selectable turnover frequencies they may be of more than cosmetic value. A badly designed steep filter can cause ringing problems; again it is better to look for well-designed curtailing of frequency extremes in the pre-amp stage. Disc equalisation can nowadays have an additional bass roll-off below 20Hz.

### Power amplifiers

The power amplifier's task is to handle the complex alternating voltage signal from the pre-amp and to step up its voltage to a sufficient level to enable the attendant current to drive the loudspeakers with the original music signal. Its problems in doing so are defined by the load presented by the loudspeakers in simple impedance terms and as a complex reactive load and by the amp's

own distortion. Loudspeakers also produce a signal which returns to the amplifier and this the amplifier must take in its stride while driving the speakers. The chapter discussing *Loudspeakers* and the chapter *Putting together a system* both offer advice on how to match power amps and loudspeakers.

### Outputs

Loudspeaker connections on amplifiers need to be able to handle fair-sized stranded wire or perhaps the better type of gold plate spade terminal. Some designs have two pairs of loudspeaker outlets which may be able to be run together or only individually. Check on the amp's capability into low impedance loads if you intend from the outset to buy an amp to drive a main set of speakers and an extension pair. Additionally the speakers should be of nominal 8ohm design without significant impedance dips.

By far the best idea is that adopted by Nytech, in having one pair of directly coupled unswitched loudspeaker outlets, and two pairs of switched sockets. This offers the no-compromise solution for the audiophile and the switched convenience for the other customers.

If your amplifier has only one pair of speaker outlets, beware before you add speaker switching boxes. The amplifier may not be able to drive the low impedance load presented by two pairs of speakers wired up together. Furthermore, the switch contacts may degrade the sound quality over a period of time.

### Power meters

Power amps are being fitted with power output meters more and more. The needle-type VU meters are not usually fast acting enough to respond to peaks, and will only give an indication of the average power being delivered. LED, LCD or fluorescent meters can act quickly enough to give peak indication, but are often given inappropriate sensitivities to let them 'show off' at even low drive levels.

These meters are voltage-sensing devices and presume that the speaker acts like a pure 8ohm resistor (which it doesn't). Power meters are of limited value but can help in keeping an amplifier below its clipping level providing the meters can act fast enough.

### Measurements

The measurements fall into roughly two groups, the basic electrical parameters and the performance measures. The most basic electrical parameter is the power output, which is quoted for a range of impedance loads across the full audio spectrum and at low distortion. The amplifiers are also measured with one channel driven and at different frequencies (midband frequency of 1kHz). If the amplifier can produce more power when driving one channel, this implies that power delivery is being limited when both channels are driven, and suggests that the power supply may be running out of steam.

Ideally an amplifier should be able to maintain its driving voltage and double its current into a halved impedance (4ohms as compared with 8ohms) and double the current output again into 2ohms.

The hurst power test indicates how

well the amp goes into distortion when driven hard.

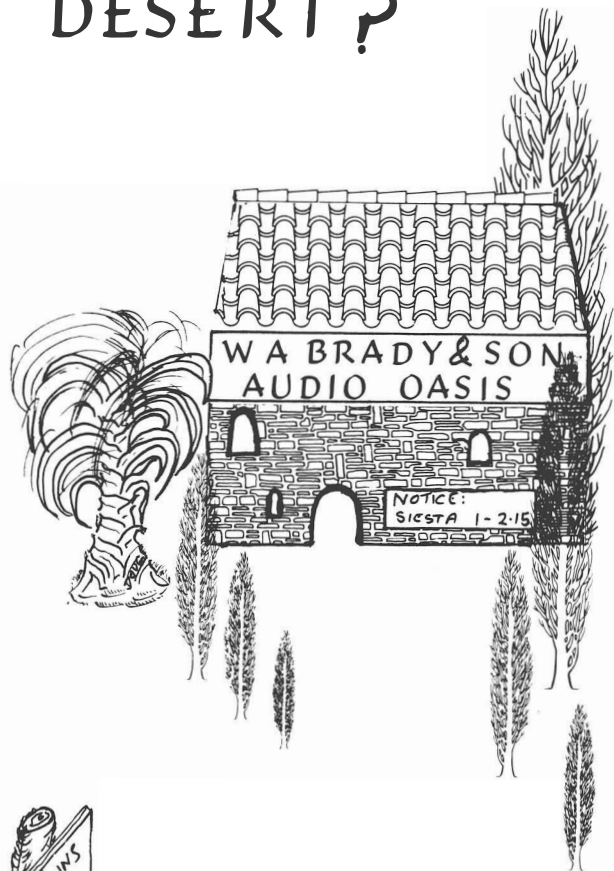
*Damping factor* is the ratio of the amplifiers own impedance to the loudspeakers and the higher the figure the better the amp is at controlling the speaker cones. The *power bandwidth* shows the highest and lowest frequencies at which the amp can deliver reasonable power cleanly; bandwidths of over 50kHz may cause problems. The *Intermodulation Distortion* graphs show the amp's ability to reproduce two similar frequencies while keeping them from interacting. The *Crosstalk* measurement is a measure of the breakthrough from one stereo channel to the next and it should exceed 40dB when it is insignificant compared with the separation of cartridges, tuners and cassette decks.

### Other models worth considering

Brief remarks follow on the amplifiers which were considered to perform and audition above average but were not given Best Buy or Recommended status; they are listed in ascending price order.

The **Marantz PM310** (£69) was considered a good effort at the price. At £100 the **Yamaha A560** offered good facilities and plenty of power but was criticised on audition; similar remarks apply to the **Denon PM510** (£144) and **PM540** (£190) models. The **NAD3140** (£189) was powerful but auditioning results were inconsistent as were both the £260 **Yamaha A960** and the **Rotel RB/RC1010** pre/power combination at £290. **Pioneer's A7** (£270) was felt to be flashy with a lively sound, while the similarly priced **Quantum 207** (£280) offered good power output with promising auditioning results. The **Sugden A48/II** at £280 and the **Rogers A100** at £320 were both felt to offer civilised sound quality and appearance. The **Bryston 3B** (£400) was badly finished but proved to be a gutsy power amp. The **Hitachi HM/CA 7500II** MOSFET combination (£390) were clean if a little 'leaden' while the £485 **JVC AX9** (complete with MC2E cartridge) proved a similar heavyweight performer but sounded more 'chromium plated'. The **Trio KA1000** (£530) auditioned quite well but was considered a little expensive. The **Yamaha C6/M4** (£540) gave excellent technical specs and proved a real heavyweight but auditioned inconsistently. The **Exposure** (£570) auditioned well but proved noisy, while both the **Electro** (£575) and **Meridian 101/105** (£696) power stages were liked (low and high power amps respectively). The **PS Audio** (£670) and **Elite Townshend** (£860) both had promising sound quality but were felt to be rather expensive, the Townshend being a bit noisy too. The **Lentek** integrated amp (£750) had clean and neutral sound with wide flexibility. **Amcron's** technical masterpiece, the £3000 **SA2/DL2**, proved an ergonomic embarrassment for domestic use at a silly price, though the power amplifier showed a lot of promise.

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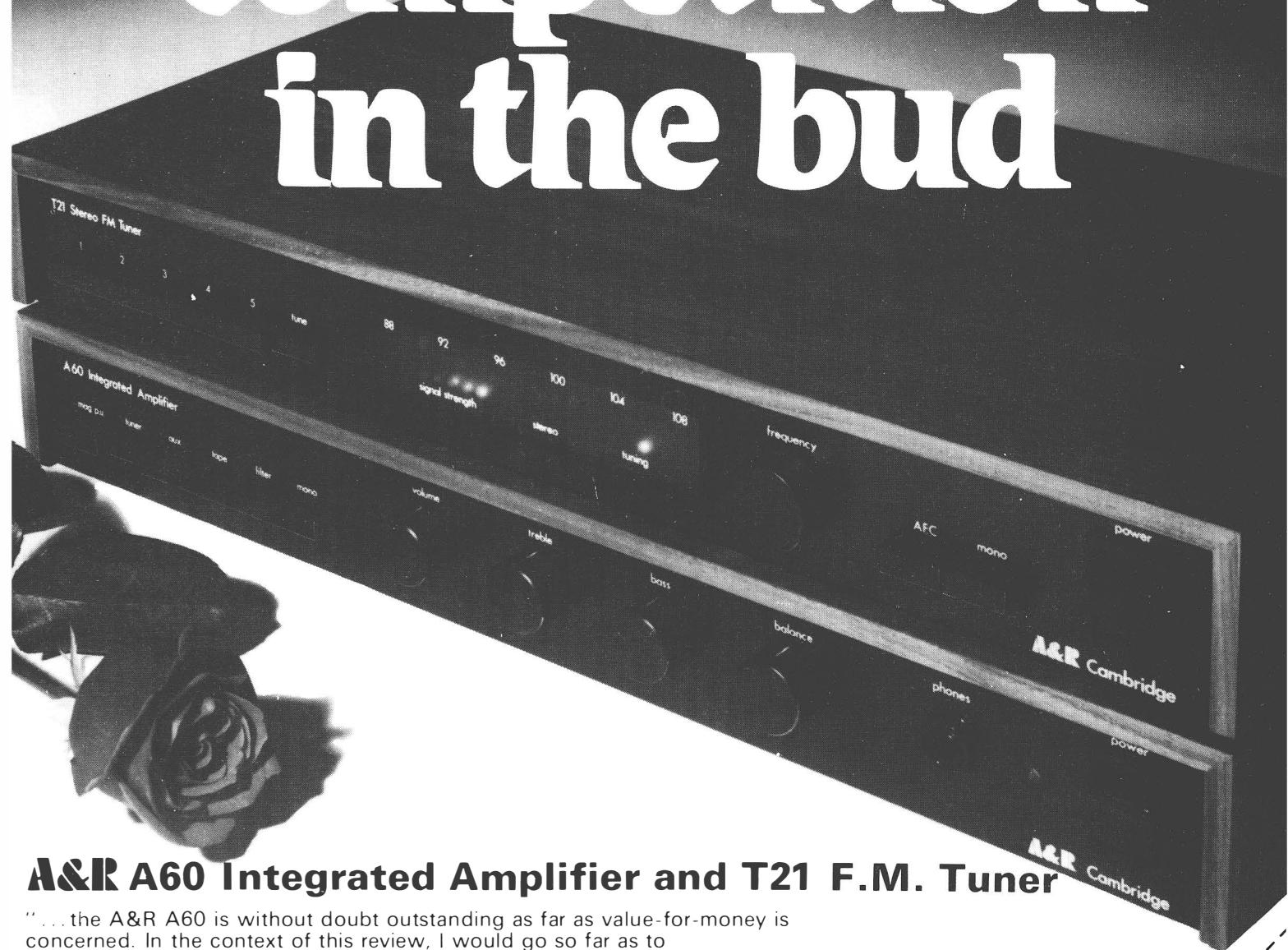
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*Chris Rogers, "Britain V. Japan", Practical Hi Fi, January 1980*

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*Chris Frankland, "Getting in Tune", Popular Hi Fi, December 1979*

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*Dave Watson and Paul Messenger, Hi Fi Choice no.19, Receivers, Tuners & Amplifiers*

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*David Wren, "First Impressions", Hi Fi for Pleasure, March 1980*

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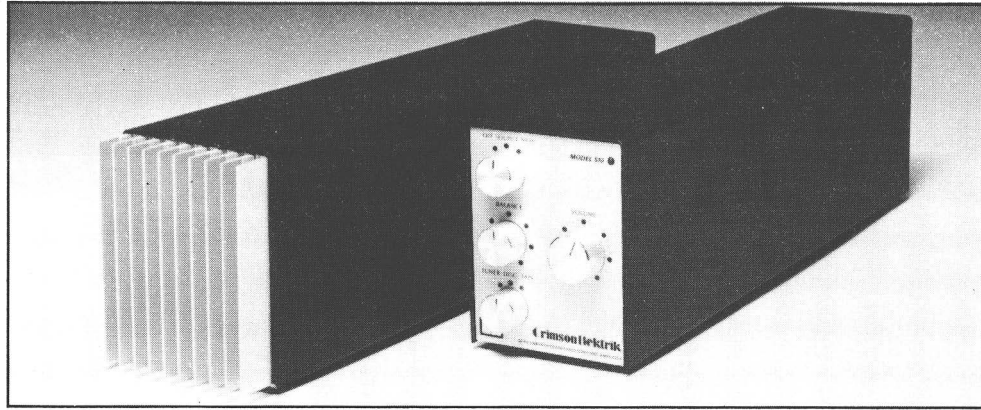
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**RECOMMENDED**

# Crimson 510/520

Crimson Elektrik, 9 Claymill Road, Leicester. Tel (0533) 761920



## Presentation, facilities etc

Crimson is quite a new company to amplifier manufacturing, with its roots in the design and preparation of low cost powerful designs for the kit market. The 510/520 is a complete break with these traditions, and is a highly unusual design in several ways. The pre- and power amplifier modules are deep (but so is a record players), and narrow, so that they take up very little space. The standard of finish is a bit 'cottage industry', though it is quite acceptable in a rather low profile way, and some might regard it as refreshingly simple and down to earth. Some care is necessary in siting to avoid hum.

The 'tubes' have a black crackle finish on the wrapped metal covers, with one end finished in silver the other in red. The silver end is the bit you look at, with the pre-amplifier sporting an LED 'on' indicator light (important, see later), and four rotary knobs, the larger one controls volume, the others balance, input selection, and on/off/tape monitor. The 'crimson' end of the pre-amp has phono sockets throughout, plus a jack socket for those using the rechargeable battery pack. Yes the pre-amp runs off batteries, 2 PP9s or rechargeable equivalent, partly for cost but mainly for technical reasons. The pre-amp may be modified internally for either moving magnet or moving-coil operation, add-on modules giving capacitance matching for the former and sensitivity/impedance for the latter. Battery life (£2.20 a set) is estimated at 3 months+ of 2-3 hrs/night, and the rechargeable batteries plus charger cost about £45. The power amplifier has an 'on' indicator LED on the silver front heatsink, though the on/off switch is inconveniently sited on the rear, with phono sockets 'in' and 4mm sockets 'out'.

## Lab performance

Power output is quite modest, though nonetheless adequate for most domestic uses, and is reasonably maintained into low impedance, though the very lowest impedance speakers should perhaps be avoided. A rather large difference between single and dual channel drive indicates some power supply limitations.

Bandwidths show generally good control, particularly at low frequencies. The RIAA LF roll-off is nicely tailored, though there is a 1 dB rise in the treble. Disc input matching is effectively infinitely flexible via the module system, and as supplied the m-c input was probably more sensitive than necessary. THD was effectively masked by the noise of the system, which was a little below average, and little perturbation can be seen on the IM spectrum, with noticeably less of the 'noise modulation effect' which we found with some amplifiers. Crosstalk was poorer than average, though adequate nonetheless, and the hum performance was a little disappointing considering the pre-amp battery operation. The manual warns that the units should not be sited side by side, with which we agree. Mains transformer mechanical hum was modulated by the demands made on the power amplifier. Overall then results are unspectacular but show some promise; this is a flexible design with still a little room for improvement.

## Listening impressions

Very positive results were obtained in the listening tests, with the units consistently receiving well above average praise, largely because the sound was felt to be much more controlled than with most designs. It stood out clearly on the blind tests, with praise for coherence, control,

dynamics, stereo and neutrality, though it was also considered a trifle 'bright' and qualitatively the bass might have been 'tauter'. It was considered to maintain its character rather well when driven loud. "A good 'un", as someone summed it up.

## Conclusions

This is a new design with its fair share of 'wrinkles' which offer some room for further development and improvement. And by its very nature it is something of an enthusiasts device, with operation not entirely convenient. But the fine subjective balance for the price demands recommendation, though the slightly quirky nature of the models are sufficient to keep it from best buy status this time around.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz  
8 ohms, 0.1% dist ..... 41/43/42 Watts  
o/p level ref 2.83V=0dB ..... 16/16.3/16.3dB  
Single channel 8/4/2 ohms

1kHz, 0.1% dist ..... 54/79/93 Watts  
o/p level ref 2.83V=0dB ..... 17.3/16.0/13.7dB  
Single cycle power 1kHz, 8/4/2 ohms ..... 74/128/189 Watts  
o/p level ref 2.83V=0dB ..... 18.7/18/16.8dB  
Dynamic headroom (IHF) ..... 0.7dB

### Bandwidth (-3dB below half power)

Disc in - power out ..... 20Hz - 58kHz  
Disc in - pre out ..... 20Hz - 103kHz  
Disc in - tape out ..... 5Hz - 142kHz  
Aux in - power out ..... 20Hz - 61kHz  
Power amp only ..... DC Hz - 65kHz

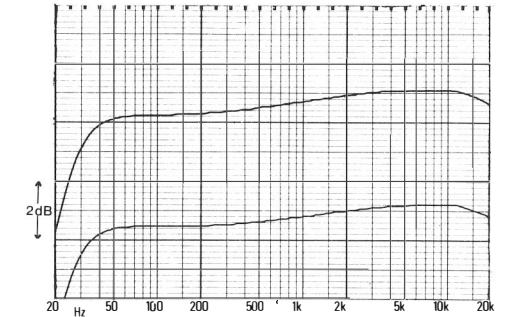
Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.3	45k	47
Disc MC	Phono	0.04	86	
Tuner/Aux	Phono	52	47k	
Tape	Phono	52	47k	

Disc overload MM ..... 38dB  
Disc overload MC ..... 38dB

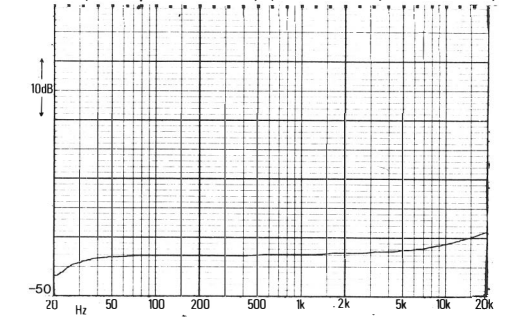
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape	Phono	100	1.7

**Noise (ref 1 Watt, 8 ohms)**  
Zero volume ..... -77dB  
Aux ref volume ..... -76dB  
MM disc ref volume ..... -76dB  
MC disc ref volume ..... -73dB

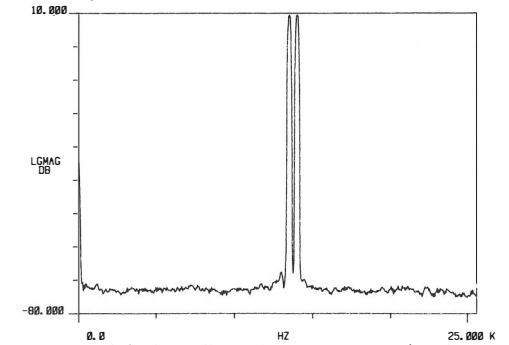
**Other**  
Damping factor ..... 31  
THD performance ..... good  
Hum performance ..... below average  
Dimensions (W x D x H) ..... 2 x [3.3(8.5) x 15(38) x 4.3(11)] ins(cms)  
Weight ..... 15 lbs  
Typical purchase price ..... £228



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

**BEST BUY**

# JVC AX1

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



## Presentation, facilities etc

Definitely for those who like the shiny silver look, the AX1 is beautifully finished but has a rather sharp protruding fascia, and is presumably intended first and foremost for console/rack mounting. Like the Technics models the fascia is divided horizontally, with the most useful functions (plus obligatory (?) 'power' meters) in the larger top section. Four long bars switch power, disc, aux and tuner inputs and a large smooth knob controls volume.

The lower section has rotary controls for balance, bass and treble, plus sensibly arranged tape monitoring, mode, loudness, speaker switching and a headphone socket. Phono socketry on the back panel is supplemented by one DIN duplicate tape connector. Construction does show some signs of economy, but this is only to be expected at the price. In all this is a smartly finished amplifier with all the necessary basic facilities, nicely laid out and easy to use.

## Lab performance

Power output is fairly modest, though adequate for most purposes nonetheless. Moreover it shows a good delivery pattern, with no restriction due to distortion rising at the frequency extremes, healthy outputs into 4 and 2 ohm loading, and a significant but by no means excessive difference between single and dual channel drive. Once again there is evidence of cost effective engineering rather than ill-balanced 'spec chasing', and it is unlikely that there will be any problem in choosing matching loudspeakers.

Bandwidths are reasonably sensible through the amplifier, and the RIAA curve is smooth with slight rolloffs at the extremes, which is usually a

good recipe for a low cost design. One anomaly which we noted was a 5dB rise in output to tape from disc between 10kHz and 100kHz: this is clearly wrong, though it is difficult to assess just what problems it may cause in practice. We are inclined to think that it is probably harmless, though the wrong high output moving-coil cartridge and the wrong tape recorder might result in interference with the bias oscillator. The IM distortion spectrum showed some low level sidebands, but the 'noise modulation effect' was less serious than in many other cases. Inputs and outputs are all sensibly chosen, with the disc input capacitance a nice and low 110pF (easily increased with external adaptors if required). Noise figures were excellent, and the fact that distortion is around this threshold is further evidence of good design.

## Listening impressions

This amplifier did consistently well in the listening tests, comfortably rating above average overall. The bass was considered very good for a budget amplifier, just a trifle 'loose' but quite convincing nonetheless. The sound did perhaps lack finesse, sounding a little 'loud' and 'untidy', but it was generally quite well integrated with good stereo/depth, plenty going on and a quite exciting sound. The question that will inevitably be asked is whether or not it is a 'NAD-beater'. The answer as far as we are concerned must be no, but then neither is the NAD an AX1 beater either. They did similarly well overall, with the AX1 being perhaps a little more lively and untidy, yet quite neutral, while the 3020 benefited from marginally better integration and control at high frequencies, yet sounded a little more 'coloured'. Certainly this amplifier looks like a worthy rival.

## Conclusions

Its nice to find a budget amp where the compromises appear to have been very well chosen, where the listening tests give positive results, and where resources do not seem to have been wasted excessively on gimmicks and in pursuit of unbalanced specification parameters.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz  
8 ohms, 0.1% dist. .... 37/37/36 Watts  
o/p level ref 2.83V=0dB ..... 15.7/15.7/15.5dB  
Single channel 8/4/2 ohms

1kHz, 0.1% dist ..... 41/65/108 Watts  
o/p level ref 2.83V=0dB ..... 16.2/15.1/14.3dB  
Single cycle power 1kHz, 8/4/2 ohms ... 51/95/138 Watts  
o/p level ref 2.83V=0dB ..... 17/16.8/15.4dB  
Dynamic headroom (IHF) ..... 0.7dB

### Bandwidth (-3dB below half power)

Disc in - power out ..... 8 Hz - 71 kHz  
Disc in - tape out ..... 4Hz - >200kHz  
Aux in - power out ..... 7Hz - 50kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.8	49k	110
Tuner/Aux	Phono	160	62k	
Tape 1 & 2	Phono	160	73k	
Tape 1	DIN	160	73k	

Disc overload MM ..... 35dB

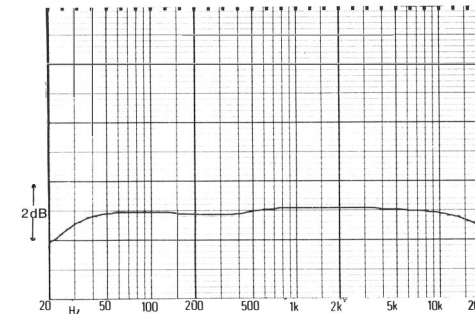
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	290	510
Tape 1	DIN	30	66k
Headphones (8 ohms)		100	
	(2 kohms)	2.6V	

### Noise (ref 1 Watt, 8 ohms)

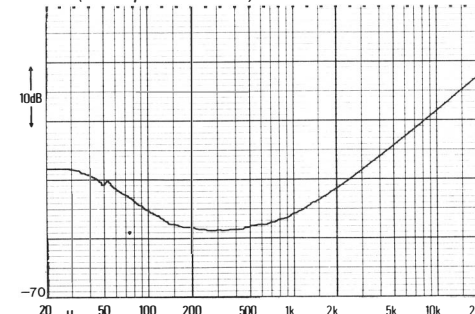
Zero volume ..... -87dB  
Aux ref volume ..... -80dB  
MM disc ref volume ..... -80dB

### Other

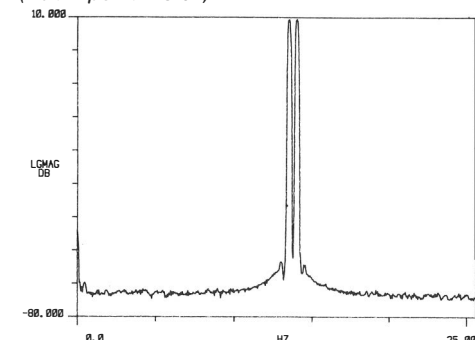
Damping factor ..... 43  
THD performance ..... very good  
Hum performance ..... average  
Dimensions (W x D x H) ... 16½(42) x 13(33) x 4¼(12) ins (cms)  
Weight ..... 13lbs  
Typical purchase price ..... £72



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz. 0-25kHz linear; vert. range 90dB)

**RECOMMENDED**

# Marantz PM5

Marantz UK Ltd., 15/16 Saxon Way Ind. Estate, Moor Lane, Harmondsworth, Middx. UB7 0LW. Tel01-897 6633



## Presentation, facilities etc

Originally marketed as part of the Marantz *Esotec* brand, the *PM5* is joining the top of the regular range now, with a welcome £100 price reduction. This large integrated model has a gold-coloured fascia which stands proud of the case proper, for console mounting, and is decorated with a large range of features. One quite unusual facility is that the power amplifier may be switched to operate either in Class A or in Class B modes: in theory Class A is considered to be superior because it eliminates 'crossover distortion' which may be caused when switching from one output transistor to another, though in practice any benefit is far from proven, and also 'wastes' power as heat.

The copious facilities include tone controls which operate independently on each channel, elaborately scaled light-type 'power' meters, a five-position mode selection switch, selection for two sets of speakers plus a headphone socket, and monitoring and dubbing for two tape recorders. Provision is made for both moving-coil and moving magnet cartridge types, and front panel switches also operate a loudness function, a subsonic 'rumble' filter, and a tone control bypass switch, the latter rather obscurely labelled 'straight DC'. The layout of the front panel knobs and switches has a pleasing symmetry, though this does not assist in finding the volume control easily, nor is it complemented by the inevitable Marantz confusion of logo typefaces scattered hither and thither. All inputs and outputs are on phono sockets. When in use, particularly in Class A mode, the unit naturally gets quite warm, so some care needs to be taken to ensure adequate ventilation.

## Lab performance

The significant heat output from this model was noted, causing a continuous 'ticking' from the heat pipe which is used to cool the transistors. Power delivery comfortably exceeded the 80/20 specification, though why the power meters are scaled to 200/50 watts/8ohms remains obscure. A significant though not excessive difference between single and dual channel drive power outputs may be seen in Class B mode, but the power delivery into low impedances was generally well maintained, so choice of accompanying loudspeakers should not be critical.

Bandwidths show sensible curtailment at the frequency extremes, but the disc input frequency responses do show a mild low frequency 'bump' of about 1dB, sufficient to be audible and introduce a measure of tonal coloration, though unlikely to be considered offensive. More worrying perhaps is our measured input capacitance of 370pF on the moving magnet input: although it could be argued that this can help control ultrasonic spurious from modern wide-bandwidth cartridges, the fact remains that it will also have an undesirable effect upon the high frequency audio band response of a significant number of models, particularly with the typical extra 150pF provided by the turntable's pickup leads. The discrepancy between our finding and the 150pF measured for a similar amplifier (*Colloms: Hi-Fi News May 1981*) remains unexplained. In other respects the inputs and outputs show well chosen values that should cause no compatibility problems.

The other measured technical performance parameters were to a competent standard, with the crosstalk better than 50dB across most of the

audio band, noise figures a little below average, while the intermodulation spectrum shows no specifically identifiable sidebands, though there is a rise in noise related to the test signals.

## Listening impressions

The listening tests gave generally positive results, with the overall ranking well above average, albeit with occasional dissent. Most criticisms were directed at a rather 'bright' treble, and little difference was noted between Class A and B operation. Some informal auditioning was also undertaken with the related *MA5* mono power amplifiers, which showed a slight improvement, and also a slight change between modes when driven from a high quality component pre-amp.

## Conclusions

This was definitely considered amongst the more lively, dynamic and informative integrated amplifiers, and gave a well balanced subjective performance for the price. Some reservations nevertheless remain concerning the moving magnet input capacitance and the perhaps unnecessarily elaborate arrangements (cooling etc) needed to provide the Class A option.

## GENERAL DATA

**Power stage** Class B  
 Both channels 20Hz/1kHz/20kHz  
 8 ohms, 0.1% dist. .... 99.4/100/98 Watts  
 o/p level ref 2.83V=0dB ..... 20/20/20dB  
 Single channel 8/4/2 ohms  
 1kHz, 0.1% dist. .... 113/182/237 Watts  
 o/p level ref 2.83V=0dB ..... 20.5/19.6/17.7dB  
 Single cycle power 1kHz, 8/4/2 ohms ..... 156/276/360 Watts  
 o/p level ref 2.83V=0dB ..... 21.9/21.4/19.8dB  
 Dynamic headroom (IHF) ..... 1.05dB

**Power stage** Class A  
 Both channels 20Hz/1kHz/20kHz  
 8 ohms, 0.1% dist. .... 25/25/25 Watts  
 o/p level ref 2.83V=0dB ..... 14/14/14dB  
 Single channel 8/4/2 ohms  
 1kHz, 0.1% dist. .... 26/44/65 Watts  
 o/p level ref 2.83V=0dB ..... 14.1/13.4/12.1dB  
 Single cycle power 1kHz, 8/4/2 ohms ..... 29/48/81 Watts  
 o/p level ref 2.83V=0dB ..... 14.6/13.8/13dB  
 Dynamic headroom (IHF) ..... 0.24dB

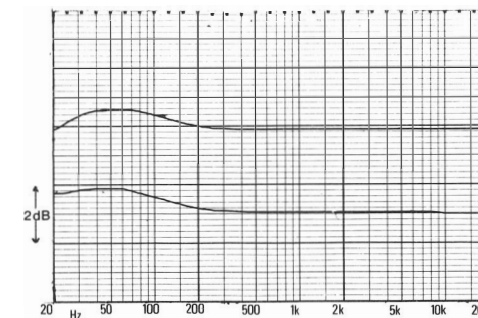
**Bandwidth** (~3dB below half power)  
 Disc in - power out ..... 5Hz - 51kHz  
 Disc in - pre out ..... 4Hz - 52kHz  
 Disc in - tape out ..... 4Hz - 175kHz  
 Aux in - power out ..... 3Hz - 46kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	54k	370
Disc MC	Phono	0.25	74	
Tuner/Aux	Phono	180	39k	
Tape 1 & 2	Phono	180	39k	

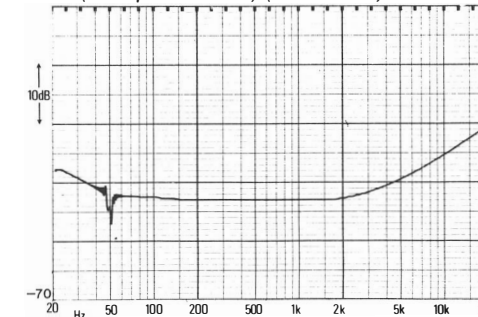
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	325	600
Headphones (8 ohms)		70	
(2 kohms)		2.5V	

**Noise** (ref 1 Watt, 8 ohms)  
 Zero volume ..... -82dB  
 Aux ref volume ..... -78dB  
 MM disc ref volume ..... -78dB  
 MC disc ref volume ..... -74dB

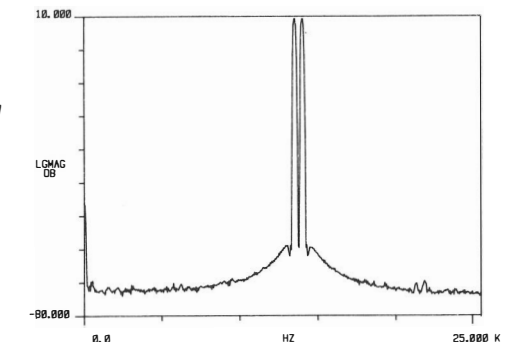
**Other**  
 Damping factor ..... 77 (Class A, 64)  
 THD performance ..... excellent  
 Hum performance ..... average  
 Dimensions (W x D x H) ... 16½(42) x 14½(37) x 6(15) ins(cms)  
 Weight ..... 28lbs  
 Typical purchase price ..... £400



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



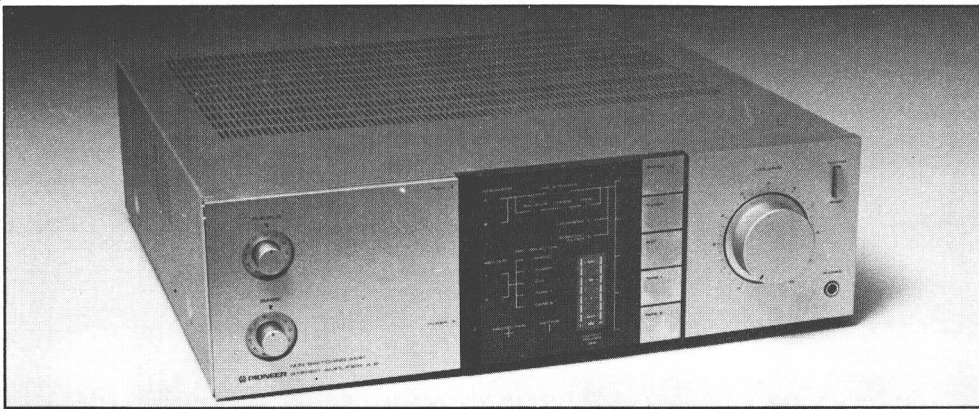
Intermodulation distortion spectrum (horiz 0-25kHz linear, vert. range 90dB)



**RECOMMENDED**

# Pioneer A8

Pioneer UK Ltd., Pioneer House, The Ridgeway, Iver, Bucks. SL0 9JL. Tel (0753) 65222/7



## Presentation, facilities etc

This middle model of Pioneer's 'big three' is difficult to distinguish from the cheaper A7. The fascia is divided into three full height sections finished in gold, black plus lights, and gold respectively. The right hand section is dominated by a huge volume control with an attendant muting button. A neatly indented row of large pushbuttons select the inputs: these are attractively engraved but not easy to read, while the light show next door only identifies them in hieroglyphics.

A hinged and retractable panel covers the left hand section, with just the tone control knobs peeking through (why?) When retracted a confusion of nine little buttons is revealed, to switch mm/m-c disc, speakers A and B, 'line straight' tone bypass, mono/stereo, subsonic filter, loudness, high/low mm and m-c loading, the latter giving 200/400pF mm options and 33/100ohm m-c alternatives.

Two extra rotary controls adjust balance and sort out tape recorder switching, allowing any input to be recorded independently of the main signal playing, and organising cross-dubbing. In the centre the 'light show' gives a graphic and hard-to-ignore display of the signal routing through the amplifier. This does help to overcome ambiguities in the switch labelling, but the absence of any dimming/off switch and the use of three lurid colours makes this a difficult item of equipment to ignore. Adding further muscle to the display is a vertical 'power' meter, while the main power switch is tucked away almost as an afterthought, black on black with only a red blip to attract attention.

## Lab measurements

Power delivery follows a similar pattern to the A7, offering about 1dB of extra level. Delivery was quite well maintained into 4 ohms, though somewhat curtailed into 2ohms, so a little caution is necessary when choosing loudspeakers particularly if wanting to use two pairs together and loudly, though the 'minimum 12ohms' instructions under these conditions on the back panel is quite impractical. Single/dual channel drive difference is on the large side.

The bandwidths show a measure of control, though with a certain randomness, and no LF rolloff has been incorporated. Although the intention was presumably to improve upon the A7, as it turned out the measurements were marginally poorer overall, though pretty good nonetheless. Once again distortion was vanishingly small, while the IM test shows some 'noise modulation effect', but no distinct sidebands to speak of. The tone control circuits should be switched out unless really (?) necessary, since they adversely affect the distortion and noise performance. The provision of alternative disc input capacitances is usually useful, but the values we measured are 10% higher than specification, and the 200/400pF spec would have been much more useful as 100/300pF in any case. So despite these alternatives some care needs to be taken with turntable and cartridge selection, though mismatches are likely to be minor. We cannot see the 450pF+ setting proving to be much benefit at all, unless it helps control the input bandwidth at high frequencies.

## Listening impressions

Listening test results were not entirely consistent,

but the overall rating was comfortably above average in spite of this, and some listeners responded quite positively towards this amplifier. The extreme bass seemed unusually well controlled, and was quite powerful with reasonable detail and definition. A slight preference was made for moving magnet over moving-coil inputs, and there were occasional touches of 'brashness', but by and large the dynamics were quite liked and the amplifier did not seem to become too distressed when driven loud.

## Conclusions

This appears to be a soundly engineered amplifier with few if any criticisms, albeit with fairly conservative power ratings for the price. Listening tests gave encouraging though not entirely consistent results, and the technical niggles were few and slight. Ergonomics are quite good, but the Star Trek presentation might not suit everybody.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz  
 8 ohms, 0.1% dist. .... 102/108/99 Watts  
 o/p level ref 2.83V=0dB. .... 20.1/20.4/20dB  
 Single channel 8/4/2 ohms  
 1kHz, 0.1% dist. .... 124/198/149 Watts  
 o/p level ref 2.83V=0dB. .... 21/19.9/15.7dB  
 Single cycle power 1kHz, 8/4/2 ohms ... 143/231/156 Watts  
 o/p level ref 2.83V=0dB. .... 21.6/20.6/15.9dB  
 Dynamic headroom (IHF) ..... 0.46dB  
**Bandwidth** (-3dB below half power)

Disc in - power out ..... DC Hz - 75kHz  
 Disc in - tape out ..... 5Hz - 40kHz  
 Aux in - power out ..... DC Hz - 90kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.3	50k	220/450
Disc MC	Phono	0.25	33/100	
Tuner/Aux	Phono	150		
Tape	Phono	150		
Tape	Phono	150		

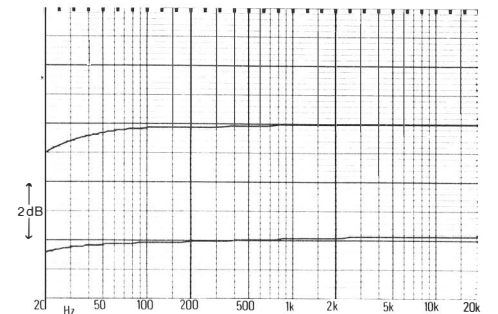
Disc overload MM ..... 39dB  
 Disc overload MC ..... 39dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1	Phono	235	3k
Tape 2	Phono	235	3k
Headphones (8 ohms)		65	
(2 kohms)		2.5V	

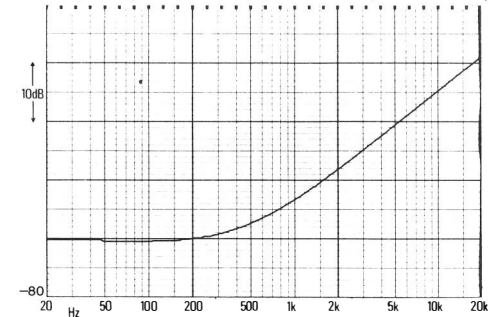
**Noise** (ref 1 Watt, 8 ohms)  
 Zero volume ..... -89dB  
 Aux ref volume ..... -81dB  
 MM disc ref volume ..... -80dB  
 MC disc ref volume ..... -77dB

### Other

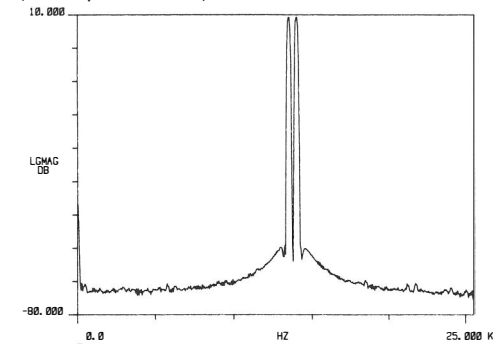
Damping factor ..... 74  
 THD performance ..... excellent  
 Hum performance ..... good  
 Dimensions (W x D x H) ... 16½(42) x 16½(42) x 5(12) ins (cms)  
 Weight ..... 29lbs  
 Typical purchase price ..... £330



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

RECOMMENDED

# Sansui A9

Sansui UK Ltd., Unit 10A Lyon Ind. Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel 01-575 1133



## Presentation, facilities etc

This is the top model of the 'super compo' threesome, and consequently is the most elaborate in terms of features and facilities. The same basic chassis has been used, as well as the 'window' along the full length of the fascia, though both the large rotary controls have been replaced by pushbuttons. Input selection has light indication and is now entirely controlled by pushbuttons/bars. The real extra is rather more useful perhaps than the mike input/blend fitted to the A7, and gives the option of moving-coil or moving magnet cartridge matching. Once again tape dubbing may be switched and recordings made from a tuner input when the amplifier is playing from any source.

The rotary controls operate tone, balance and variable loudness, while control over volume has been delegated to two large pushbuttons necessarily augmented by a light indicator bar. How this can be anything but a fatuous gimmick on any item not actually needing digitised controls for remote operation escapes us. Not only does one lose control of the rate at which volume may be changed and is unable to set the volume before connecting power, but the simple single analogue control must be replaced by two buttons and a visual indicator. Other pushbuttons of rather fiddly dimensions control either/or/off loudspeakers and a high filter. Phono sockets are used throughout, with the tape 2 set duplicated on the front panel, a useful way of temporarily connecting a second machine without entangling the 'spaghetti' at the back of the installation.

## Lab performance

Power output is again generous for the price,

showing some similar characteristics to other A-series models, being reasonably well maintained into 4ohm loads and even able to deal quite respectably with 2ohms particularly in the short term. Our specification for power being measured at the level of 0.1% distortion has restricted our reading at high frequencies to an unfortunate degree, showing that the distortion begins to rise quite early on. There is still a significant difference between single and dual channel drive, though this is not as pronounced as in the cheaper models in the series.

Bandwidths show some attempt at control, but the RIAA equalisation at high frequencies is not correct and can lead to over-driving within the amplifier and give rise to slew rate limiting problems. The amplifier is just at the threshold of this. Disc input capacitance is rather high, which will restrict the range of cartridges which can be optimally loaded. Shure and Ortofon models, plus those insensitive to loading like moving-coil, Grado and Technics models, are likely to give the best match. Tape output impedances are rather high, though practical problems are most unlikely. Although the IM distortion test gave good results, hum breakthrough and THD+ noise via disc were well below average.

## Listening impressions

This amp received a somewhat mixed reception on the listening tests, though it was certainly better received than its cheaper brethren, and on occasion attracted quite favourable comment. Results were not entirely consistent, and the m-c input did not give such good results (bandwidth matching?). The midrange was well liked if a little 'forward', and the dynamics were considered

reasonable. Extreme bass and treble received criticism for lack of control, likewise the overall performance when the volume level was increased. But the sound as a whole was slightly above average, which is quite respectable for an amplifier in its price class.

## Conclusions

Lots of power and facilities for the money, and clearly a better power supply and listening test results than its cheaper stablemates suggest that this model has quite a lot going for it. But there are a number of areas of technical reservation, particularly on the disc input and its high frequency capability, so pre-auditioning in a system context is vital if this amplifier is considered.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz  
 8 ohms, 0.1% dist ..... 86/88/20 Watts  
 o/p level ref 2.83V=0dB ..... 19.3/19.4/13dB  
 Single channel 8/4/2 ohms  
 1kHz, 0.1% dist ..... 105/156/162 Watts  
 o/p level ref 2.83V=0dB ..... 20/18.9/16dB  
 Single cycle power 1kHz, 8/4/2 ohms ... 126/220/272 Watts  
 o/p level ref 2.83V=0dB ..... 21/20.4/18.3dB  
 Dynamic headroom (IHF) ..... 0.5dB

### Bandwidth (-3dB below half power)

Disc in - power out ..... 7Hz - 63kHz  
 Disc in - tape out ..... 6Hz - 52kHz  
 Aux in - power out ..... DC Hz - 61kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	49k	330
Disc MC	Phono	0.16	9	
Tuner/Aux	Phono	156	60k	
Tape 1	Phono	156	60k	
Tape 2	Phono	156	60k	

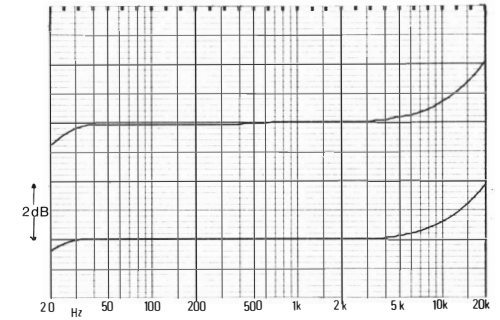
Disc overload MM ..... 38dB  
 Disc overload MC ..... 36dB

Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1	Phono	200	4.9k
Tape 2	Phono	800	4.9k
Headphones (8 ohms)		100	
(2 kohms)		2.5V	

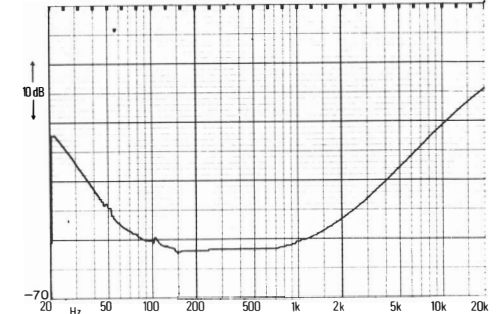
**Noise** (ref 1 Watt, 8 ohms)  
 Zero volume ..... -77dB  
 Aux ref volume ..... -73dB  
 MM disc ref volume ..... -72dB  
 MC disc ref volume ..... -71dB

### Other

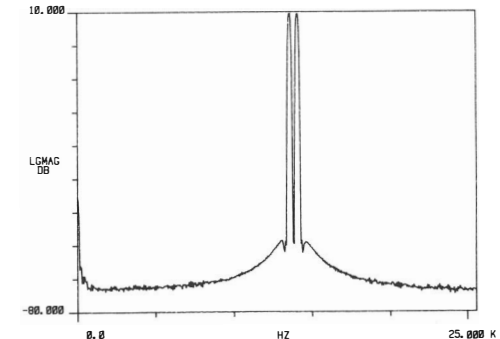
Damping factor ..... 48  
 THD performance ..... below average  
 Hum performance ..... below average  
 Dimensions (W x D x H) ... 17(43) x 10(25) x 5½(13½) ins (cms)  
 Weight ..... 16 lbs  
 Typical purchase price ..... £135



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)

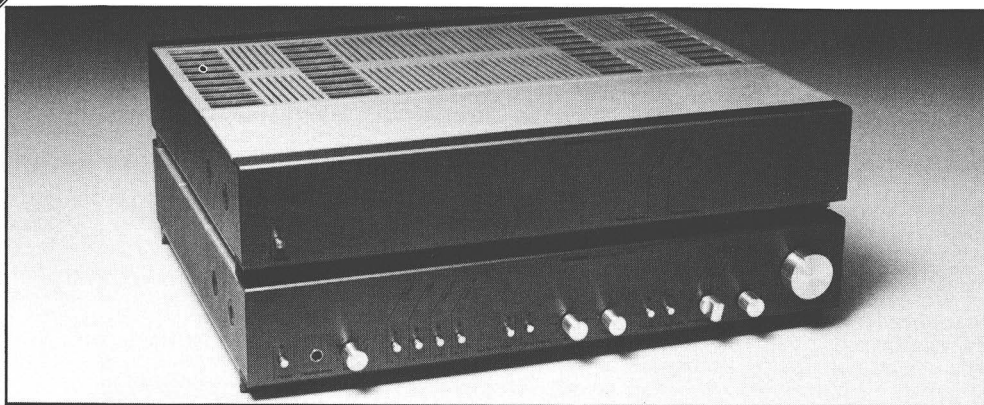


Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

RECOMMENDED

# Tandberg 3000 series

Tandberg UK Ltd., 81 Kirkstall Road, Leeds LS3 1HR. Tel (0532) 774844



## Presentation, facilities etc

This combination of pre- and power amplifier is most attractive, with a standard of finish the equal of anything around, and a design that has distinct touches of Scandinavian flair, while sensibly not flying in the face of current fashion. Of the two units, the power amplifier is perhaps the most interesting in appearance, with the sculptured louvres through the case looking quite dramatic.

The large rotary control on the pre-amp (naturally) adjusts volume, and alongside are two smaller rotaries for balance and input selection. Two more rotaries further along adjust bass and treble, while at the other end another controls the output to the headphone socket, driven independently of the power amplifier. One pair of pushbuttons switch mono and loudness, the next pair subsonic filter and tone defeat, a group of four give tape monitoring and cross-dubbing, while the one on its own switches power. Apart from the attractive metalwork, the power amplifier is almost featureless (as it should be?), with its matching power switch and two LEDs indicating peak clipping. The rear panels use phono throughout, which is a bit of a break from European tradition, but not unwelcome. Inputs are provided for both moving-coil and moving magnet cartridges, with switching for variable impedance (100/47/33 kohm) and variable capacitance (20/120/350pF) beside the sockets. Incidentally, a matching tuner is also available, as well as a most interesting (and expensive) piece of modern furniture designed specially to house the units along with other equipment.

## Lab performance

Belying its compact dimensions (if not its price),

these units were capable of a whopping 180 or so watts both channels driven, though the increase of 12% under single channel drive is a little high, so the power supply is not perhaps quite as 'stiff' as we would have liked. The power delivery is very well maintained into low impedances, showing a voltage drop of only 3.2dB into as low as 2ohms. Obviously this amplifier will drive any loudspeakers without problems, although there was slight current limiting into the lowest impedances.

Bandwidths show reasonable curtailment at the frequency extremes (or at any rate an avoidance of excess), the RIAA equalisation is very flat and nicely tailored, and the moving magnet impedance/capacitance variations are accurate and usefully flexible. The moving-coil input impedance is higher than usual, though we would be surprised if this made any significant difference. Distortion is quite low (if not quite as low as the latest Japanese amplifiers), and the noise and hum performances were not quite as good as we expected. One curiosity is that the gain matching through the pre-amp is not quite right, so that it is not difficult to clip the output section with modest level inputs when the volume control is set high. This may not matter in practice as there is plenty of volume at the control mid position with a typical input, and here the overload margin is high. But it does represent a chink in the armour of this otherwise impressive system. The IM spectrum showed the slightest sideband, and was noticeably free of the 'noise modulation effect'.

## Listening impressions

Tandberg have no recent track record for ampli-

fiers, so it was pleasant to find that this expensive model did seem to deliver the goods subjectively, and was placed consistently high in the listening tests. The sound was considered 'open', 'clean' and commendably clear of confusion, if a trifle lacking control at high frequencies and not entirely well-defined at low frequencies. Generally quite 'busy' sounding with plenty going on, it nevertheless lacked the full dynamics and 'focus' of the best audiophile amplifiers.

## Conclusions

This is an expensive combination, but one which did consistently well throughout the tests. As an amplifier for the music lover who would rather avoid the occasional eccentricities of the audiophile market, and who rates style and engineering quality above simplistic value for money, the Tandbergs stand up extremely well, and are a welcome surprise from this tape recorder specialist.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz

8 ohms, 0.1% dist. .... 175/181/178 Watts

o/p level ref 2.83V=0dB ..... 22.4/22.5/22.5dB

Single channel 8/4/2 ohms

1kHz, 0.1% dist ..... 205/315/386 Watts

o/p level ref 2.83V=0dB ..... 23.1/21.9/19.9dB

Single cycle power 1kHz, 8/4/2 ohms ... 225/378/400 Watts

o/p level ref 2.83V=0dB ..... 23.3/22.8/20dB

Dynamic headroom (IHF) ..... 0.4dB

**Bandwidth** (-3dB below half power)

Disc in - power out ..... 7Hz - 89kHz

Disc in - pre out ..... 7Hz - 110kHz

Disc in - tape out ..... 7Hz - 77kHz

Aux in - power out ..... 5Hz - 114kHz

Power amp only ..... 3Hz - 122kHz

### Inputs

	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.2	33/48/98k	34/131/334

Disc MC.....	Phono	0.16	1k	
Tuner/Aux.....	Phono	150	48k	
Tape 1.....	Phono	150	48k	
Tape 2.....	Phono	150	48k	
Power amp.....	Phono	1.1V	10k	

Disc overload MM..... 42dB

Disc overload MC..... 41dB

**Outputs** (5.0mV disc input)

	Type	Level (mV)	Imp (ohms)
Tape 1.....	Phono	300	1k
Tape 2.....	Phono	300	1k

Headphones (8 ohms)..... 300 max (separate control)

(2 kohms)..... 17V max

**Noise** (ref 1 Watt, 8 ohms)

Zero volume..... 88dB

Aux ref volume..... 82dB

MM disc ref volume..... 78dB

MC disc ref volume..... 73dB

**Other**

Damping factor..... 159

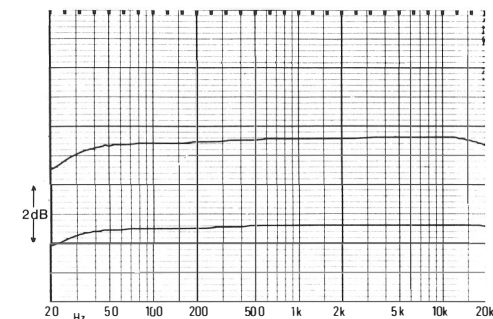
THD performance..... excellent

Hum performance..... very good

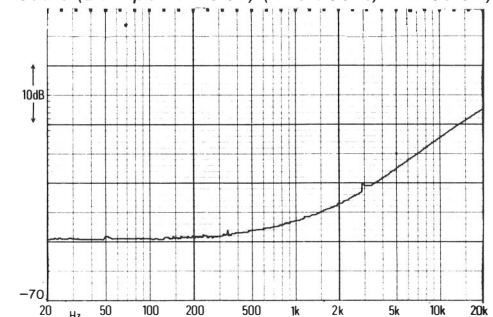
Dimensions(W x D x H) ... 17(43.5) x 15(38) x 6.5(16) ins(cms)

Weight..... 35lbs

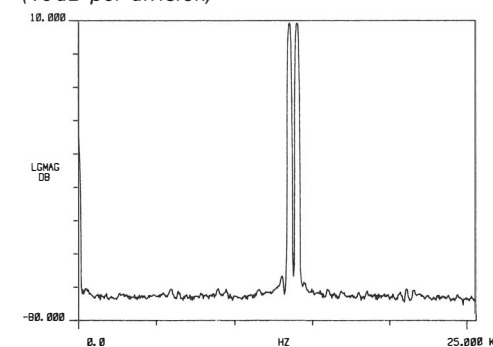
Typical purchase price..... £850



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

**BEST BUY**

# Technics SU-V3

Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



### Presentation, facilities etc

This is a reasonably compact and slim amplifier, with a very well finished satin-silver fascia. The control layout is neat and unobtrusive, apart from the light-type 'power' meters which are a little garish. The volume control is sensibly large and distinguishable, and function switching is delegated to three rotary controls, controlling speaker selection, tape recorder selection, and main amplifier input/output respectively; this arrangement permits tape recording to be made from any input whatever source has been selected for listening at the time.

Subsidiary controls are relegated to the bottom third of the fascia, and include bass, treble, and balance controls, and switches for low and high filters, 'loudness', and meter range. Sadly there is no mono switch, an unfortunate omission for owners of old and treasured recordings, as in such cases this helps to reduce surface noise and rumble. Phono inputs are used throughout, though there is DIN duplication on one tape position. Certain claims for operating principles such as 'new Class A synchro-bias' and 'DC' circuitry are made with unnecessary vigour on the front panel: such features are of nebulous benefit in themselves (the whole being greater than the sum of the parts), their main purpose being to give the copywriter or salesman something to talk about.

### Lab performance

We are accustomed to excellent laboratory results on Technics models, and the SU-V3 is no exception despite its comparatively modest price. Indeed it is somewhat encouraging to note that Technics do not seem prepared to sacrifice performance

and quality in an attempt to meet a particular commercial price target. Power delivery is generous for the price, and well maintained into low impedances, so selection of partnering loudspeakers is uncritical. However the difference between single and dual channel capabilities approaches 20%, indicating some limitations in the power supply 'stiffness', though this is by no means unreasonable for a modestly priced amplifier.

Most of the points one can raise concerning the technical performance are in the nature of quibbles rather than criticisms. The hum performance only rated average, and the disc input bandwidth might have been curtailed an octave below the measured 70kHz with advantage. Inputs and outputs have been sensibly chosen, so no matching problems are likely. Crosstalk measured quite well, rising to a reasonable -42dB from a very good low frequency -68dB. The intermodulation spectrum shows no specifically identifiable sidebands, though the noise floor did rise somewhat with the application of the tests signals on either side of these. The normally measured noise figures were however very good.

### Listening impressions

Listening test results were consistently in the average and above average class, which is very encouraging for a model in this price class. Most descriptions included the adjectives 'bright', but in a 'forward' or 'open' sense rather than indicating aggressiveness. A somewhat 'powerful' sounding bass was felt by some to be slightly less well controlled than the best amplifiers. Detail and information presentation was generally praised

for an amplifier in this class, and it managed the far from easy feat of sounding quite lively and generally well-controlled at the same time. Amongst non-moving-coil models, it was clearly one of the top performers.

### Conclusions

This is clearly a very competent design, which is modestly priced but has made few compromises to this end. Certainly there are some indications that the power supply has to work fairly hard, but then this is part of what cost-effective engineering is about. The auditioning gave consistently encouraging results, which suggest that this is amongst the leading budget designs in terms of sound quality (something which we would have been reluctant to say about earlier Technics models). And if this alone is not enough, the power delivery is also generous for the price. Our only regret is that the choice of features is very much consumer- rather than audiophile-oriented, and it would have been nice to have had a moving-coil cartridge input instead of flashy power meters, mono and tone-bypass switches instead of speaker switching.

### GENERAL DATA

#### Power stage

Both channels 20Hz/1 kHz/20kHz  
 8 ohms, 0.1% dist ..... 50.5/54.6/54.6 Watts  
 o/p level ref 2.83V=0dB ..... 17.0/17.4/17.4dB  
 Single channel 8/4/2 ohms  
 1 kHz, 0.1% dist ..... 65/95/112 Watts  
 o/p level ref 2.83V=0dB ..... 18/16.8/14.5dB  
 Singlecycle power 1 kHz, 8/4/2 ohms ..... 78.7/136/195 Watts  
 o/p level ref 2.83V=0dB ..... 19/18/17dB  
 Dynamic headroom (IHF) ..... 0.07 dB

#### Bandwidth (-3dB below half power)

Disc in - power out ..... 10Hz - 70kHz  
 Disc in - tape out ..... 11 Hz - 57kHz  
 Aux in - power out ..... 5Hz - 104kHz

Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM	Phono	2.5	47k	160
Tuner/Aux	Phono	140	86k	
Tape 1 & 2	Phono	170	78k	
Tape 2	DIN	170	78k	

#### Disc overload MM

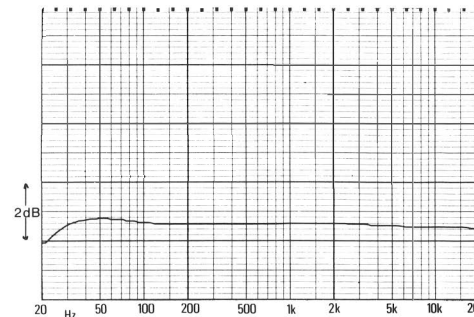
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	260	550
Tape	DIN	28	78k
Headphones (8 ohms)	Jack	68	
(2 kohms)		2.5V	

#### Noise (ref 1 Watt, 8 ohms)

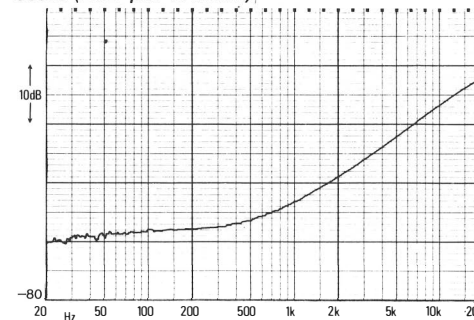
Zero volume ..... -90dB  
 Aux ref volume ..... -84dB  
 MM disc ref volume ..... -80dB

#### Other

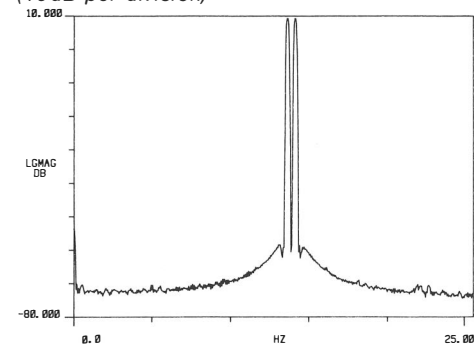
Damping factor ..... 34  
 THD performance ..... excellent  
 Hum performance ..... average  
 Dimensions (W x D x H) ..... 17(43) x 13 1/2(34) x 4(10) ins (cms)  
 Weight ..... 16 lbs  
 Typical purchase price ..... £120



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

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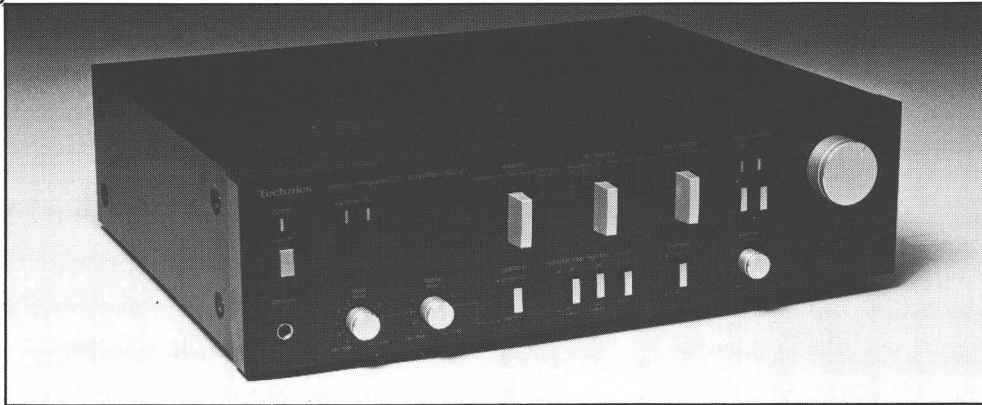
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**BEST BUY**

# Technics SU-V7

Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



## Presentation, facilities etc

The SU-V7 delivered to us was pleasingly finished in a dark, neutral matt-brown, with the panel lettering in a complementary lighter colour; an alternative version is available with a silver fascia. The front is divided horizontally into two sections, the top part featuring the most used volume and selector controls. Showing the way fashions change, the volume control has a nice continuous smooth action without discrete steps, and the 'power' meters fitted to the cheaper V3 have been dispensed with.

By and large the facilities provided appear to have been carefully chosen. Moving magnet or moving-coil type cartridges may be accommodated, recordings may be made from any source irrespective of the source being listened to, and a full tone control bypass switch is fitted. Switching also controls speaker selection, mono/stereo, high and subsonic filters and loudness. There is a smattering of indicator lights as well as Technics' traditionally tasteless illuminated 'new class A synchro bias' panel. These niggles aside it is a pleasantly unassertive design which is easy to use. Phono sockets are used throughout on the back panel, with DIN duplication of one tape set.

## Lab performance

The power output is very generous for an amplifier at this price level, and delivery is well maintained into 4ohm loads. However, the 2ohm load tests actuated the protection relays and also showed some limitations under our single cycle burst conditions, so some of the most awkward speaker loads might be best avoided, and a little care may be needed if driving two pairs of speakers hard,

at a party for instance. One curiosity which we found was that after the protection had operated, if the amplifier was switched off and then on again immediately, the maximum power available was reduced by 2dB until the amplifier had been left off for a considerable time: this may be a useful extra measure of protection or a sample irregularity, but regular party givers might take note. There was virtually no difference between the power outputs with one or both channels driven, which is a good point.

The disc frequency responses were commendably flat, and the measured bandwidths showed some attempt at control, with no excessively high frequencies present. Inputs and outputs showed sensible values throughout with no potential matching problems; the headphone output had slightly greater attenuation than usual, though this may well be no bad thing. The intermodulation test showed better than average results, but the background noise spectrum did not appear quite as 'clean' as other amplifiers under these conditions. Measured noise figures, harmonic distortion performance and hum performance were all fine. Overall this is clearly a very competently and cost-effectively designed amplifier.

## Listening impressions

The results of the various listening tests were both consistent and favourable, the sound being described as generally 'lively' and 'open', perhaps a little presence/treble 'bright', but with good overall coherence and reasonable dynamics. Some misgivings were made of a lack of real 'power' at the bass end and a rather 'grainy' effect on the sound as it was driven harder, but stereo and separation were both well liked. The con-

sistency of these comments was unusually good, so we feel reasonably confident in presenting them, and confirming a solid above-average rating for this model.

## Conclusions

This is a pleasantly styled amplifier which consistently gave above average results on both the technical and the listening tests. The price is quite modest, the power quite generous, and there is very little ground for criticism, so we can do little but endorse its obvious merit.

## GENERAL DATA

### Power stage

Both channels 20Hz/1kHz/20kHz  
 8 ohms, 0.1% dist ..... 96/96/96 Watts  
 o/p level ref 2.83V=0dB ..... 19.8/19.8/19.8dB  
 Single channel 8/4/2 ohms  
 1kHz, 0.1% dist ..... 102/170/Relay Watts  
 o/p level ref 2.83V=0dB ..... 20/19.3/Relay dB  
 Single cycle power 1kHz, 8/4/2 ohms ..... 107/200/224 Watts  
 o/p level ref 2.83V=0dB ..... 20.3/20/17.5dB  
 Dynamic headroom (IHF) ..... 0.12dB  
**Bandwidth** (-3dB below half power)  
 Disc in - power out ..... 3Hz - 59kHz  
 Disc in - tape out ..... 4Hz - 104kHz  
 Aux in - power out ..... DC Hz - 76kHz

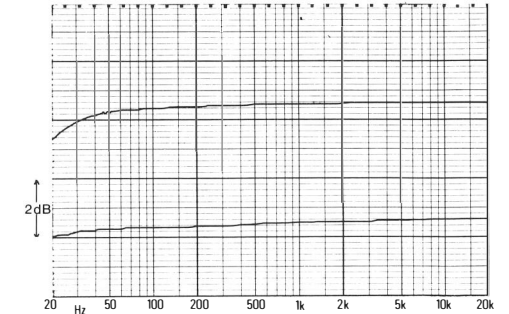
Inputs	Type	Sens (mV)	Imp (ohms)	Cap (pF)
Disc MM.....	Phono	2.8	47k	163
Disc MC.....	Phono	0.190	215	
Tuner/Aux.....	Phono	170	61k	
Tape 1 & 2.....	Phono	170	64k	
Tape 2.....	DIN	210	64k	

Disc overload MM ..... 35dB  
 Disc overload MC ..... 35dB

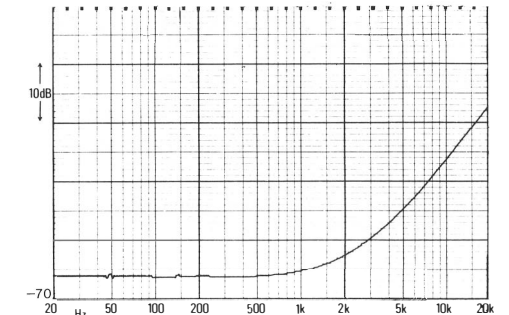
Outputs (5.0mV disc input)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2.....	Phono	300	530
Tape 2.....	DIN	32	77k
Headphones (8 ohms).....		22	
Headphones (2 kohms).....		800	

**Noise** (ref 1 Watt, 8 ohms)  
 Zero volume ..... -87dB  
 Aux ref volume ..... -80dB  
 MM disc ref volume ..... -80dB  
 MC disc ref volume ..... -77dB

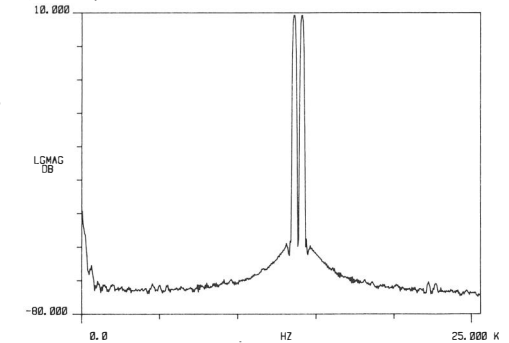
**Other**  
 Damping factor ..... 42  
 THD performance ..... excellent  
 Hum performance ..... good  
 Dimensions (W x D x H) ... 17(43) x 14(36) x 5(12) ins(cms)  
 Weight ..... 26 lbs  
 Typical purchase price ..... £190



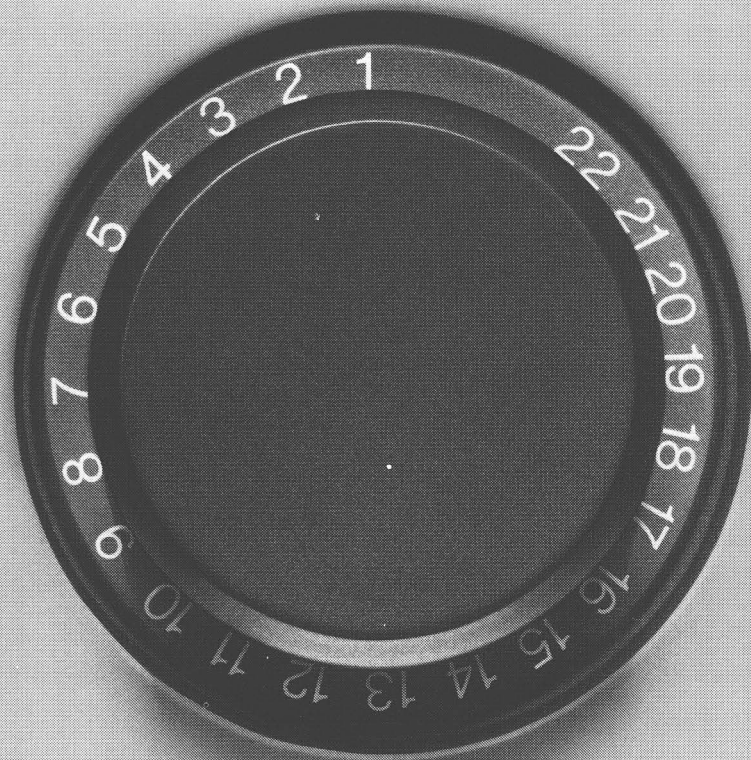
Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)



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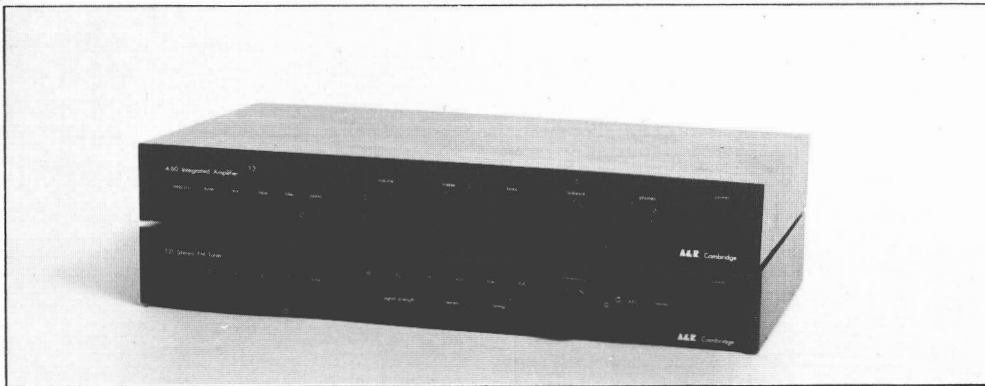
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## A&R A60 /T21

A&R (Cambridge) Ltd., Denny End Industrial Centre, Waterbeach, Cambridge CB5 9PB  
Tel (0223) 861550



### Presentation, facilities, etc.

A&R's *A60* amplifier has been fundamentally unchanged for some years, though the company policy is one of continuous detail improvement. It has acquired a good reputation for sound quality at its price, which tended to be confirmed in the recent *Choice: Amplifiers* book. The *T21* tuner is a more recent introduction, and uses A&R's expertise in designing LED displays for the professional market. These are amongst the slimmest units in the book – stacked together they would still be dwarfed by some of the single units in this survey – and are attractively discrete, with black faces and wooden cases.

The tuner has five presets on the back panel in addition to the normal tuning knob on the fascia, and all may be selected by front pushbuttons which also switch mono and AFC. Centre-tune, stereo and signal strength are displayed; the back panel accepts both aerial types, and also offers variable signal output. The amplifier offers fairly basic traditional facilities, but in addition one or two which are less common. These include alternative speaker terminals which allow direct or *via* head-phone connection, so switching in the output signal path may be avoided by those who so desire; comprehensive alternative components are available from the manufacturer to optimise cartridge matching; the DIN disc input uses a spare pin to power A&R's head amp, an optional extra for those using moving-coil cartridges. Overall an attractively finished unusual design with particular appeal to the enthusiast.

### Lab performance

A little on the expensive side for the measured

power, this was nevertheless well maintained under the various measurement conditions, and is probably limited by the size of power supply that can be fitted into the very slim case. The disc input bandwidth is nicely limited, and cartridge loading flexible, while the crosstalk shows a welcome 20dB improvement over that measured in *Choice: Amplifiers*. Though using DIN sockets, the equipment should interface without problems with either standard. Performance characteristics were generally fine, but with hum performance below average.

The tuner absolute sensitivity measurement was not exceptional, but the more important 50dB stereo figure was well above average, as were all the measurements apart from distortion.

### Subjective impressions

In a repeat of our *Amplifiers* findings, the A&Rs consistently appeared in the top group in audition, being described as coherent, integrated, smooth and quite 'lively' on disc and FM. The LED tuning scale did not hold much appeal for our radio enthusiast, who found it irritatingly imprecise, but he also rated the performance highly.

### Conclusions

Our familiarity with these models makes dispassionate evaluation difficult, but our findings still indicate that by dint of well balanced design compromise without fancy aspirations they simply deliver the goods, and may therefore be confidently recommended as offering good value in the medium price class.

### AMPLIFIER

#### Power

Bandwidth (–3dB ref max power, disc)..... 11Hz–43kHz  
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) ... 30/36/30 Watts  
Single channel 8/4/2 ohms (1kHz, 0.1% dist) ..... 43/74/28 Watts  
Burst power 1kHz, 8/4/2 ohms ..... 57/92/29 Watts

Inputs	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	DIN	2.0	48k	240pF
Disc MC				
head amp optional extra				
Tuner/aux.	DIN	100	100k	
Tape	DIN	100	48k	

Disc overload 1kHz..... 37dB

Outputs (5mV disc)	Type	Level (mV)	Imp (ohms)
Tape	DIN	165	50k
Headphones (8 ohms)	Jack	70	—

#### Noise (ref 1 Watt, 8 ohms)

Zero volume..... –81dB  
Aux ref volume..... –75dB  
Disc ref volume..... –82dB

#### Other

Damping factor..... 44  
THD performance..... good  
IMD performance..... average  
Hum performance..... below average

### TUNER

#### RF Performance

30dB S/N Ratio, mono sensitivity..... 2.00uV  
50dB S/N Ratio, mono/stereo sensitivity..... 3.50/25uV  
IHF 30dB S/N Ratio, mono..... 2.00uV  
Muting level..... 3.00uV  
Limiting level, –1dB..... 2.00uV  
RFIM..... 79dB  
Capture ratio..... 1.5dB  
Selectivity..... 48dB  
IF rejection..... 107dB  
AM suppression..... 61dB  
Image rejection..... 78dB

#### Audio Section

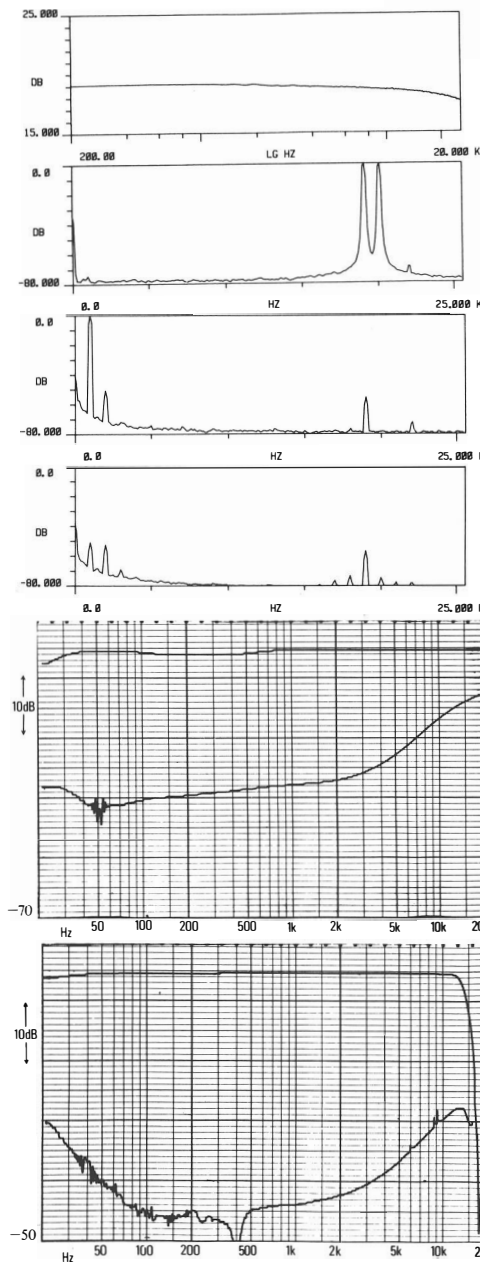
S/N ratio 1mV i/p, mono/stereo..... 75/71dB  
Distortion, mono 20%/100% modulation..... 0.30/0.45%  
Distortion, stereo 20%/100% modulation..... 0.55/1.00%  
Pilot tone suppression..... –55dB  
Crosstalk, 1kHz..... –42dB

### GENERAL

Total size (W x D x H)..... 17¼(45) x 10(25) x 4¾(12) in(cm)  
Approximate weight..... 19lb  
Typical retail price..... £190–£173

## A&R A60 /T21

**BEST BUY**

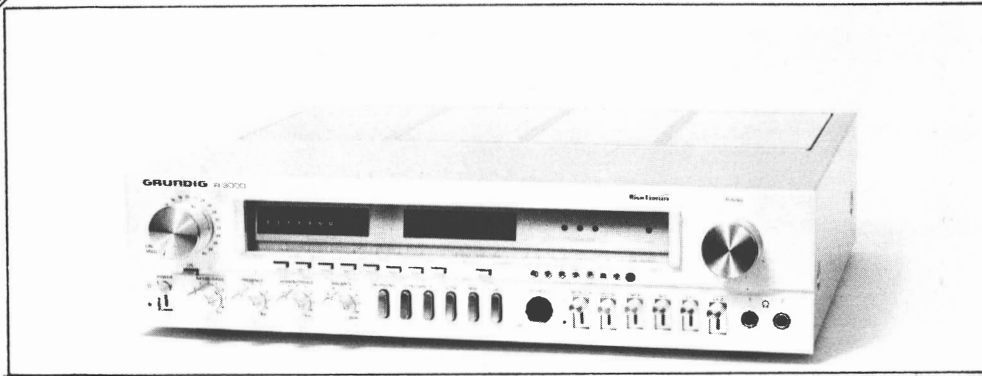


**CAPTIONS** (1–6 top to bottom right hand column, all at 1 watt/8 ohms)  
1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

**BEST BUY**

## Grundig R3000

Grundig International Ltd., 40/42 Newlands Park, Sydenham, London SE26 5NQ  
Tel: (01) 659 2468



### Presentation, facilities, etc.

This is the larger of two receivers in Grundig's new 'international style' range, which together with a 'mini system' represents this major European manufacturer's response to the growing strength of Japanese competition in its home market. It is a substantial, heavy unit, though quite compact, and uses digital frequency display to enable the many facilities to be fitted on a nevertheless crowded fascia without undue confusion.

The tuner operates manually or *via* (seven) presets on FM, and manually on long and medium wave AM, with signal strength, stereo and centre-tune ('tunoscope') indicators, and switching for AFC, muting and mono/stereo. Aerial socketry matches 75 and 300 ohm FM and external AM, and provision is made to use the FM downlead as a compromise AM antenna. The amplifier has tone controls for bass, presence and treble, and the volume control may be switched to operate as a variable loudness control. Socketry is DIN throughout, apart from the two headphone jacks on the front panel, and permits complex interswitching of tape functions, with the added usefulness of a duplicate front panel Tape socket; a rear panel switch changes sensitivity on Disc. In summary this is a compact, comprehensively specified receiver, with some useful facilities, which remains reasonably simple to operate.

### Lab performance

This medium powered model may not be offering the cheapest watts around, but their general stability under different loading conditions was quite reassuring, and the disc input bandwidth was sensibly restrained (the impedance however defied

our measurement). Frequency response was reasonably flat, and crosstalk very good. Inputs and outputs are to DIN standards, and these should be used for interconnections to avoid problems. Performance parameters were generally good, with IM distortion excellent.

Tuner measurements were generally very good, but with crosstalk and capture ratio below average; though quite low, distortion showed significant rises in stereo and with 100% modulation.

### Subjective impressions

This unit scored consistently good marks and received some praise in the listening tests. Information and detail was considered better than usual, with a clear open midrange, though rather 'boomy' in the bass nonetheless. FM was also well received, though again some bass heaviness was criticised. Certain aspects of the tuner ergonomics were considered mildly irritating, though there was nothing serious and FM performance was considered very satisfactory. AM sensitivity was quite good, but the usual flat, dull sound was produced.

### Conclusions

The well-balanced performance and well-received sound quality dictate strong recommendation for this model amongst the products in this price class.

### AMPLIFIER

<b>Power</b>				
Bandwidth (-3dB ref max power, disc)	24Hz-45kHz			
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist)	36/36/36 Watts			
Single channel 8/4/2 ohms (1kHz, 0.1% dist)	40/56/67 Watts			
Burst power 1kHz, 8/4/2 ohms	42/72/98 Watts			
<b>Inputs</b>	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	DIN	2.0	47k	?
Disc MC	—	—	—	—
Tuner/aux	DIN	140	480k	—
Tape	DIN	140	420k	—
Disc overload 1kHz	31 dB			
<b>Outputs (5mV disc)</b>	Type	Level (mV)	Imp (ohms)	
Tape	Phono	100	9k	
Tape	DIN	20	1M	
Headphones (8 ohms)	Jack	140	—	
<b>Noise (ref 1 Watt, 8 ohms)</b>				
Zero volume	-89dB			
Aux ref volume	-81dB			
Disc ref volume	-87dB			
<b>Other</b>				
Damping factor	134			
THD performance	good			
IMD performance	excellent			
Hum performance	good			

### TUNER

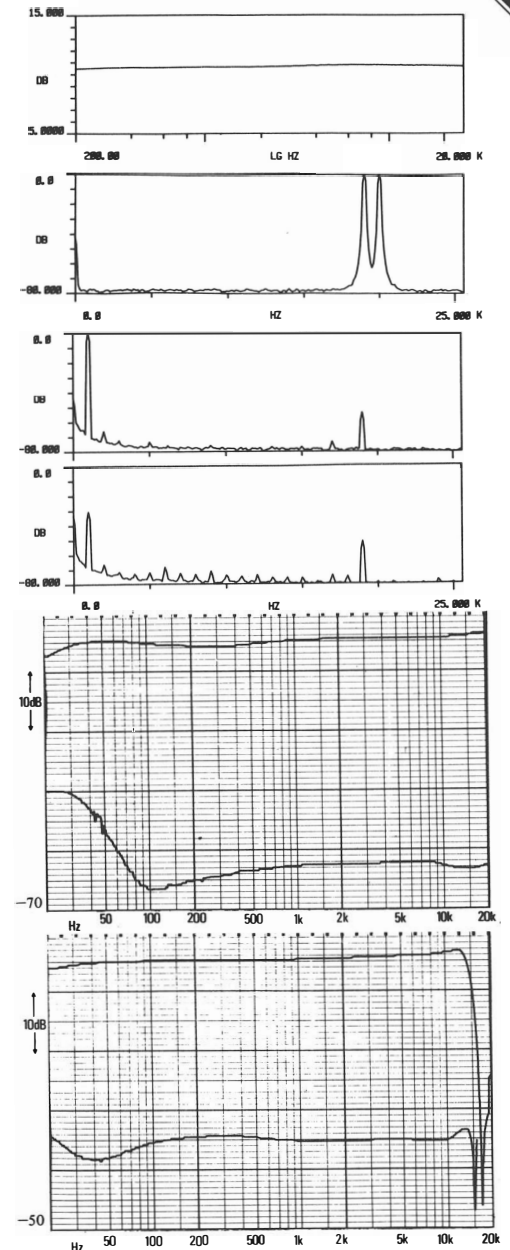
<b>RF Performance</b>		
30dB S/N Ratio, mono sensitivity	0.50uV	
50dB S/N Ratio, mono/stereo sensitivity	0.60/1.3uV	
IHF 30dB S/N Ratio, mono	1.25uV	
Muting level	5.0uV	
Limiting level, -1 dB	0.8uV	
RFIM	64dB	
Capture ratio	6.0dB	
Selectivity	69dB	
IF rejection	115dB	
AM suppression	59dB	
Image rejection	88dB	
<b>Audio Section</b>		
S/N ratio 1mV i/p, mono/stereo	74/74dB	
Distortion, mono 20%/100% modulation	0.08/0.45%	
Distortion, stereo 20%/100% modulation	0.30/0.63%	
Pilot tone suppression	-55dB	
Crosstalk, 1kHz	-30dB	

### GENERAL

Total size (W x D x H)	17¼(45) x 15¼(39) x 4¼(11) in(cm)
Approximate weight	27lb
Typical retail price	£226

## Grundig R3000

**BEST BUY**



**CAPTIONS** (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)  
1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

RECOMMENDED

# Meridian 101/105/104

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



### Presentation, facilities, etc.

The largest of the Boothroyd-Stuart designed module systems, this uses the same pre-amp and tuner as the other two systems reviewed on the previous pages, but this time with two entirely separate and much more powerful 'double module' mono power amplifiers (one for each channel). In all, this is the equivalent of six small modules, but the power amplifiers' doubled width precludes straightforward vertical stacking, though the system remains flexible.

To re-iterate, the tuner operates *via* six screwdriver-set presets on FM only, the rather cramped tuning scale doubling as centre-tune meter. Aerial signal is supplied *via* a 75 ohm socket, and stereo beacon and stereo-plus-mute/mono-without switch are also fitted. The system signal interconnections are *via* DIN socketry, and European-style mains plugs link the items so all are switched on from the 'master' pre-amp volume/balance/on-off potentiometer. Internal circuitry is based on module systems to permit upgrading without full replacement in case of future technical improvements, and enables precise matching to a variety of pickup cartridges, including m-c and m-m models. To avoid signal path switching and processing, tone controls and alternative speaker and headphone outputs are omitted. In summary, an audiophile system of extreme elegance which is very simple to use, and which has achieved something of a 'cult' reputation for good sound quality.

### Lab performance

The very generous power output to some extent

justifies the very high price, while the power delivery is superb into low impedances and under 'burst' conditions, the separate modules ensuring that there are no inter-channel effects. The disc input bandwidth is sensibly restrained, with the tested module offering sensible capacitance (alternatives available), while the frequency response conforms to the new IEC bass rolloff recommendations and suggests a slightly bright character. The DIN inputs and outputs do in fact match phono standards, and should be used accordingly. Performance parameters were generally good, with IM distortion performance rating average.

The tuner measurements were generally pretty good, with very good sensitivity and pilot tone suppression, about average results for noise, AM rejection and RFIM, and lower selectivity than most.

### Subjective impressions

Consistently superior listening test results were only really to be expected, the overall marks being the best of the lot, with particular praise for the bass performance, general integration, and power, but also with mild criticism of slightly fatiguing high frequencies; FM was also considered well above average. Though hardly a dial-twiddler's delight, the tuner was quite liked in use in spite of the tiny meter, with good tune indication and muting and stereo thresholds, plus good response to weak stereo signals, albeit with some sensitivity to multipath distortions.

### Conclusions

Although expensive, the consistently good subjective results and excellent power delivery dictate

# Meridian 101/105/104

RECOMMENDED

recommendation to those with the aspirations and good enough ancillaries to feel the benefit.

New retro-fit output module and double input/EQ module (for mc cartridges) now fitted as standard. Power amps now S modified with feedback loop taken around protection circuitry.

### AMPLIFIER

<b>Power</b>				
Bandwidth (-3dB ref max power, disc).....	20Hz-50kHz			
Both channels 20Hz/1kHz/20kHz(8 ohms, 0.1% dist)....	100/106/100 Watts			
Single channel 8/4/2 ohms(1kHz, 0.1% dist).....	106/169/212 Watts			
Burst power 1kHz, 8/4/2 ohms.....	160/289/475 Watts			
<b>Inputs</b>				
Disc MM.....	Type	Sens (mV)	Imp (ohms)	Cap
Disc MC.....	DIN	2.7	47k	125pF
Tuner/aux.....	various modules available			
Tape.....	DIN	190	32k	
Disc overload 1kHz.....	DIN	950	32k	
<b>Outputs (5mV disc)</b>				
Tape.....	Type	Level (mV)	Imp (ohms)	
Noise (ref 1 Watt, 8 ohms)	DIN	205	6k	
Zero volume.....				-89dB
Aux ref volume.....				-79dB
Disc ref volume.....				-84dB
<b>Other</b>				
Damping factor.....				141
THD performance.....				good
IMD performance.....				average
Hum performance.....				excellent

### TUNER

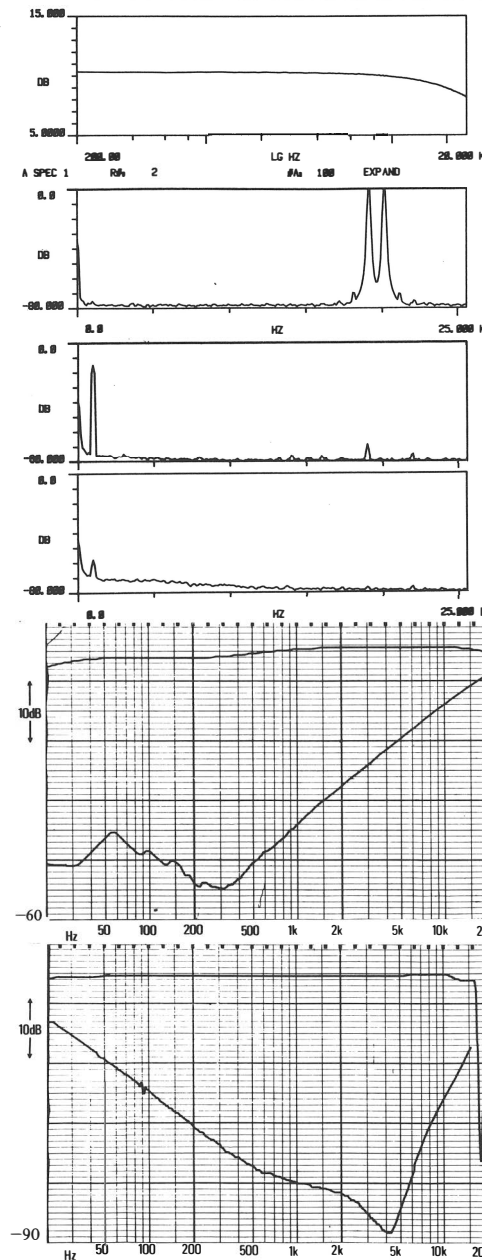
<b>RF Performance</b>	
30dB S/N Ratio, mono sensitivity.....	0.90uV
50dB S/N Ratio, mono/stereo sensitivity.....	1.50/23uV
IHF 30dB S/N Ratio, mono.....	1.10uV
Muting level.....	1.3uV
Limiting level, -1dB.....	0.9uV
RFIM.....	54dB
Capture ratio.....	1.6dB
Selectivity.....	35dB
IF rejection.....	98dB
AM suppression.....	54dB
Image rejection.....	74dB
<b>Audio Section</b>	
S/N ratio 1mV i/p, mono/stereo.....	69/67dB
Distortion, mono 20%/100% modulation.....	0.08/0.10%
Distortion, stereo 20%/100% modulation.....	0.10/0.24%
Pilot tone suppression.....	-53dB
Crosstalk, 1kHz.....	-43dB

### GENERAL

Total size (W x D x H).....	11(28) x 13(33) x 6(15) in(cm)
Approximate weight.....	36lb
Typical selling price.....	£600+£225 when reviewed, now £696+£259

### CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)

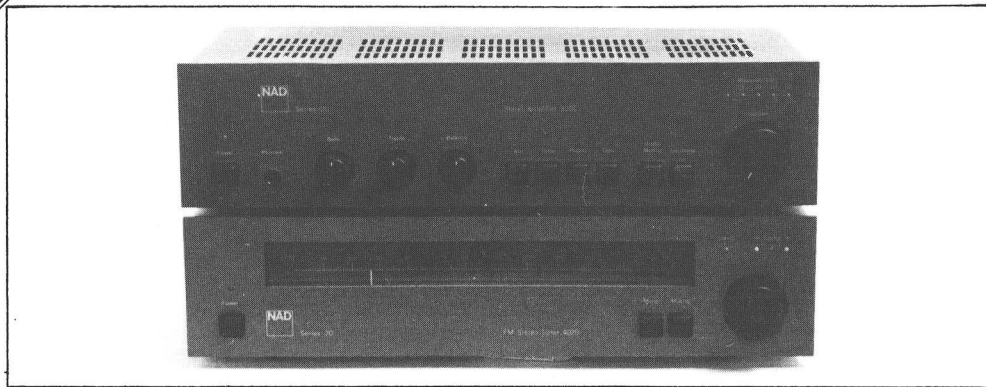
1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.



**BEST BUY**

# NAD 3020/4020

NAD Sales, Cousteau House, Greycaine Road, Watford WD2 4SB  
Tel (0923) 27737



### Presentation, facilities, etc.

NAD's 3020 amplifier has already acquired something of a cult reputation in a surprisingly short time, featuring as it does some quite advanced circuitry ideas from some of America's leading designers; rather less Press attention has been paid to the matching 4020 tuner which is included in this review.

The tuner is a basic FM-only model, with switched muting and mono, and light indicators for stereo and centre-tune. The rear panel accepts 75 and 300 ohm aerials, and offers switchable 25/50/75us de-emphasis. The amplifier has ample facilities without excessive frills, with four phono inputs and DIN duplication on tape, simple tone controls with loudness and muting, pre/power break socketry, a single set of speaker sockets and a headphone output. The rear socketry is conveniently accessible on a horizontal panel. The amplifier features a selectable 'soft-clipping' circuit, which is intended to allow the unit to exceed its rated power on short peaks without audible degradation. Both matching units are reasonably slim, and discretely dark coloured with matt finish.

### Lab performance

The limited power is nevertheless respectable for the price, and the delivery under various conditions was quite reasonable, with the usual single/dual channel differences, and fair performance into low impedances, marred a little by the 'burst' figure on 2 ohms. The special 'soft clipping' switch appeared to have the desired effect, though it also reduced the available power by some 50%, and might therefore be better left out of circuit for normal listening. The disc input had a sensibly limited

bandwidth, with capacitance that can be matched to all cartridge/arms, though the frequency response characteristic might mislead by exaggerating detail, and crosstalk was below average. Other inputs/outputs are fine. Performance measurements were generally good, but with hum only average.

The tuner gave consistently average or better than average results, with pilot tone suppression very good.

### Subjective impressions

The listening tests gave significantly above average results, though not entirely consistently, with descriptions of impressive 'solidity' and integration, slightly lacking in 'punch', but not aggressive. FM was felt to be a little 'bassy', but again above average. In use, the sensitivity did not seem very high, calibration showed a slight consistent error, there was some multipath sensitivity, and muting and stereo thresholds were set a little high.

### Conclusions

The generally fine performance and good auditioning results at a modest price dictate firm recommendation, though the tuner leaves some room for improvement.

The 4020 tuner is now available only in the 4020A MW/FM form. FM performance should be unchanged.

# NAD 3020/4020

**BEST BUY**

### AMPLIFIER

**Power**  
 Bandwidth (-3dB ref max power, disc)..... 14Hz-40kHz  
 Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) . . . 31/35/34 Watts  
 Single channel 8/4/2 ohms (1kHz, 0.1% dist) . . . . . 36/48/45 Watts  
 Burst power 1kHz, 8/4/2 ohms . . . . . 42/67/16 Watts

**Inputs**

	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Phono	3.4	47	60pF
Disc MC	—	—	—	—
Tuner/aux	Phono	230	14k	—
Tape	Phono	230	15k	—
Tape	DIN	230	15k	—

Disc overload 1kHz..... 38dB  
 Zero volume..... -92dB  
 Aux ref volume..... -81dB  
 Disc ref volume..... -89dB

**Other**  
 Damping factor..... 60  
 THD performance..... excellent  
 IMD performance..... good  
 Hum performance..... average

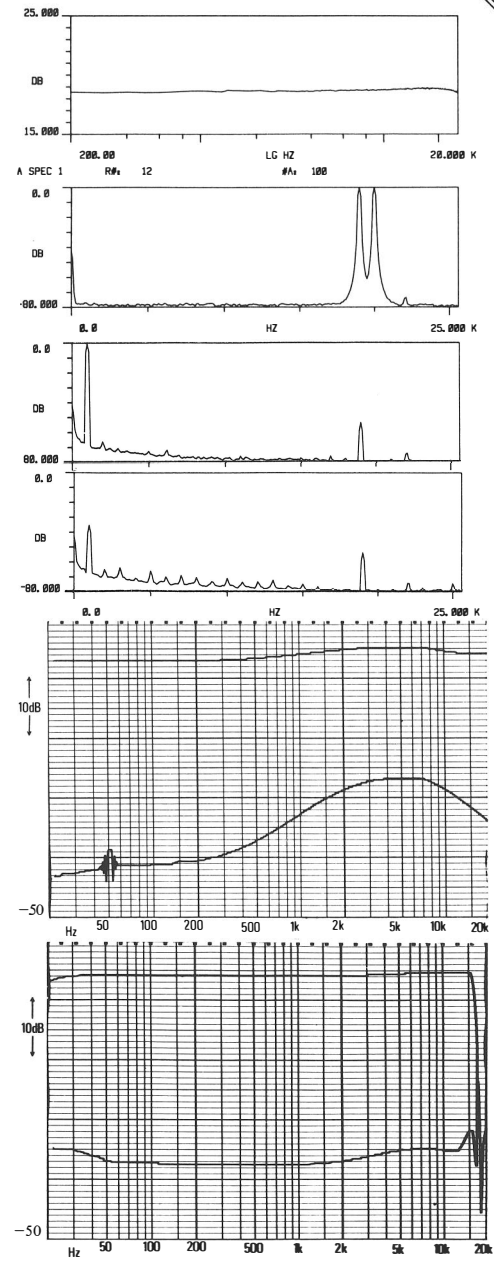
### TUNER

**RF Performance**  
 30dB S/N Ratio, mono sensitivity..... 1.25 uV  
 50dB S/N Ratio, mono/stereo sensitivity..... 2.25/32uV  
 IHF 30dB S/N Ratio, mono..... 1.50uV  
 Muting level..... 7.0uV  
 Limiting level, -1dB..... 1.0uV  
 RFIM..... 70dB  
 Capture ratio..... 1.5dB  
 Selectivity..... 70dB  
 IF rejection..... 80dB  
 AM suppression..... 56dB  
 Image rejection..... 52dB

**Audio Section**  
 S/N ratio 1mV i/p, mono/stereo..... 73/69dB  
 Distortion, mono 20%/100% modulation..... 0.40/0.30%  
 Distortion, stereo 20%/100% modulation..... 0.63/0.40%  
 Pilot tone suppression..... -53dB  
 Crosstalk, 1kHz..... -35dB

### GENERAL

Total size (W x D x H)..... 16½(42) x 8¼(21) x 10(25) in(cm)  
 Approximate weight..... 21lb  
 Typical selling price..... £86 +£86 when reviewed,  
 now £89.50+£89.50



**CAPTIONS** (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)  
 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

**RECOMMENDED**

# Nytech CTA252 XDII

Nytech Audio Ltd., High Street, Chew Magna, Bristol BS18 8PW  
Tel: (027589) 3232



### Presentation, facilities, etc.

There is no way that either author can be entirely unprejudiced about this model, as both have known it too long, coming to appreciate its virtues and learn to accept its idiosyncracies. That said, this unusual British design (intended originally for the Scandinavian market) has been around a number of years, acquiring an excellent reputation for sound quality, marred perhaps by some reports of unreliability (now thought to be a problem of the past!) It is certainly the most compact receiver in the book, if not on the market, and unusually is available ex-factory only in either moving magnet or moving-coil pickup matching options.

Tuning FM only via 75 ohm socket, four presets are concealed beneath a top plate sliding cover and selected from the main pushbutton array, in addition to a manual tune facility; both the tuning wheels and frequency meter have constricted ranges of movement, so fine discrimination is difficult. Indicators are provided for signal strength, centre-tune and stereo, and AFC and mono are switchable. In addition to the aforementioned pickup input option, via phono plugs, there are DIN tape and pre/power sockets, plus three sets of DIN speaker outputs and two headphone sockets; one of the speaker outlets has no switching in the signal path, though the others are top plate controlled. Other facilities include switching for mono/stereo, high and low filters and loudness, while the tone controls include 'middle' alongside bass and treble. Ergonomically the slant top plate layout is perhaps the most convenient for shelf-mounted equipment, and though the array of pushbuttons with ideogram legends, and the row of sliders and 'cramped' tuning mechanism/scale are

less than ideal, these are certainly offset to some degree by the preset provisions and compactness.

### Lab performance

Considering the compactness, power output is quite good, though it also comes fairly expensive. The delivery showed a commendably small difference between single and dual channel drive, and was reasonably well maintained into low impedances. Disc frequency response showed a gentle rise which will be audible, and the sensitive disc input has a well-controlled input bandwidth, though the capacitance resisted our measurement and the overload margin was lower than most. The DIN inputs/outputs operate to phono-type standards. Performance parameters were average, with IM distortion performance below average.

Tuner measurements were generally good, but with stereo sensitivity (50dB S/N), AM rejection and crosstalk below average. RFIM and pilot tone rejection were excellent.

### Subjective impressions

Despite our prejudices, the Nytech did not score quite as well as we had expected, though it was nevertheless well above average, and described as informative, busy and detailed, but with some muddling and bass softening. FM was also very well received. In use, the fiddly tuning wheels and small scale were not particularly liked, though the presets largely render them redundant once set up, and the centre-tune meter was effective. Sensitivity was on the low side, and an odd HF instability was noticed when detuning.

### Conclusions/Update

Competent technical performance and good listening test results dictate recommendation. Socketry has now changed with one pair of direct 4mm speaker outlets and two pairs of switched DIN speaker outlets. New cartridge input boards are fitted and pre/power input/output levels are now to ALSO (low source impedance 0.775V/75ohm) standard offering wider pre-amp compatibility. Improved material/components have been incorporated.

### AMPLIFIER

#### Power

Bandwidth (-3dB ref max power, disc)..... 8Hz-30kHz  
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) ... 23/25/25 Watts  
Single channel 8/4/2 ohms (1kHz, 0.1% dist) ..... 28/37/17 Watts  
Burst power 1kHz, 8/4/2 ohms ..... 36/52/20 Watts

#### Inputs

	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Phono	1.0	47k	?
Disc MC		optional, ex factory		
Tuner/aux	DIN	80	90k	
Tape	DIN	950	32k	

Disc overload 1kHz..... 28dB

#### Outputs (5mV disc)

	Type	Level (mV)	Imp (ohms)
Tape	DIN	300	4k
Headphones (8 ohms)	Jack	170	—

Noise (ref 1 Watt, 8 ohms)..... -84dB

Zero volume..... -86dB

Aux ref volume..... -74dB

Disc ref volume..... -84dB

#### Other

Damping factor..... 99

THD performance..... average

IMD performance..... below average

Hum performance..... average

### TUNER

#### RF Performance

30dB S/N Ratio, mono sensitivity..... 1.20uV

50dB S/N Ratio, mono/stereo sensitivity..... 3.75/80uV

IHF 30dB S/N Ratio, mono..... 3.25uV

Muting level..... 2.5uV

Limiting level, -1dB..... 2.5uV

RFIM..... 76dB

Capture ratio..... 1.2dB

Selectivity..... 56dB

IF rejection..... 95dB

AM suppression..... 40dB

Image rejection..... 67dB

#### Audio Section

S/N ratio 1mV i/p, mono/stereo..... 73/69dB

Distortion, mono 20%/100% modulation..... 0.10/0.63%

Distortion, stereo 20%/100% modulation..... 0.09/0.63%

Pilot tone suppression..... -57dB

Crosstalk, 1kHz..... -28dB

### GENERAL

Total size (W x D x H)..... 8½(22) x 15(38) x 4½(12) in(cm)

Approximate weight..... 10lb

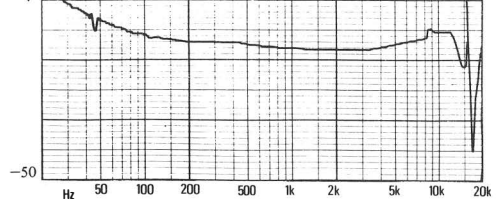
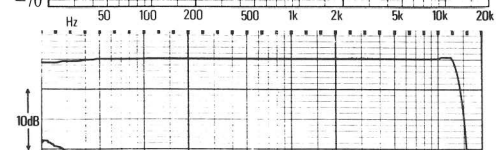
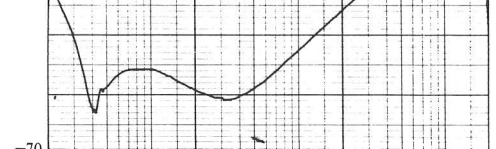
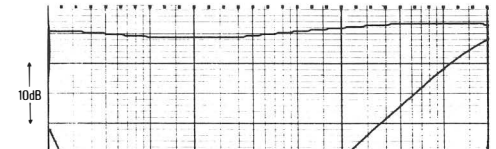
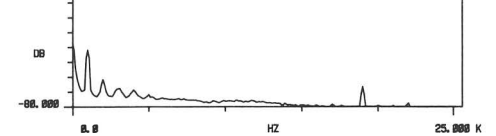
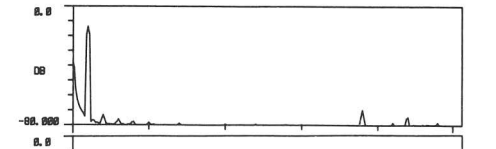
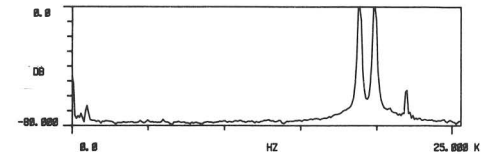
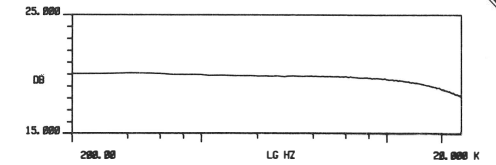
Typical selling price..... £300 when reviewed, now £345

### CAPTIONS (1-6 top to bottom r. hand column, all at 1 watt/8 ohms)

1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

# Nytech CTA252 XDII

**RECOMMENDED**



RECOMMENDED

# Revox B780

F. W. O. Bauch Ltd., 49 Theobald Street, Borehamwood, Hertfordshire WD6 4RZ  
Tel: (01) 953 0091



### Presentation, facilities, etc.

This beautifully finished Swiss heavyweight has probably more comprehensive facilities than any other model in this book. Typically Revox with its blue-grey and silver finish, this is a big unit with massive heatsinks, though little apparent wasted space – indeed it effectively combines the company's separate amplifier and tuner in a case the size of one of them.

The microprocessor-controlled FM only tuner section features full frequency synthesis with complex mechanisms for dialling and scanning the frequency band, plus some eighteen 'memory' presets, which are preserved when power is disconnected by backup batteries. Indicators are provided for signal strength, stereo and centre-tune, variable thresholds for station and stereo selection; switching for de-emphasis, noise reduction, high-blend, mono, muting, and stereo only; and socketry for 75 and 300 ohm aerials, plus 'scope feed' and a 'blank', intriguingly labelled 'ant contr', which will perhaps permit automatic control of aerial rotation? On the amplifier side, socketry is phono, but with DIN on Tape 2 and pre/power, and with a front panel 'pre-out' jack. Headphones and two sets of switchable speakers (one DIN) are provided. Switchable tone controls cover bass, presence and treble, and other switches cover loudness, mono, -20dB muting, and one of three filter positions (low, high, and the appallingly named 'low high'). Electronic switching permits any input to be fed to 'record' while any input is playing. Though it is hard to think of anything omitted, the control layout is a trifle fussy and cluttered, and the ease of use is only marginally improved by a small and awkward folding flap, that

leaves plenty of superficial controls still on display. The quality of construction inspires considerable confidence.

### Lab performance

The high power output of this model comes expensive, shows very good stability between single and dual channel drive, but is rather restricted into low impedances (a pity, as the mass and heatsinking suggest this may not be necessary). Disc input bandwidth was unnecessarily wide (with aux. restricted at 70kHz), capacitance well-chosen, and a frequency response that perhaps conformed to the IEC recommendations, but was less flat than desirable. Other inputs/outputs seem fine, and performance parameters reasonable, though the well below average IM distortion performance could have been better.

Quite outstanding tuner measurements were recorded throughout, the measurements being highly consistent, often testing the limits of the test gear, and imparting considerable confidence.

### Subjective impressions

Well above average listening test results were reasonably consistent, with comments concerning a slightly 'thick' sound, though with praise for good general control, definition, and power, but criticism of the performance near and into clipping. FM was also liked, and had a good bandwidth. Users confronted with this device were normally slightly overwhelmed (*ie* 'wow'), and started reading the manual. Once mastered (?), RF performance was exemplary, though a slight asymmetry of response (or error of reading) was detected. The final plea from our consultant was for an AM version.

# Revox B780

RECOMMENDED

### Conclusions

The outstanding tuner performance and above average amplifier performance dictate recommendation, though the high price mitigates against value-for-money endorsement.

### AMPLIFIER

#### Power

Bandwidth (-3dB ref max power, disc) ..... 17Hz-130kHz  
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) ... 96/102/96 Watts  
Single channel 8/4/2 ohms (1kHz, 0.1% dist) ... 107/137/29 Watts  
Burst power 1kHz, 8/4/2 ohms ..... 156/246/45 Watts

Inputs	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM	Phono	3.8	49k	115pF
Disc MC	—	—	—	—
Tuner/aux.	Phono	190	53k	—
Tape	Phono	190	53k	—
Tape	DIN	190	53k	—

Outputs (5mV disc)	Type	Level (mV)	Imp (ohms)
Tape	Phono	200	2k
Tape	DIN	70	?
Headphones (8 ohms)	Jack	45	—

Disc overload 1kHz	Type	Level (mV)	Imp (ohms)
Disc overload 1kHz	—	—	31dB
Zero volume	—	—	-83dB
Aux ref volume	—	—	-76dB
Disc ref volume	—	—	-80dB

#### Noise (ref 1 Watt, 8 ohms)

Damping factor	98
THD performance	good
IMD performance	well below average
Hum performance	average

### TUNER

#### RF Performance

30dB S/N Ratio, mono sensitivity	0.50uV
50dB S/N Ratio, mono/stereo sensitivity	1.30/15uV
IHF 30dB S/N Ratio, mono	1.00uV
Muting level	7.0uV
Limiting level, -1dB	0.8uV
RFIM	75dB
Capture ratio	2.0dB
Selectivity	67dB
IF rejection	110dB
AM suppression	61dB
Image rejection	110dB

#### Audio Section

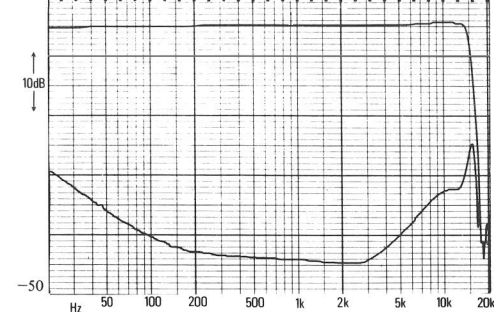
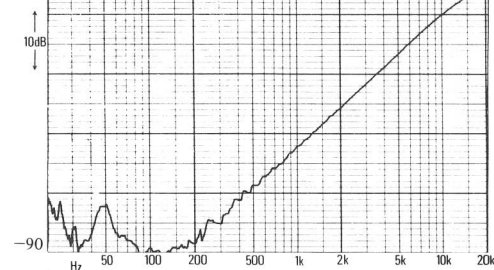
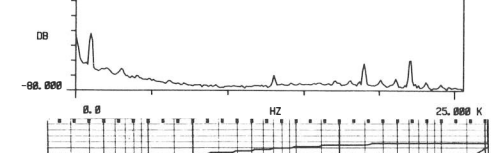
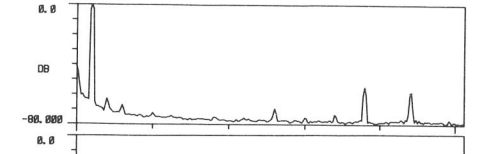
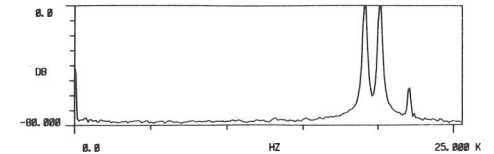
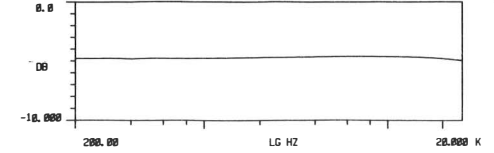
S/N ratio 1mV i/p, mono/stereo	74/71dB
Distortion, mono 20%/100% modulation	0.06/0.12%
Distortion, stereo 20%/100% modulation	0.10/0.30%
Pilot tone suppression	-50dB
Crosstalk, 1kHz	-40dB

### GENERAL

Total size (W x D x H)	17¼(45) x 16½(42) x 5½(14) in (cm)
Approximate weight	35lb
Typical retail price	£1000

### CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)

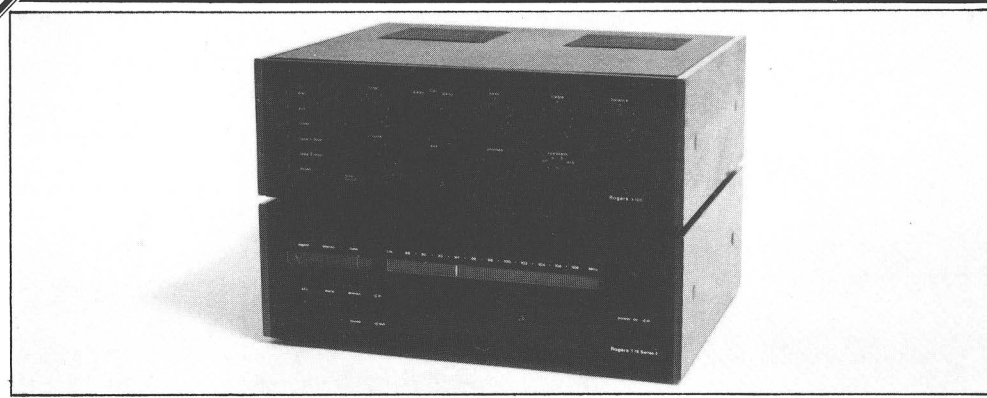
- 1) Aux i/p white noise frequency response.
- 2) IM distortion (19kHz, 20kHz aux i/p).
- 3) Tuner distortion (1kHz, 20% mod).
- 4) Tuner crosstalk distortion ref (3).
- 5) Disc i/p frequency response/crosstalk.
- 6) Tuner frequency response/crosstalk.



RECOMMENDED

## Rogers A100/T75 Series 2

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN  
Tel: (01) 697 8511



### Presentation, facilities, etc.

This alternative combination from Rogers partners the same T75-2 tuner with the more recent and more powerful A100 amplifier. Presentation is practically identical to the cheaper pair, with the austere but discrete black fascias broken by a 'grille' effect, and attractive wooden endplates. Though fairly high, the units are narrower than most, and will use correspondingly less shelf space.

The FM-only tuner is rather brightly lit and has indicators for signal strength, stereo and centre-tune, and switches for mono, AFC and muting; the back panel DIN socket has variable output, and the aerial sockets have a switchable sensitivity reduction for operating in strong signal areas. The amplifier front panel has switching for the rear (phono) inputs and a DIN auxiliary input on the front. Tone controls are conventional, but the HF filtering is unusually sophisticated, with choice of two operating frequencies and variable slope. Two sets of speakers and headphones may be connected, and the rear panel also has European-style mains sockets, and switches for 'fine-tuning' the disc input loading. The overall effect is attractively smart, yet restrained, sturdy and fairly compact.

### Lab performance

Quite expensive for the power output offered, delivery was well maintained into low impedances, but with the usual single/dual channel difference. Disc input bandwidth followed the new IEC recommendations for bass rolloff, and was a little over-extended at HF (though much better than the '75). Disc input capacitance was usefully variable, and other inputs/outputs should pose no problems. Once again performance parameters were average

or better, with hum performance well below average, but a significantly flatter frequency response than the '75 on disc was measured.

In general the tuner gave good results, indicating a fundamentally well-balanced design, though crosstalk, RFIM and distortion at 100% mod levels left some room for improvement.

### Subjective impressions

Described as significantly more 'authoritative' than the '75, the A100 was rated significantly above average overall, with particularly favourable comments at lowish powers, describing nice balance with plenty of detail, good bass performance and good overall control, though it was a trifle bright with tendencies to harshness nearer full power. The tuner sound was very pleasant. In use the scale divisions and disablement of tuning meter with AFC were both found irritating, but muting thresholds and alignments were fine (except on the centre-tuning meter), and the stereo decoder was found to 'spit' slightly with very weak signals.

### Conclusions

Although on the expensive side, this combination had evidence of a general competency of design, with few if any weak spots, so the added confidence of respectable listening test results implies recommendation.

A digital tuner, the T100 is now available, offering a more traditional price match at £229.

## Rogers A100/T75 Series 2

RECOMMENDED

### AMPLIFIER

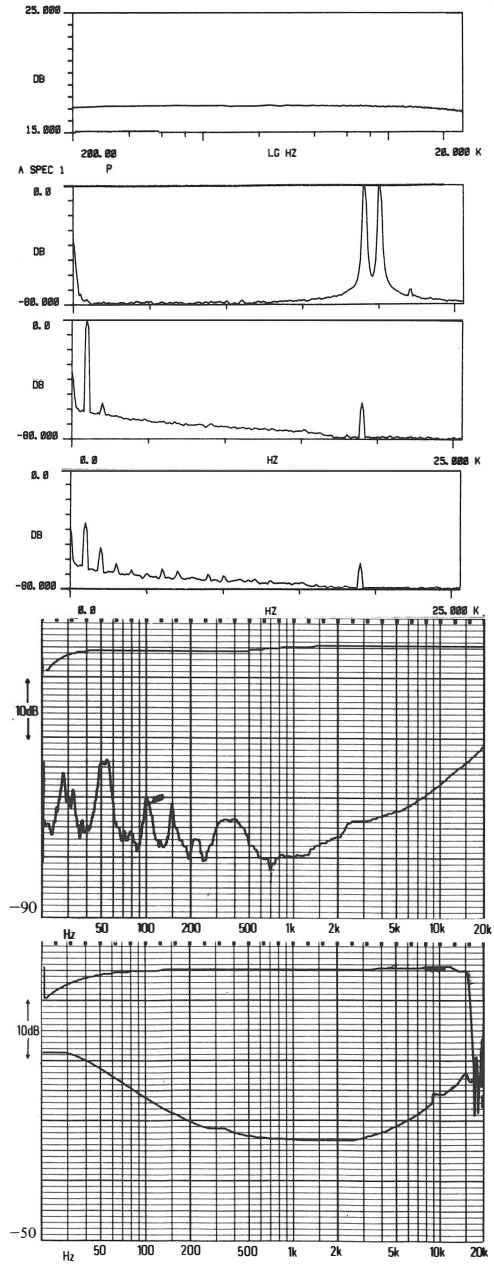
<b>Power</b>				
Bandwidth (-3dB ref max power, disc).....	20Hz-85kHz			
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist) ..	53/53/53	Watts		
Single channel 8/4/2 ohms (1kHz, 0.1% dist) ..	63/91/100	Watts		
Burst power 1kHz, 8/4/2 ohms ..	75/116/107	Watts		
<b>Inputs</b>				
	Type	Sens (mV)	Imp (ohms)	Cap
Disc MM .....	Phono	1.8	49k	Var
Disc MC .....	—	—	—	—
Tuner/aux. ....	Phono	110	50k	—
Tape .....	Phono	110	50k	—
Tape .....	DIN	110	50k	—
Disc overload 1kHz.....				38dB
<b>Outputs (5mV disc)</b>				
	Type	Level (mV)	Imp (ohms)	
Tape .....	Phono	280	460	
Tape .....	DIN	150	82k	
Headphones (8 ohms) ..	Jack	120	—	
<b>Noise (ref 1 Watt, 8 ohms)</b>				
Zero volume.....				-75dB
Aux ref volume.....				-73dB
Disc ref volume.....				-74dB
<b>Other</b>				
Damping factor.....				82
T:ID performance.....				good
IMD performance.....				average
Hum performance.....				well below average

### TUNER

<b>RF Performance</b>	
30dB S/N Ratio, mono sensitivity.....	1.20uV
50dB S/N Ratio, mono/stereo sensitivity.....	2.25/19uV
IHF 30dB S/N Ratio, mono .....	1.25uV
Muting level.....	1.5uV
Limiting level, -1dB .....	2.5uV
RFIM .....	56dB
Capture ratio .....	1.0dB
Selectivity .....	60dB
IF rejection .....	85dB
AM suppression .....	57dB
Image rejection .....	88dB
<b>Audio Section</b>	
S/N ratio 1mV i/p, mono/stereo .....	78/64dB
Distortion, mono 20%/100% modulation .....	0.40/1.25%
Distortion, stereo 20%/100% modulation .....	0.17/1.50%
Pilot tone suppression .....	-52dB
Crosstalk, 1kHz.....	-32dB

### GENERAL

Total size (W x D x H) .....	14½(36) x 12(31) x 9½(24) in(cm)
Approximate weight .....	33lb
Typical retail price .....	£320+£155



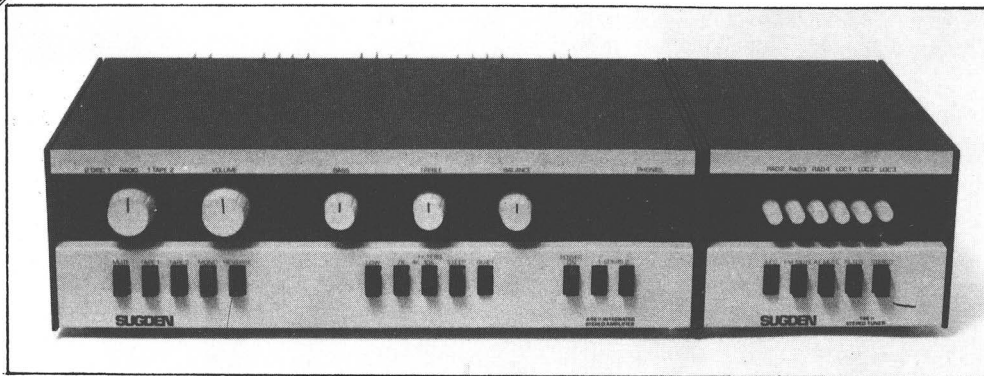
**CAPTIONS** (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)  
1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.



RECOMMENDED

# Sugden A48II/T48II

J. E. Sugden and Co. Ltd., Carr Street, Cleckheaton, West Yorkshire BD19 5LA  
Tel: (0274) 872501



### Presentation, facilities, etc.

One might be forgiven for an Oldenberg-inspired shock when first seeing this unusually styled combination from the well established Yorkshire firm: "It looks furry" being one reaction. In fact, the exterior is in the very durable Nextel finish, which has a suede-like appearance; the lack of reflections and tastefully chosen two-tone brown makes this an appropriately well-domesticated product. Construction is reassuringly 'solid', though placed side by side (the obvious configuration), the units will take up a fair amount of shelving.

The FM-only tuner uses six rotating push-buttons for preset station selection, the only indicator being a stereo beacon (though rear sockets enable a multi-meter to be connected to assist accurate tuning). Different push-buttons operate the other functions, but their rather unusual nomenclature may take a little getting used to: the 'mute' button merely cancels the output; 'squelch' operates interstation muting; 'filter' is a 'high-blend' facility; AFC and stereo/mono are also provided. A 75 ohm socket and 300 ohm terminals are provided. The amplifier feeds two sets of switchable speakers and a headphone jack, with inputs on DIN socketry including three sensitivity positions for disc. Traditional tone controls are supplemented by switches for stereo/mono, mode, tape monitoring and cross-dubbing, loudness (labelled 'quiet'), low and high filters, the latter being particularly comprehensive, with six alternatives. In summary, this is an interesting and refreshingly domestic design, soundly constructed, and with plentiful facilities.

### Lab performance

The modest power output for the price is perhaps explained by the 'solidity' of delivery, with no difference between single and dual channel outputs, and with reasonable delivery into low impedances (the HF constriction being distortion limited, and not serious). The disc input bandwidth is well constrained, frequency response reasonable, though impedance and capacitance resisted our measure (findings in *Amplifiers* suggesting no problems). The DIN socketry is best used as such. Performance parameters were average, with hum excellent.

The tuner showed (possibly unrealistically) high sensitivity, but below average AM rejection, capture ratio and crosstalk; generally rather good results were found overall.

### Subjective impressions

Steadily above average listening test results were recorded, with common descriptions of a smooth, powerful sound, with good 'integration', but a little 'gentle', and perhaps slightly fatiguing when loud. The tuner was felt to sound well above average, a little 'bright' but with good perspectives and coherence, and very gentle noise. The absence of a tuning scale might give some qualms, but our 'enthusiast' consultant found this tuner a joy to use, with good performance and sound quality, and nice muting circuitry, though the thresholds were set a little low.

### Conclusions

With decor that is attractive to live with and generally good ergonomics and facilities, the respectable sound quality and technical performance give reassurance that implies recommenda-

tion. A built-in head-amp would have been a useful addition.

### AMPLIFIER

<b>Power</b>					
Bandwidth (-3dB ref max power, disc)	21 Hz-30kHz				
Both channels 20Hz/1kHz/20kHz (8 ohms, 0.1% dist)	41/41/34 Watts				
Single channel 8/4/2 ohms (1kHz, 0.1% dist)	41/52/60 Watts				
Burst power 1kHz, 8/4/2 ohms	52/78/90 Watts				
<b>Inputs</b>					
	Type	Sens (mV)	Imp (ohms)	Cap	
Disc MM	DIN	Var	?	?	
Disc MC					
Tuner/aux	DIN	170	150k		
Tape	DIN	170	150k		
Disc overload 1kHz	31dB				
<b>Outputs (5mV disc)</b>					
	Type	Level (mV)	Imp (ohms)		
Tape	DIN	100	46k		
Headphones (8 ohms)	Jack	50			
<b>Noise (ref 1 Watt, 8 ohms)</b>					
Zero volume	-75dB				
Aux ref volume	-71dB				
Disc ref volume	-74dB				
<b>Other</b>					
Damping factor	52				
THD performance	average				
IMD performance	average				
Hum performance	excellent				

### TUNER

<b>RF Performance</b>	
30dB S/N Ratio, mono sensitivity	0.50uV
50dB S/N Ratio, mono/stereo sensitivity	2.00/22uV
IHF 30dB S/N Ratio, mono	1.50uV
Muting level	2.0uV
Limiting level, -1dB	1.5uV
RFIM	57dB
Capture ratio	4.0dB
Selectivity	45dB
IF rejection	71dB
AM suppression	50dB
Image rejection	110dB
<b>Audio Section</b>	
S/N ratio 1mV i/p, mono/stereo	70/66dB
Distortion, mono 20%/100% modulation	0.10/0.30%
Distortion, stereo 20%/100% modulation	0.17/0.70%
Pilot tone suppression	-47dB
Crosstalk, 1kHz	-22dB

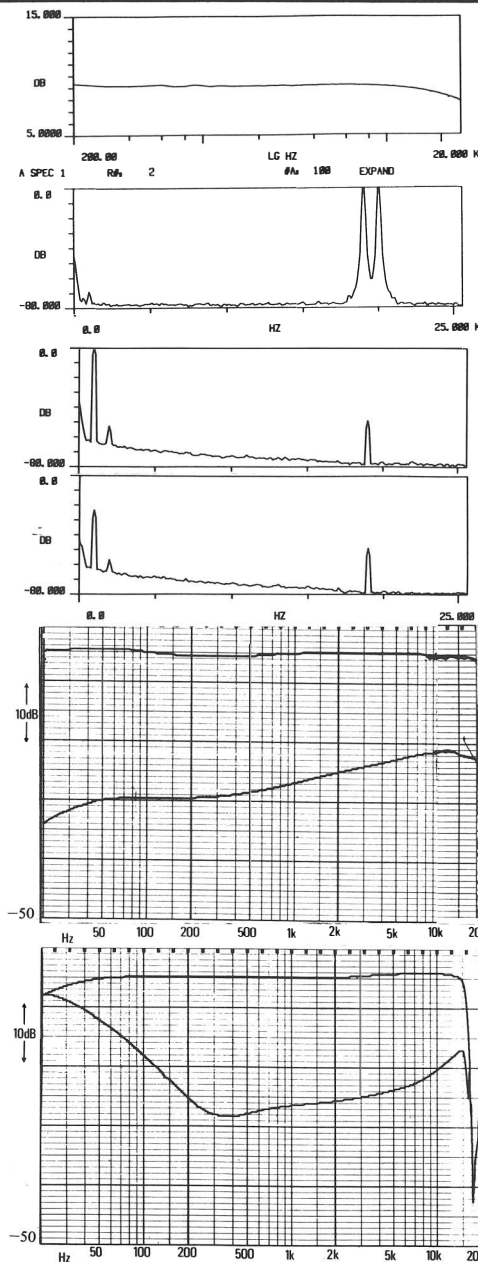
### GENERAL

Total size (W x D x H)	22½(57) x 11½(29) x 5(13) in(cm)*
Approximate weight	31 lb
Typical selling price	£250+£150 when reviewed, now £285+£161

**CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms)**  
 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

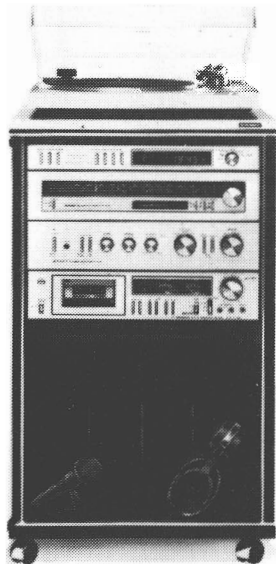
# Sugden A48II/T48II

RECOMMENDED



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# RODGER AND GREEN

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9 Red Lion Square, Stamford, Lincs

Tel: Stamford 2128

Kettering Hi-Fi

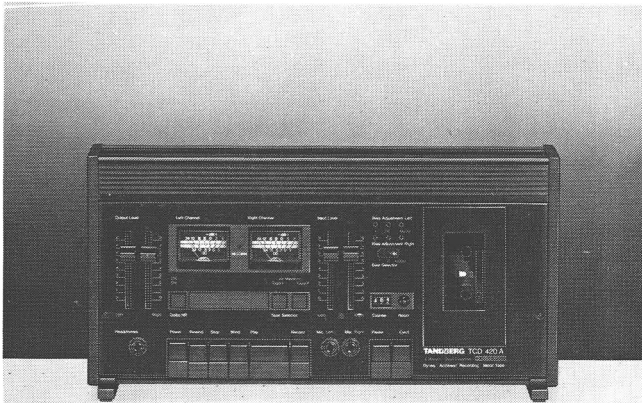
68 Stamford Road, Kettering

Tel: Kettering 515266

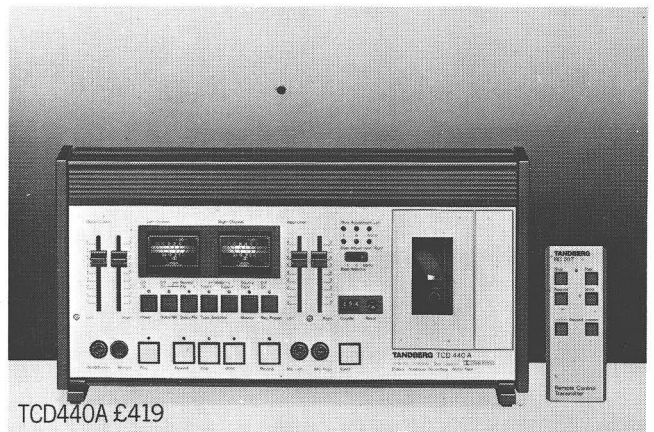
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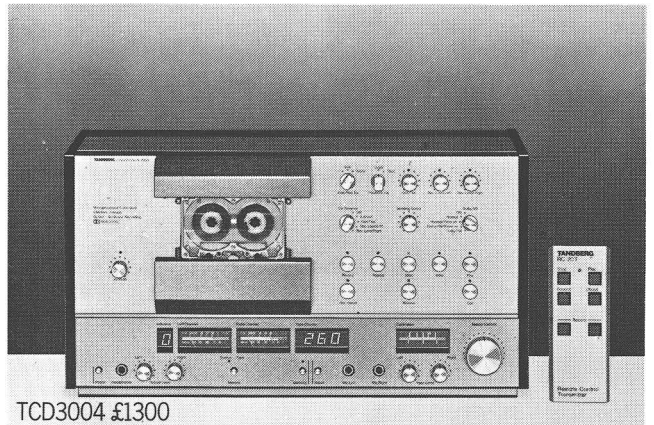
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# LOUDSPEAKERS

The loudspeaker's job is to convert the electrical energy which corresponds to the music signal from the amplifier into acoustical energy - *ie*, sound. Sound is transmitted by vibrations in the air and the loudspeaker is designed to mimic the specific vibrations that correspond to the musical event encoded in the audio signal. The vibrations in which we are interested vary in frequency from around 20 times a second (20Hz), which is perceived as the deepest bass, to around 20 thousand times a second (20kHz), which may not be perceived at all by some listeners but is where the highest harmonics of treble notes come.

As usual audio designers are faced with very specific problems; with loudspeakers you need a large drive unit to shift enough air at the low frequencies to produce enough power, while at the top end of the audio spectrum you need a small lightweight driver to produce and disperse the short wavelength high frequencies. Using two such units helps overcome the additional problem when drive units tend to focus their high frequency output into a beam which can spoil the stereo effect and produce a loudspeaker which sounds very different a little way off its axis than it does when heard from in front. The control of the dispersion pattern of a loudspeaker has become more important over the years as more gross problems with frequency response, etc, have been ironed out.

The simplest speaker therefore of hi-fi pretensions uses two moving-coil drivers, one for mid frequencies and bass commonly called a *woofer* (though this term should relate more specifically to a true bass driver only) and a high frequency unit to handle the treble called a *tweeter*. The big problem is to avoid bass signals arriving at the tweeter and causing it to freak. The simplest solution which is adopted by many companies is to use a protection capacitor across the tweeter which acts as a filter to roll-off bass frequencies from the tweeter but to allow past the treble frequencies for which the tweeter is designed. This is the simplest form of crossover though the natural progressive inability of a woofer to handle ever higher frequencies acts as a crude mechanical roll-off. If the rate and characteristic of these roll-off curves are required to be modified then a series of tuned circuits can be built into the speaker circuit to filter and tailor the response of the drive units at the extremes and even in the middle of their range if necessary. This is called a *crossover* and such a circuit may comprise nothing more than one resistor and one choke to integrate a couple of drivers or it may have 10 or even 20 components to flatten out the finished response of

the speaker or to integrate three or four drivers.

## Drive units

There are a number of different principles on which drive units that convert electrical energy into movement can be built. The most common is the already-mentioned moving-coil driver where the audio signal is passed through the voice coil of the speaker which is attached to the back of a suspended piston or cone and free to move back and forward in the gap of a ring magnet. Like a motor the loudspeaker will move its coil in and out of the magnetic gap with changing current. The movement is imparted to the cone of the speaker which in turn imparts this movement to the air where it can be heard by the ears.

The art of drive unit design and production is to choose the right materials and adhesives for consistent manufacture as well as to choose the right shape for the cone, the right 'flex' of its suspension, the right power handling and heat dissipation, and a strong enough basket which holds the thing together and by which it is mounted into the loudspeaker enclosure.

There are other exotic principles used to convert electricity into sound, electrostatic elements (as used by Quad), flat plate etched coil tweeters (as used by Wharfedale) ribbons, piezo electric crystal tweeter, ionisation and plasma tweeters. It still seems that the moving-coil rules the roost.

There is much talk about the materials used in the cones of moving-coil drive units so this seems a suitable place to give a quick run down of materials, their benefits and drawbacks. Paper was one of the first materials to be used for drive unit cones; being light and reasonably stiff, it offered efficiency with so-so distortion performance. Paper cones were treated with plastic dopes to improve what is known as their breakup characteristic, this reduced their efficiency due to increased weight but improved their distortion figures. Metal was also an early cone material but fell out of favour; vacuum deposition and new cold drawing methods have caused something of a renaissance particularly when the more exotic 'space age' metals are involved - note the beryllium drivers in the recommended Yamaha NS1000M in this issue.

Plastics became all the rage with research headed by the BBC in this area. Bextrene was used in BBC designed and derived speakers like the LS3/5A and the Spendor BC1 to great effect. This plastic material has reasonable self damping showing less distortion than paper cones but with some sacrificed efficiency. When the dopers got around to plasticising

bextrene cones to improve them further as had been done with paper, speaker efficiency dropped to an all time low.

A replacement plastics material came from the BBC's labs again - polypropylene. This was lighter and stronger than both paper and bextrene and suffering less from a characteristic 'quack' colouration said to be exhibited by bextrene units. Yet being well self-damped avoided the need for doping and lower efficiency. Polypropylene is used in some of the best low colouration designs on the market today, the Mission 770 for example, but the use of any one of these materials doesn't guarantee performance. As ever applications and techniques are as important as the material itself.

## Cabinets are not just boxes

The loudspeaker's woodwork is not just a convenient package for two or three drive units, it plays an integral part in the performance of the loudspeaker. When a drive unit rushes forwards to produce a positive wave at the front of its cone it also produces a negative wave behind. Let these meet each other and they will cancel each other out. Drive units used to be mounted on big boards to let these back waves stay behind but the size of board required to keep the waves from cancelling each other out at bass frequencies (*ie*, long wavelengths) was so big as to be domestically out of place. The back waves of a drive unit were first absorbed in a closed box by Acoustic Research in what they called an acoustic suspension or infinite baffle speaker. The back waves go into the sealed box and are dissipated into the structure and the fibre damping in the box.

Some sealed box designs use the cabinet's response to enhance the response of the loudspeaker system, other manufacturers insist that this is lost information and go for the stoutest most massive box they can build for the money. More recently manufacturers like KEF and B&W have started mounting their drivers on resilient washers and grommets to avoid them passing too much energy too soon into the cabinets in an attempt to reduce colouration.

There are other methods of dealing with the back waves off drivers. The reflex port tunes these back waves and returns them into the listening room to extend the response of the bass driver. Auxiliary Bass Radiator (ABR or drone cone) designs close the port off with a motor-less driver tuned to the response of the bass driver to achieve the same effect. Transmission lines of great length are built into some cabinets to tune this back wave into the room. Again it's not which design that is used but the skill with which it is applied.

### Loudspeaker characteristics

Our reviews include material taken from listening tests conducted on the speakers and from a physical inspection of the materials and engineering in each design. Additionally a considerable number of measurements are made. This section is to explain what these measurements tell us in terms the layman can understand.

### Frequency response

These curves show how, when fed with a constant level signal which changes only in frequency, speakers do not produce an even loudness at every frequency. This gives us vital information on how a speaker will change the tonal balance of a signal. Unlike amps and even cartridges, speakers do not measure perfectly flat from low bass through highest treble but this measurement does give a basis for comparison.

The main chart looks at the speaker's response at a number of positions in front of the speaker, above below and to the side. This gives an indication of the uniformity of response over an area in space which should include the typical listening area. The smoothness and similarity of the response trends both on and off axis show how well the speaker will reproduce stereo material as well as the level of colouration and tonal balance.

The big traces were made with an average noise signal (containing all frequencies simultaneously) to avoid emphasising insignificant response trends. The second trace is made with a swept pure tone and shows more precisely how the bass rolls off and how far down it goes.

### Colouration

This term describes the 'character' that a speaker can add to a sound. A gentle change in response alters the tonal balance of a loudspeaker but a rapid dip or peak over a small band will give a speaker a particular character. A range of adjectives are used to describe the particular character of a loudspeaker - you'll come across words like 'boomy', 'chesty', 'nasal', 'gritty', 'fizzy', 'hard', etc, throughout this chapter. Briefly, colourations occur because of rattle in the mechanics of the speaker or vibrations in its cabinet. Some occur because obstructions lie in the way of the even distribution of certain frequency and many designs show colourations when used with their grilles on; the grille frames acting as tunnels, traps or diffractors for sound.

### Impedance

This refers to the electrical impedance presented to the amplifier which is driving a given speaker. The concepts behind this are difficult to explain and as hard to grasp but suffice it to say that when the impedance drops this makes greater demands on the amplifier's ability to supply power (the product of voltage and current). The impedance determines the ratio of volts to amps that a speaker draws and this is important in matching speakers to power amps and amps to speakers.

Additionally speakers present complex electrical loads to amplifiers, some demanding that the voltage and current be supplied out of phase with each other. Some amps can and some

can't without getting hot or blowing fuses. Each review discusses not only the impedance character of the speaker but also explains if it will be difficult to drive, ie, showing out-of-phase conditions at an impedance dip. The target that designers aim for is to produce a nominal 8ohm design which means the speaker shouldn't present less than say 6ohms more than once or twice.

### Sensitivity and efficiency

Confusion time! *Efficiency* is an attempt to measure the actual conversion of electricity into sound and is referred back to a constant electrical input. More relevant to the consumer is the measure of sensitivity which is based on a fixed amplifier gain and is measured at a fixed distance from the speaker by a mike 'listening' to the midband of the speaker. (Low impedance speakers draw more current and use more power so can be expected to show greater sensitivity.) *Sensitivity* is a useful measure of how loud a speaker will go in a domestic setting though it must be looked at alongside other performance parameters as some designs trade off high sensitivity against early bass roll-off. Sensitivity is covered under the heading *How to make your amp sound twice as loud* in the chapter *Putting together a system*.

### Matching amps and power handling

Offering sensible, consistent advice on the minimum power required and the maximum power handling of a pair of loudspeakers is a very difficult task. First what you may call loud, I may call deafening. Also the room you are using to listen in may be full of soft sound-absorbing furniture which will also affect the perceived loudness.

The dynamic range of the music being played is important too. The relationship of the peaks to the mean level is important. While the mean power level will be that which heats up the drive units and will damage them if they are underrated, the peaks will determine the size of the amplifier as they should be within its capabilities without it generating distortion. Few people appreciate that it is small amps running into distortion that damage drive units, tweeters in particular. A 500watt amp may just tootle along with 10 watts on most programmes but will be able to deliver hundreds of watts on peaks cleanly. Even a speaker rated at 75 watts can handle a *clean* 300watt peak for a short space of time.

It is most important to use an amplifier within its capabilities with a given pair of speakers rather than match numbers between amp and speakers. Our reviews give minimum and maximum amplifier power ratings, the lower figure takes the speaker's sensitivity into account, the upper limit is based on listening experience and tests on measurement with the speakers.

### Stereo

The idea that stereo means bass out of the right speaker and treble out of the left is surprisingly prevalent some quarter of a century after stereo was commercially launched. Stereophony refers to the possibility of recreating a solid image of the recorded sound field

by using two loudspeakers. To capture this sound field coherently requires the use of two microphones, rather like stereo pair photos requiring two lenses and two negatives/prints.

More heavily produced records use the separation possibilities of stereo by recording an instrument in mono (1 channel) and then placing it at any point between the speakers in the stereo image by manipulating the levels in the two channels. This is really multi-track mono and even classical music producers use spotlight miking of some instruments to reinforce their 'image' in an otherwise simple stereo stage. In assessing loudspeakers for stereo performance we have chosen to use a good proportion of simply miked material.

### Other models worth considering

Old favourites that are no longer produced but may still be in the shops include designs like Celestion's 551, the Celef *Mini Pro HE*, the Monitor *Audio MA6 Imp* and the RCL *Reference*.

Other worthy designs that are still available but didn't receive full reviews include the **Audiomaster MLS1** (£129), described as probably the most neutral baby loudspeaker. Sound quality is good and stereo performance particularly so, but of course sensitivity, loudness and bass are limited.

The **Castle Richmond II** (£105) was firmly recommended two issues ago and can be regarded as a scaled down version of the *Kendal II* reviewed in this guide. Sound quality was rated as having a bright balance and shelf mounting seems appropriate to help with this.

The **Mordaunt Short Pageant 2** (£200) fell behind as a price leader in the last issue but is a well balanced design with now a touch of colouration in comparison with its price competitors though detail rendition and imaging are excellent.

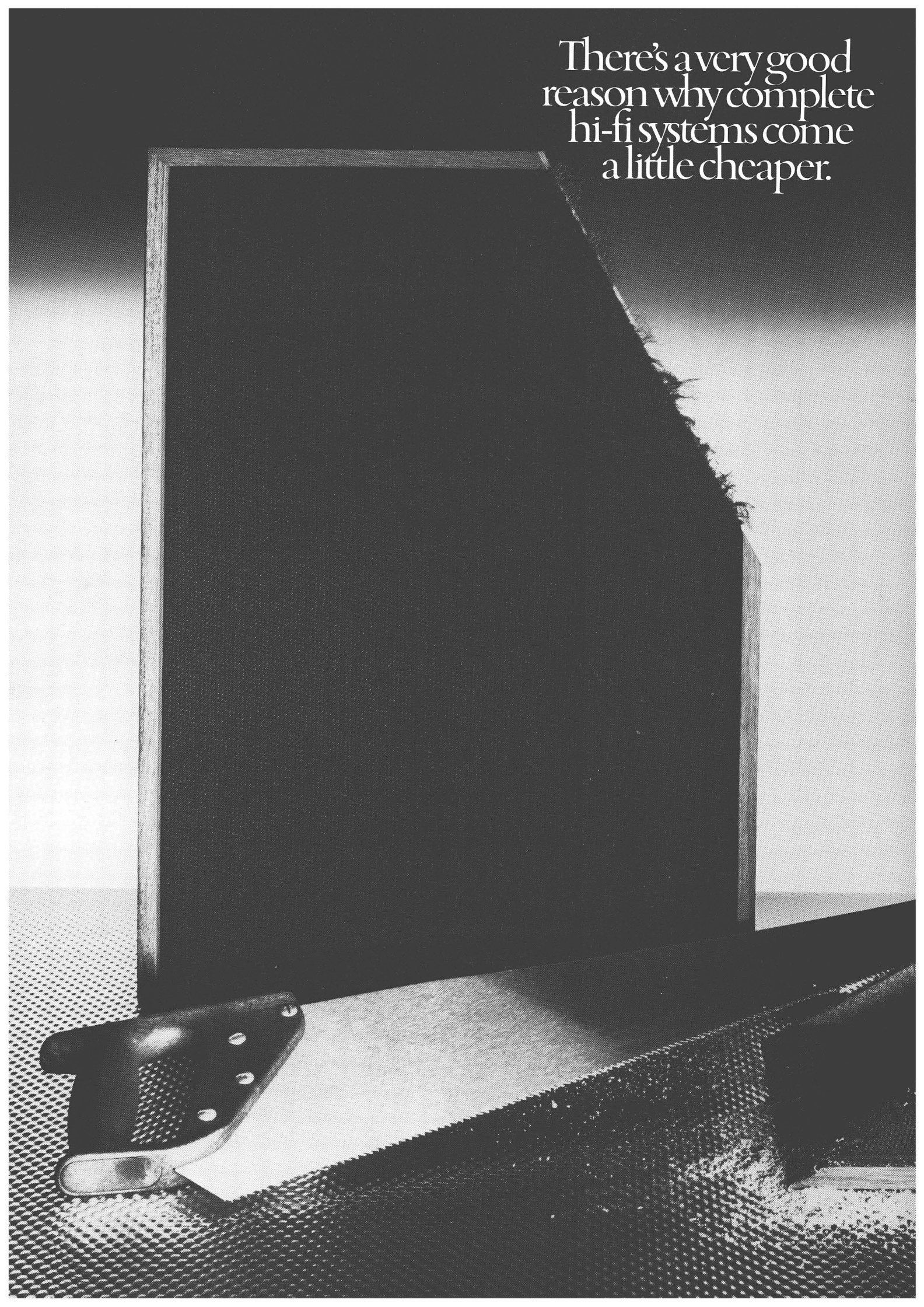
The **Spendor SA1** (£200) is Spendor's version of the baby monitor idea and was rated 'good' in listening tests with slight reservations over balance and colouration. The speaker was easy to drive but had a low sensitivity though both power handling and bass extension were unusually good.

The **Swallow CM70** (£180) only just missed recommendation as panel listening tests were not consistent. It gave promising auditioning results and rated above average despite mid-range emphasis in the frequency balance. The *CM70* is capable of producing high sound levels but because of its below average sensitivity this will require the use of a large amplifier, as a load it is easy to drive.

More expensive models in the Worth Considering bracket are designs like the **Yamaha NS590** (£300) and the **Gale GS401 A** (£490).

Other models excluded from this guide are the **JR149** which is now in a MkII version and the **JBL L150** which is now designated the **150a** and fitted with a new tweeter.

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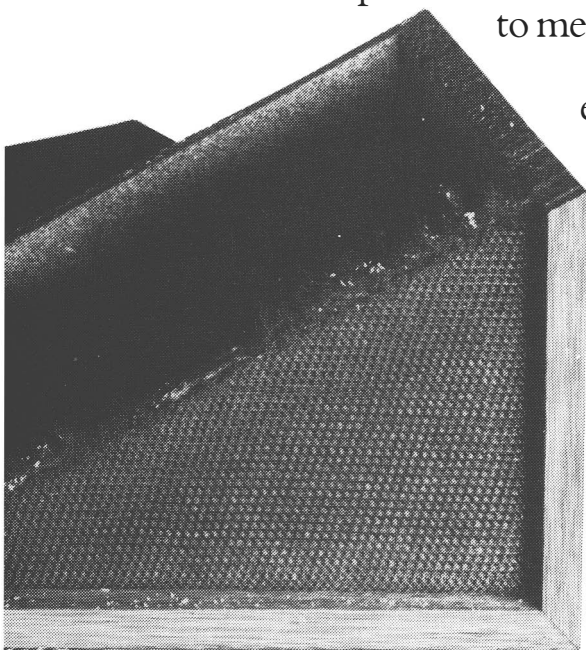
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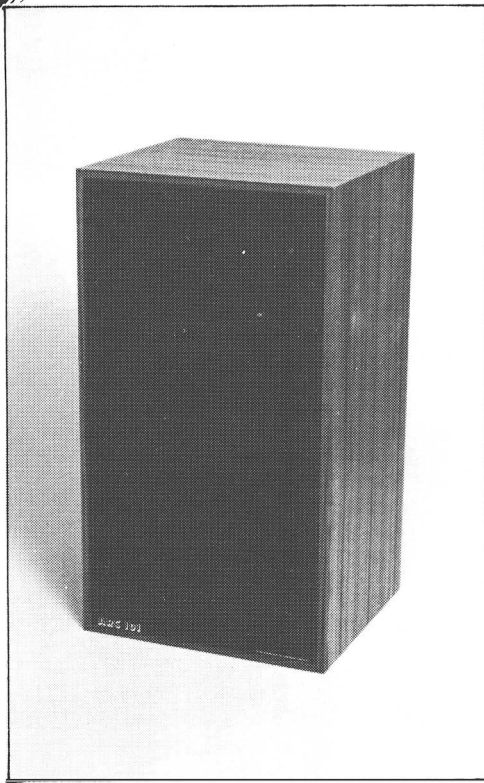
**WHARFEDALE**  
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BEST BUY

# ARC 101A/P

ARC Ltd., Horton House, 2 Urmston Lane, Stretford, Manchester M32 9BP  
Tel 061-865 6494



British made and designed, the ARC models are newcomers and possess some interesting design and operating features. Subscribing to the philosophy of high cabinet rigidity, this sealed box enclosure of some 28 litres is reinforced by two massive circumferential internal braces with double layer bitumen and fibre-board damping. A low diffraction foam grille is fitted to conceal the two drive units; the bass/midrange is handled by a rigid pulp cone 200mm driver with special modifications including doping, while a 25 mm MB soft fabric dome tweeter completes the vertical lineup. The two are integrated by a reasonable quality five element plug-in crossover which is located on the outside rear of the cabinet. This is done deliberately so the user has the option of 'active' operation, *via* separate power amplifiers and a special electronic active crossover. (The British electronics firm Nytech have worked closely with ARC in this respect.)

The design includes a tapered low frequency response to account for placement interactions, the recommended position being on stands backed against a wall. We found 0.2m to be the optimum gap between speaker and wall.

Initial tests on our first samples showed signs of an out-of-phase tweeter, and although we corrected this a second pair was requested for checking. These exhibited no such fault and were an improved version bearing a 'A/P' designation.

### Lab results

These relate to the first sample, and the published curves should be viewed with caution as they are not very representative of current production. The phase cancellation was clearly apparent at the 3.5Hz crossover point before we reversed the tweeter leads, but this anomaly aside the characteristic response above 200Hz was quite even and well balanced, with indications of good dispersion. The low frequency rolloff will be augmented by its recommended location close to a wall, improving the -6dB at 60Hz point to a little below 50Hz.

Fine third harmonic distortion results were obtained at 96dB, though second harmonic reached 3.3% around 2kHz, possibly from a damped breakup mode in the midrange driver. Driven to 100W on tone pulses little additional distortion was recorded at 500Hz and 5kHz, though some dynamic compression was noted (respectively -0.3 and -0.5dB). Rated as 'good' on amplifier loading the 101 was a true 8 ohm design, with low reactive effects (30° max at 2kHz) and at the same time showed a reasonable 88dB/W terminal sensitivity at 1m. With a 150W power ceiling, respectably high 106dBA sound levels are available in a typical room, while the pair match was very close (even so far as the notch depth of the first incorrect samples was concerned!) The grille introduced negligible change.

### Sound quality

These results relate to the second and improved pair. Scoring 'average' on the live sound comparisons the 101 was a trifle coloured with a slightly middy and wooden effect. Detail was good however, giving a lively result without excessive brightness. Bass power handling was also fine with 60W average (200W peaks) accepted from electric bass guitar, producing an even and well differentiated output.

The results improved on stereo programme. The balance tended to be slightly thin and forward, but

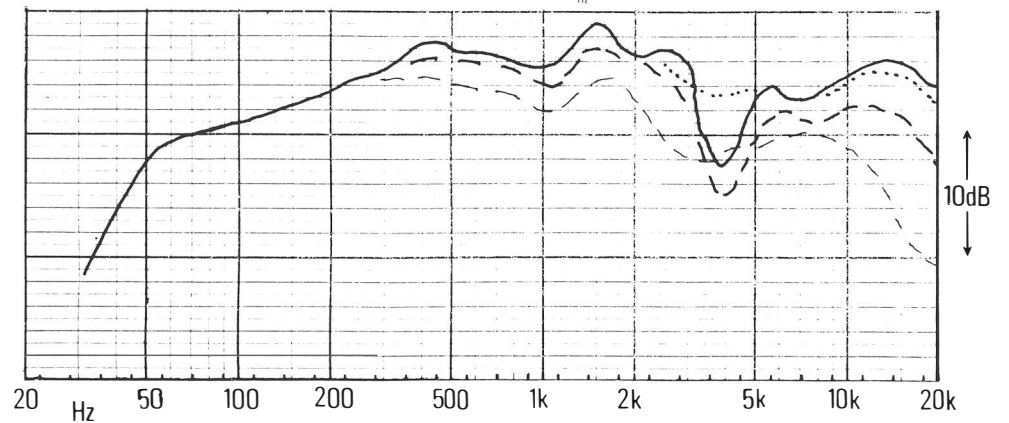
with good smoothness and fine driver integration. Found to be a touch 'reedy' on organ, and also slightly aggressive, it was also agreeably transparent and direct; stereo imaging was undoubtedly good, with a fine depth and ambience where appropriate. The bass was notably dry, even and extended for a system in its class, and dynamics were also well reproduced.

### Summary

Deserving a highly recommended tag, ARC have shown that specialised pulp cone technology can produce a reasonably efficient and compact speaker possessing a good subjective bass performance and fine stereo as well as a lively, transparent and relatively neutral sound. A particular feature is the need for close to wall positioning, which may well be a convenience for owners who do not wish to move speakers out for use or leave them well clear of walls, as is ideally required with most stand systems. Furthermore, the easy option for 'active' future upgrading should not be overlooked.

- Size (H, W, D) ..... 56.5, 31, 28 (22, 12, 11) cm(inches)
- Weight ..... 12 (26) kg(lbs)
- Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) ..... 15-150W
- Recommended placement ..... 0.3m from wall on shelf or stand
- Frequency response within  $\pm 3$ dB (2m) ... 150Hz-20kHz\* (2nd sample)
- Low frequency rolloff (-6dB) at 1m ..... 60\*
- Voltage sensitivity (ref 2.83V, *i.e.*: 1 watt in 8 ohms) at 1m ... 88dB
- Approximate maximum sound level (pair at 2m) ..... 106dBA
- Distortion (96dB at 1m) ..... good
- Distortion (100W peak) ..... good
- Impedance characteristic (ease of drive) ..... good
- Forward response uniformity ..... good (2nd sample)
- Typical price per pair ..... £275 when reviewed, now £329

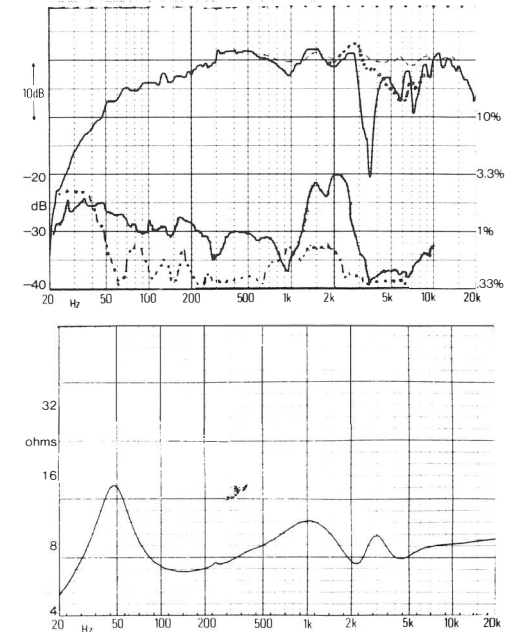
\*see text



# ARC 101A/P

BEST BUY

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/8-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

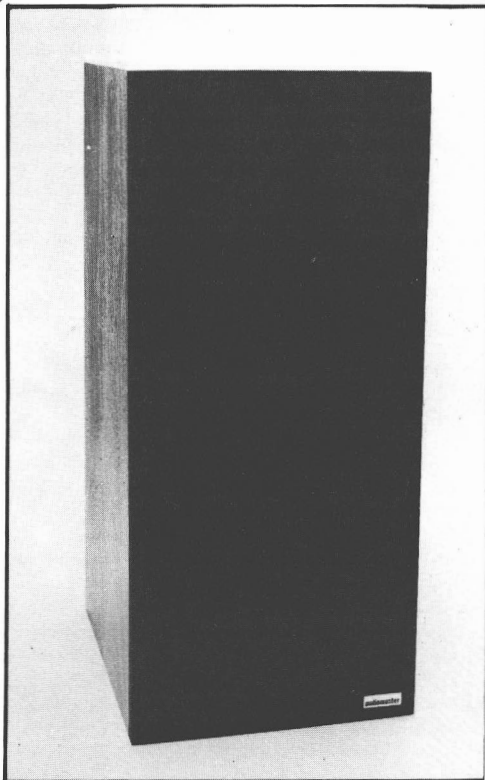




**BEST BUY**

## Audiomaster MLS4

Audiomaster Ltd., 33 Bridle Path, Watford, Herts. WD2 4BZ. Watford 33010.



The *MLS4* represents yet another UK designed two-way stand mounted enclosure, employing a lowish efficiency plastic cone bass/mid unit. While its price is modest, the designer does not appear to have compromised either performance, external finish, or constructional quality. Our samples were finely veneered in American walnut with matching square-edged brown grilles.

This 46 litre enclosure is reflex loaded by a 64mm tunnel port, and has bituminous panel damping and an acoustic foam lining. Bass/midrange is handled by a large magnet, bextrene-coned driver from Audax, who also provide the 25mm soft fabric dome tweeter. A good quality 12-element crossover is employed, the whole design exhibiting attention to detail.

### Lab results

Pair matching was good with a maximum

deviation of 1dB in the 300-500Hz range, although both speakers showed a dip at 2.3kHz. Sensitivity was fairly low at 85dB/watt, which is in part due to the useful low frequency extension to 37Hz -6dB, and by the fact that the over most of the range the speaker proved pretty easy to drive. However the impedance graph does show a dip to just under 5 ohms at around 9kHz, and so only qualifies for an 'average' rating; from 20Hz-2kHz the mean value was around 10 ohms.

Third harmonic distortion was rated as very good, with a moderate 6% at the 96dB reference level, 46Hz, reducing to 0.8% 100Hz and holding at typically 0.3% over the remainder of the range, with the exception of a small region of 0.5% around 300Hz. Power handling was surprisingly good, and with care amplifiers of up to 150w per channel could be used. Up to 40W programme of bass guitar was tolerated with mild port chuffing, reproduction remaining clean up to 20W, while up to 101dBA was possible from a pair at 2m in the listening room.

At the measuring distance of 1m, the sine wave reference curve was generally well balanced and controlled, bar a 5dB trough centred on 2.6kHz. The treble response was smooth but slightly rising. At 2m the 1/3-octave averaged curves revealed that the trough was not a phase anomaly, while the uniformity of, and more particularly the consistency of the off-axis curves was exceptional. The latter illustrated skillful crossover design, and indicated that the minor trough noted above was in fact due to an inherent drive unit characteristic. Finally, the good curves in the vertical axis above and below further indicate that this model should be relatively uncritical of listener positioning.

### Sound quality

When compared with simple live sounds the *MLS4* scored consistently high, showing a well balanced character with only slight criticisms made of a tendency to show up program hiss a little, coupled with some exaggeration of sibilants. The bass register was a trifle boomy but quite truthful and well extended.

This good rating was maintained on the stereo program sequences, thus confirming the results of a previous panel test using earlier samples and conducted for Hi Fi News (June '79 issue.) Stereo imaging was rated as good if not

exceptional; lateral positioning was fine, but some depth loss was noted, giving a 'flattened' impression.

In general the sound was considered to be detailed and neutral but there was also an unmistakable, albeit moderate, emphasis in the upper treble range, lending a 'breathy' effect on voices, and suggestive of 'fizziness' on violins and other similar sounds. This factor was considered to be the major coloration effect, and its seriousness may well depend on the qualities of the ancillary equipment employed.

### Summary

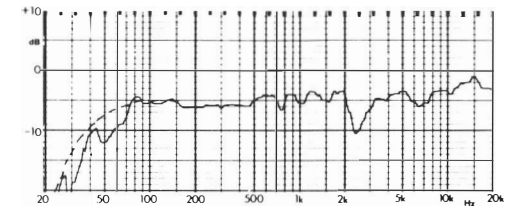
Overall the *MLS4* has clearly achieved a creditable standard. With a minor reservation concerning the treble range, the model has showed useful power handling, moderate coloration, good clarity and an neutral character. The bass register was extremely clean and well extended, while the engineering and finish were both very good, as was the dispersion and forward uniformity. The *MLS4* clearly deserves recommendation at its current price of c. £215 per pair inclusive.

## Audiomaster MLS4

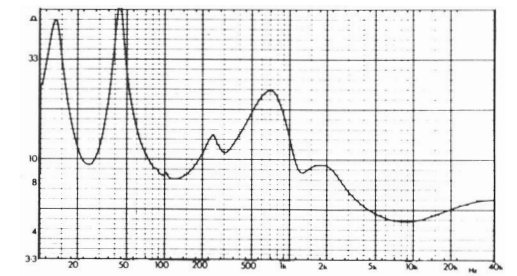
(revised and reprinted)

**BEST BUY**

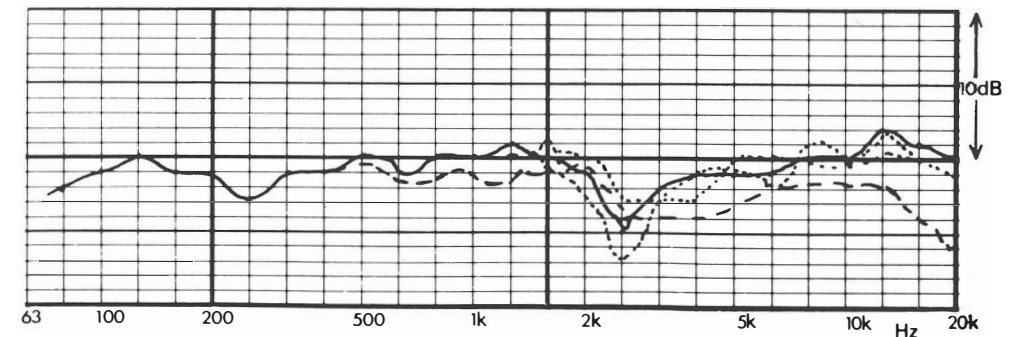
Size	62.5(24) H; 27.5(11) W; 31(12) D. cm(inches)
Weight	14(30) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15-150W
Recommended placement	25cm stand, clear of walls
Frequency response within $\pm 3$ dB (2m)	80Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	37Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	46Hz-6%, 100Hz 0.8%, 300Hz 0.5%, 0.3% typical
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£215



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashed corrects chamber anomalies.)



Impedance vs frequency (mod Z)

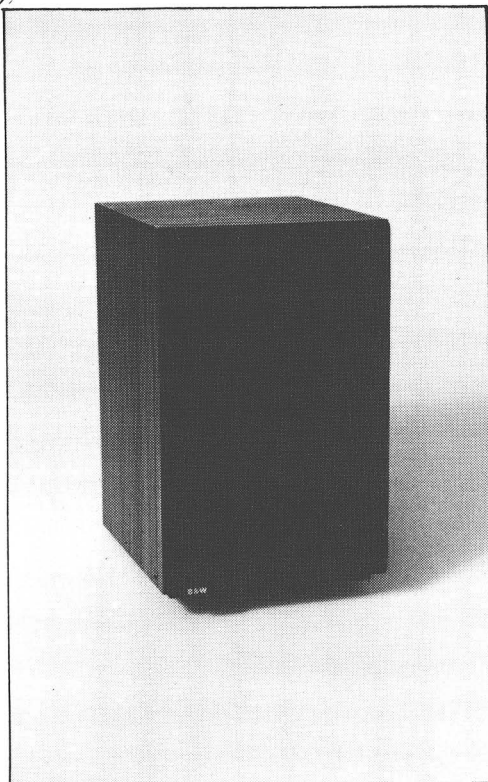


1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

## B&W DM12

B&W Loudspeakers Ltd., Meadow Road, Worthing, West Sussex  
Tel (0903) 205611



In terms of driver complement and physical size, the *DM12* could perhaps be regarded as a successor to the *DM5*, but in terms of sophistication and performance, it is closer to the long-lived *DM4*. A high power compact, it parallels the KEF *R101* in several respects, notably in its use of resilient driver decoupling to reduce cabinet resonance excitation, its electronic protection circuit which guards against abuse or amplifier faults, and also in the third order method for low frequency alignment, which is employed in both models, using a series capacitor element.

The bass/mid driver uses a massive ceramic magnet mounted on a die-cast 185 mm frame and is fitted with a 150mm bextrene cone. The high quality 10-element crossover incorporates protection against thermal overload and DC amplifier faults. The high frequency band above 3kHz is covered by B&W's own *T26* fabric dome tweeter.

It had a foam-lined grille offering good diffraction characteristics and the well finished 12 litre sealed box enclosure is constructed of 12mm chipboard with bituminous panel damping.

### Lab results

As expected the composite grille did smooth the response, particularly in the 5kHz region; but it also attenuated it, for example, by 2dB at 17kHz. The pair match was excellent to 5kHz, above which the output differed by 1-2dB at several points; a worst case 4dB was recorded at 20kHz. Sensitivity was marginally higher than claimed at an average of 86dB.

An elevated midrange region around 1kHz was a feature of the response - a point not properly brought out by the low resolution factory curves which accompanied these samples. On a relative basis the presence band was mildly depressed before the treble energy output recovered to a mild prominence around 13kHz. On the lateral axis the dispersion was clearly good, and the 15° vertical response taken above axis showed that the speaker should in fact be at or slightly higher than ear level in order to produce the most uniform frequency response (shelf or high stands location is suggested).

As claimed, the impedance was that of a good 8 ohm design, and while phase angles of up to 45° existed, these were at harmless higher impedance points. Appropriate for the size and sensitivity, the -6dB point rolloff point was noted at 60Hz. Driven to 96dB (a high level for its size) good distortion results were obtained, although inevitably with rising third harmonic towards the low frequencies; however, a figure of 3%, 100Hz for the latter was still good. The 100W pulsed distortion test was passed with flying colours, exhibiting negligible extra compression or distortion (less than 0.1dB).

### Sound quality

When mounted fairly high on a stand (0.4m) the *DM12* did not fare too well compared with live sounds. The reproduction was considered 'boxy' and 'thickened', while a treble band unevenness was also noted with odd sibilants on speech. Some nasality was also present, and the mid prominence was obvious to the panel. However for its size the bass power handling was very good, with the speaker tolerating an average of 40W of electric guitar. While the upper bass sounds were clearly

delineated, the low bass was deficient in power.

On the stereo sessions the speaker sounded 'large' for its size, though bass notes were still subdued. Coloration was moderate with some midrange bias and 'boxiness', plus a slightly 'dulled' treble, this countered by a degree of extra zip in the higher ranges, which tended to bring out surface noises and clicks a little. The image quality was in fact quite good, with respectable depth, and the general sound quality was certainly well above average.

### Summary

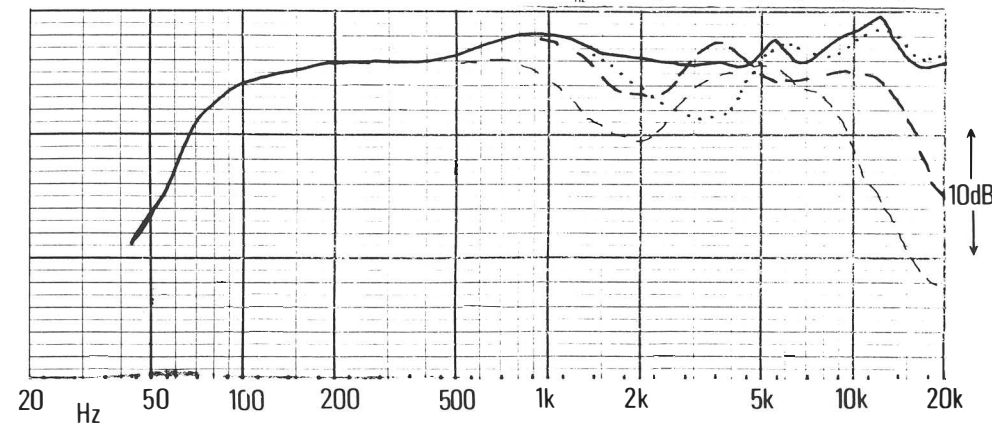
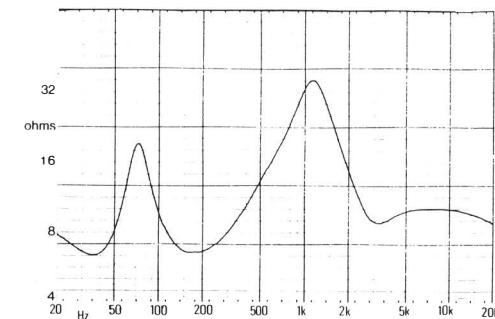
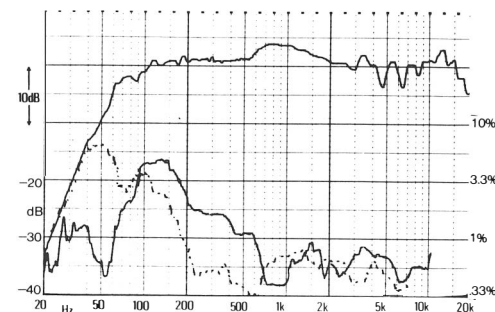
The subjective performance of this model was uneven, mainly due, we feel, to the charted response trends. However, the results were good for the size of enclosure and in relation to its price of just under £200. Construction and appearance were both very good, and the protection provides a further plus point, so a recommendation is clearly indicated

Size (H. W. D).....	35.5, 22, 27 (14, 8.75, 10.5) cm (inches)
Weight.....	9.6 (21) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	25-150W
Recommended placement.....	open shelf or stand
Frequency response within ±3dB (2m).....	90Hz-20kHz
Low frequency rolloff (-6dB) at 1m.....	60Hz
Voltage sensitivity (ref 2.83 V, ie: 1 watt in 8 ohms).....	86dB
Approximate maximum sound level (pair at 2m).....	102dBA
Distortion (96dB at 1m).....	good
Distortion (100W peak).....	very good
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	good
Typical price per pair inc VAT.....	£190

## B&W DM12

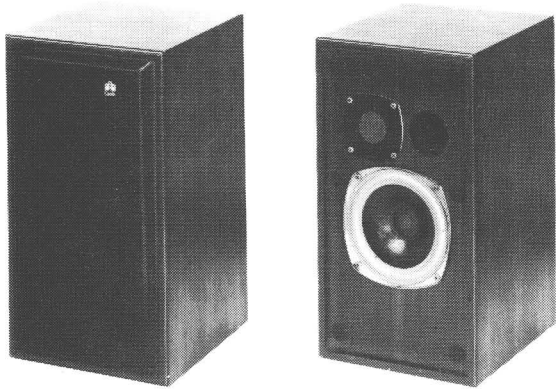
RECOMMENDED

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/8-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



# THE CASTLE RANGE OF SPEAKER SYSTEMS

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## KENDAL II



## CONWAY IIA



## HOWARD II



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RICHMOND II	KENDAL II	CONWAY IIA	HOWARD II
2 SPEAKER SYSTEM	2 SPEAKER SYSTEM	3 SPEAKER SYSTEM	4 SPEAKER SYSTEM
2 WAY	2 WAY	3 WAY	3 WAY
4-8 OHMS	4-8 OHMS	4-8 OHMS	4-8 OHMS
8-30 WATTS	8-40 WATTS	15-100 WATTS	15-150 WATTS



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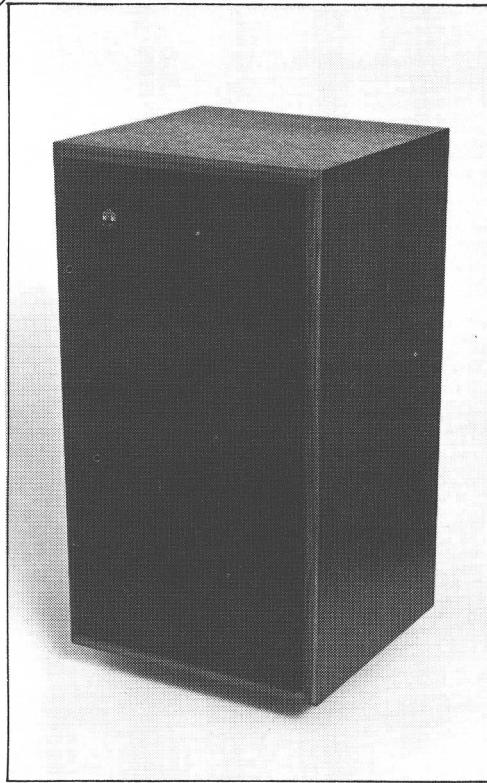
Address .....

.....

**BEST BUY**

## Castle Kendal II

Castle Acoustics Ltd., Shortbank Road, Skipton, North Yorkshire  
Tel (0756) 5333



The latest version of the *Kendal* incorporates a slightly improved high frequency unit, the original 30mm plastic cone with a small centre dome and a somewhat peaky upper range being replaced by a more sophisticated unit, which approximates to an annular radiator with a centre phase correcting plug; the modest fabric cover from earlier designs has however been retained. The remaining driver is a robust 200mm cast frame unit with a rigid flared pulp cone, coated with a damping agent.

Possessing a very good finish, this 30 litre enclosure is rather traditional in its appearance, and is constructed mainly of 15mm chipboard, with bracing and some rear damping. It is reflex loaded *via* a sensibly large 52mm diameter tunnel port, and a good quality, essentially four-element crossover at 3.5kHz is used (12dB/oct electrical), whose function is complemented by designed acoustic rolloff in the drivers. A detachable foam grille helps to minimise cabinet diffraction effects.

### Lab results

Having tested a number of Castle models, I was disappointed to find poorer than usual pair matching for these samples. A 1-2dB imbalance was apparent from 600Hz to 4kHz, but I would suspect on past track record that this is not typical of production. The sensitivity was usefully high at 89dB, and is in no way compromised by the easy to drive impedance characteristic. The -6dB LF rolloff was appropriate at 52Hz, and is in fact quite extended in view of the sensitivity.

The axial frequency response met tight  $\pm 2.5$ dB limits between 65 Hz and 20kHz, but contained a small elevated region at 600Hz, and a hint of restraint in the treble registers. The group of off-axis curves were very well integrated showing excellent crossover phase control; clearly this speaker should prove relatively uncritical of listener position.

Swept distortion analysis at a 96dB sound level (1m) showed good results especially at low frequencies, although third harmonic did exceed 1% in the 1-3kHz range. Peak power distortion was also good, though a significant 0.6dB compression was recorded at 500Hz, the -0.3dB result at 5kHz being rather better. Possessing a low maximum power rating, the sensitivity allowed a high 105dBA maximum sound level from a pair at 2m - very good at the price.

### Sound quality

The *Kendal* scored 'very good' on the live sound comparisons, being aided by its good bass rendition, which was quite even with fairly good extension and surprising acoustic power. Coloration was quite low with a neutral frequency balance and surprisingly explicit transients; one panelist commented that although imperfect, the *Kendal* nonetheless gave a very plausible imitation.

A weaker performance was experienced on the stereo programme, with a noticeable loss of image focus which was probably due to the noted pair imbalance. (Previous *Kendals* gave good results on this test.) In addition, the depth impression was somewhat masked, which is attributed to residual coloration in the design, while the LF register did not sound quite as smooth as the responses suggested. These problems aside, however, the general sound quality was promising, being well above average for its price and class.

### Summary

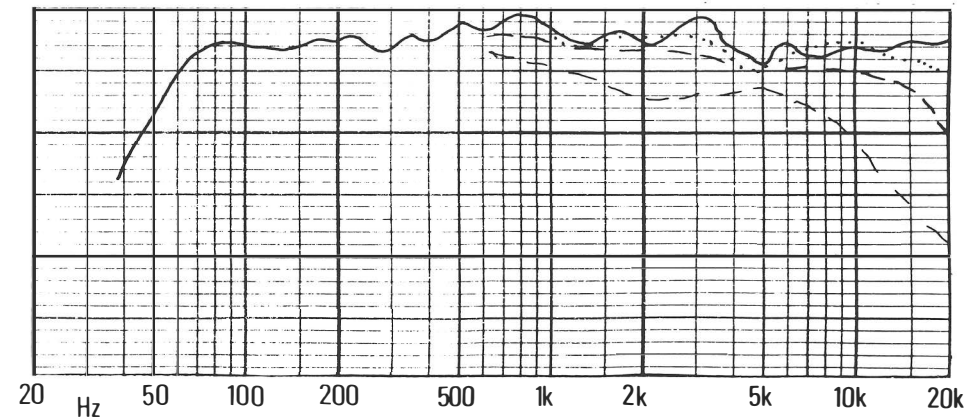
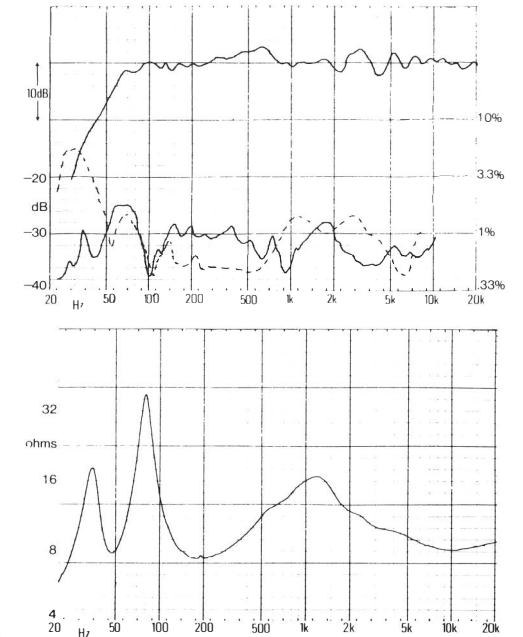
On track record we can expect *Kendals* to be

rather better balanced than our test samples, but even accepting the performance of the latter, a recommendation is still indicated. The combination of modest size and high constructional quality together with good efficiency and bass, plus generally good sound reproduction combine to merit best buy status at around £160. The high sound level capability may also be important to a purchaser.

## Castle Kendal II

**BEST BUY**

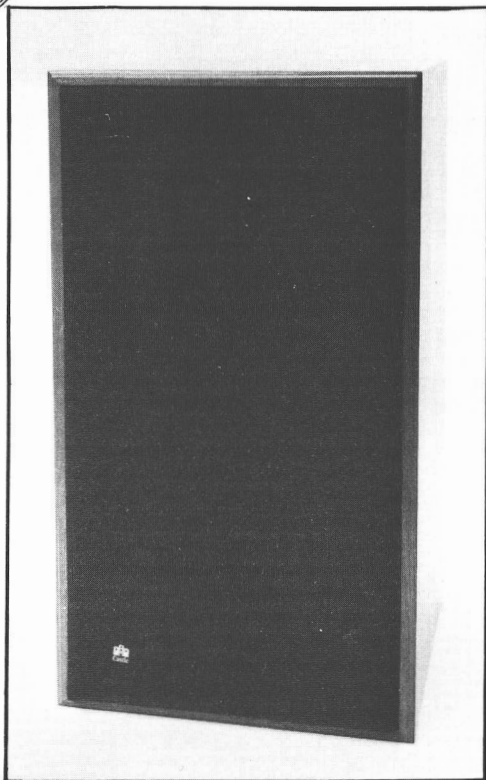
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m  $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

## Castle Conway II

Castle Acoustics Ltd., Shortbank Road, Skipton, North Yorkshire  
Tel (0756) 5333



This rather bluff enclosure measuring some 63cm(H) by 35cm(W) and 37cm(D) conceals a larger than average internal volume of 52 litres, and this, taken together with Castle's good track record on low frequency design, promised a worthwhile bass performance. Our samples were teak veneered on all surfaces with a glossy lacquer finish, the grille being of black Declon foam with some ribbing to lighten the appearance.

A three-way system with crossover points at 750Hz and 4kHz, the dividing network is of good quality, comprising 13 elements. The three drive units are Castle's own, namely a 210mm doped pulp cone bass on a diecast frame, reflex loaded by a 53mm diameter tunnel port; a 80mm doped pulp paper-cone mid unit, also with a die cast frame, and finally, the Castle cone/dome mylar tweeter, nominally 30mm in diameter.

The cabinet is rigidly constructed in high density board with beam bracing and a foam lining. A universal connector provides DIN and 4mm socket connections. Curiously, the three protection fuses are located inside the enclosure on the crossover board beneath the bass driver; however, as the units were not damaged and the fuses remained unblown with up to 300W program per channel, this should not prove any sort of a problem.

### Lab results

The match illustrated by the review pair was very good and generally to within 0.5dB throughout. The sensitivity was fairly low at 86.5dB/W, although the speaker was quite easy to drive, and is in fact marginally more efficient than the typical plastic-coned systems of the same dimensions. The -6dB LF point was well extended at 38Hz.

Rated as very good on third harmonic distortion, 3% was noted at 50Hz, reducing to 0.3% by 100Hz and holding typically to that level throughout, bar minor lapses to 1%, 1.5kHz and 0.5% in the treble. The *Conway* also demonstrated fine power handling, coping well with all program particularly live electric bass guitar. Slight port chuffing was noted at around 20W input, but the audible failure did not occur until beyond 60W, and on wide range program up to 250W per channel was gracefully accommodated. The impedance dipped to just under 6ohms between 100 and 150Hz implying an 'average' amplifier loading, although the *Conway* is elsewhere easy to drive with the values at nominally 9ohms.

At 1m the reference trace illustrated a fine +2, -3dB characteristic from 45Hz to 20kHz, being essentially even and well balanced. Minor dips were present at 1.6kHz and 2.4 kHz, plus a small irregularity above 15kHz.

The smooth frequency response was maintained at 2m, meeting fine +1, -2dB limits overall. The set of characteristic forward responses were excellent, showing fine uniformity and integration on all measured axes. Thus the *Conway* is relatively uncritical of listener position and does not 'beam' in the forward plane.

### Sound quality

Living up to the promise indicated by its lab performance, the *Conway* acquitted itself well in

the live sound comparisons. While not entirely free of boxy effects — noted on male voice for example — the general quality was open and clear, with fine, well controlled and powerful bass.

With the more complex stereo programme the results were even better, the speaker gaining a top class rating for stereo imaging, with depth, precision and ambience all well conveyed.

Driven to high levels it did not sound 'loud' in the fatiguing sense, and performed well on solo piano and heavy rock program alike. Mild criticisms centred around a slightly 'fizzy' HF register, plus a trace of mid 'wiriness' and hardness; overall the panelists were favourably impressed.

### Summary

Once again Castle have come up with a very strong competitor, and like its smaller brother the *Richmond*, the *Conway* has done well in our exhaustive tests. Relatively easy to drive and of normal sensitivity, it proved quite uncoloured and showed good dynamic range and stereo, plus fine detail rendition, with a clean extended bass and low distortion. Dispersion was excellent, and at just over £250 the *Conway* can be strongly recommended as fine value.

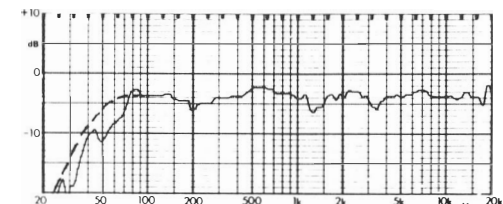
A new version of the *Conway*, designated *IIA*, has recently been added to the range. Featuring an integral stand and styling changes, it is claimed to be acoustically identical and is a little more expensive. Both new and current models feature a revised and improved tweeter, and may be confidently recommended.

## Castle Conway II

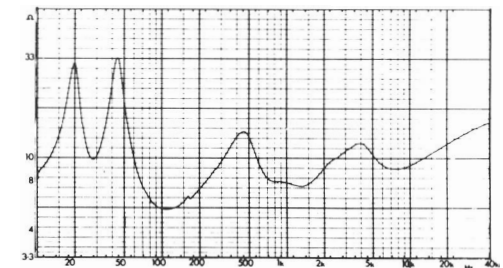
(revised and reprinted)

**BEST BUY**

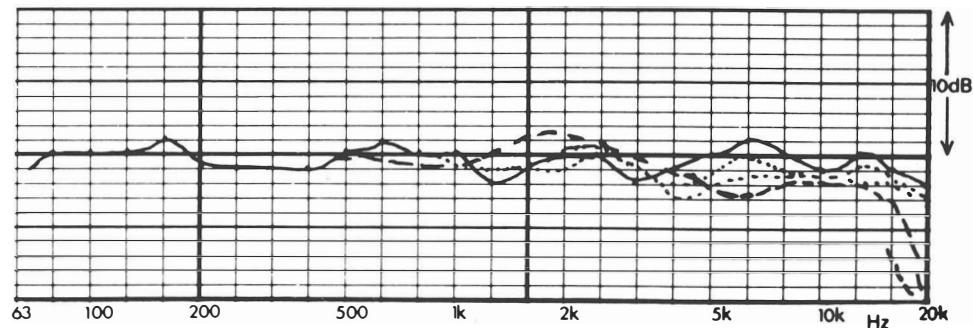
Size	63.4(25) H; 27.5(11) W; 31(12) D: cm(inches)
Weight	18.5(41) kg(lbs)
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	20-200W
Recommended placement	on stands clear of walls
Frequency response within ±3dB (2m)	63Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	38Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86.5dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
	50Hz-3%, 100Hz-0.3%, 1.5kHz-1%,
	6kHz-0.5%, typically 0.3%
Impedance characteristic (ease of drive)	average
Forward response uniformity	excellent
Typical price per pair inc. VAT	£275



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)

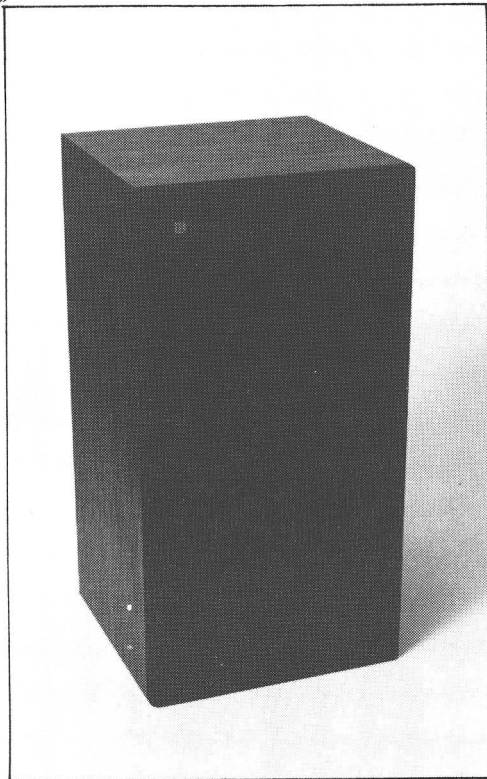


1/3-octave averaged frequency response. 2m solid axial: dotted 10m above and below: dashed 30m horizontal

**BEST BUY**

## Celestion 130

Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP  
Tel (0473) 73131



One of the brand new cost-conscious range of speakers from Celestion, the 130 is a two-way system using a 20 litre sealed box enclosure, a 200mm bass/midrange unit and a 25 mm soft fabric dome tweeter. The latter is a new design made by Celestion themselves, and offers good sensitivity as well as an improvement in sound quality over earlier types. A doped pulp cone with a high loss pvc surround is used for the 200mm driver. The five-element high power crossover is electrically second order at low frequencies, and third order for the treble range filtering.

The dark walnut vinyl clad enclosure is made from chipboard with a polyester fibre volume filling. The grille baffle is not chamfered internally.

### Lab results

The 130 exhibited very good pair matching with a

lab sensitivity of 88dB/W – an above average figure which is not unduly compromised by the impedance minimum of 5.3 ohms at 6.5kHz. An ‘average’ amplifier loading was indicated by the results, and a fairly high 55° phase angle was measured at 2.2kHz, albeit at a safe 11 ohms. Removal of the grille was found to change the response significantly in the 2–6kHz range, entirely eradicating the dip at 5.5kHz, and some listeners could very well prefer to use this model with the grille discarded.

The axial frequency response was quite tidy for an inexpensive model, and except for the grille ‘notch’ it met ±3dB limits from 80Hz to 18kHz on critical sine wave excitation. 1/3-octave analysis smoothed things out somewhat and helped to clarify the major response trends – a slightly depressed treble plus an even more depressed presence range between 1.5 and 6.0kHz. The group of off-axis responses were however well controlled, denoting a good system design as well as good stereo potential.

A fine distortion performance was produced at 96dB 1m, which is a highish sound level for this size of box. Some third harmonic distortion was evident at 1kHz (about 1.5%), but the low frequency range was particularly good, indicating a well-optimised motor design. A 0.4dB compression was measured at 100W, 500Hz, but the 5kHz short toneburst was well handled, with less than 0.1dB loss. Classified as suitable for amplifiers of up to 75 watts per channel, the 130 was capable of quite decent sound levels, recording up to 102dBA for a pair under normal conditions.

### Sound quality

The rather unexciting word ‘average’ described the 130 performance on all listening tests, but as price-vs-performance is an important consideration, this is in fact a very good result as the speaker costs around a third of the group average.

On live tests colorations were audible, with speech considered fairly ‘boxy’ and ‘sibilant’, the latter despite a general and slight dullness in the frequency balance. The midrange was thickened and prominent. Some audible bass distortion was apparent on the bass guitar input above an average of 4 watts, but the 130 went on to cope with 40W before gross overload occurred. Inevitably fundamental bass notes were weak.

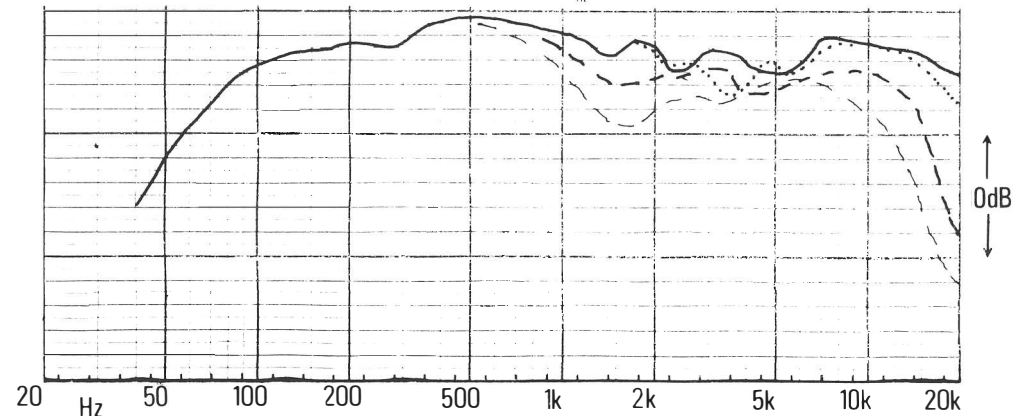
On the stereo programme the speaker sounded a trifle ‘loud’, again demonstrating a mid domin-

ance and a lack of openness and transparency, but still better than many other models in this report.

### Summary

The performance and engineering represent good value for money, and the system was fairly easy to drive. It offered above average efficiency and sounded pleasant enough, so at a modest £110 a pair the 130 qualifies for inclusion in the ‘best buy’ category.

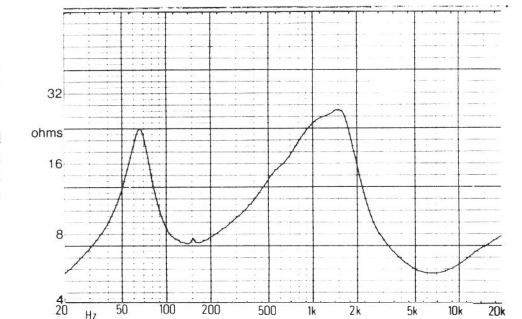
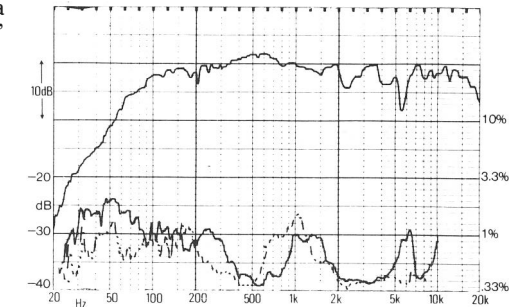
Size (H. W. D).....	48.5. 25. 24 (19. 10. 9.5) cm(inches)
Weight.....	7.7 (17) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	15–75W
Recommended placement.....	open shelf or stand
Frequency response within ±3dB (2m).....	77Hz–20kHz
Low frequency rolloff (–6dB) at 1m.....	60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m.....	88dB
Approximate maximum sound level (pair at 2m).....	102dBA
Distortion (96dB at 1m).....	good
Distortion (100W peak).....	good
Impedance characteristic (ease of drive).....	average
Forward response uniformity.....	good
Typical price per pair.....	£110 when reviewed, now £120



## Celestion 130

**BEST BUY**

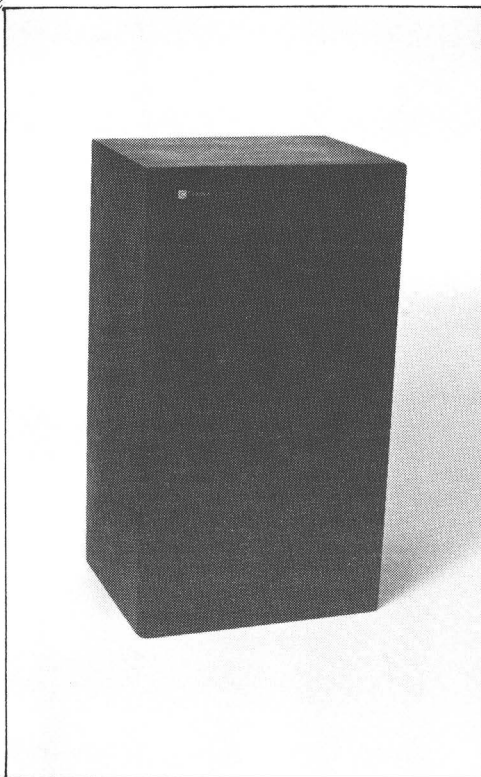
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



RECOMMENDED

## Celestion 200

Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP  
Tel (0473) 73131



The 200 is another new Celestion model and appears to belong to that increasingly popular type whereby two 200mm units are used in tandem to provide good power handling, but where only the upper driver of the pair is allowed to continue into the midrange to meet the ubiquitous 25mm soft dome tweeter. Other examples of this *genre* are now available from KEF, AR and B&W, for example. However, the technical data for the 200 describes an interesting though puzzling variation on this theme, in that both 200mm drivers work in parallel through the midrange while one acts as an ABR at low frequencies. This is done in order to maintain an 8 ohm system impedance using two 8 ohm nominal drivers, and is achieved by a good quality six-element crossover.

The wood veneered chipboard cabinet has an internal sealed volume of 37 litres, and is undamped. A volume filling of polyester wadding is

included and the plain grille baffle is not rebated (see response comments).

### Lab results

The pair matching was fairly good, and generally to within  $\pm 1$  dB, but removal of the grille provided some improvement, notably in the depth of the notches at 2.5 and 5 kHz. Lab sensitivity measured 88.5 dB/W which is somewhat higher than specified; with our estimate of 150W peak programme power handling, this offers a generous sound level maximum of 104dBA in a typical environment. The low frequency cut off was 58 Hz – very similar to the 130 – although the power handling capacity was higher. At an undisputed 8 ohms, the impedance characteristic confirmed that the 200 presents a good amplifier load.

The sine wave response at 1 m was promisingly flat in the fundamental area of 70 to 500 Hz, but deteriorated thereafter with an irregular upper mid and presence range, showing peak-to-trough differences of the magnitude of 8 dB. Above 6 kHz however the treble range was quite even. At 2 m and using  $\frac{1}{3}$ -octave averaging the anomalies were plain to see, persisting at 15° above axis and exhibiting good correlation with the axial responses. Laterally off-axis the loss in output at 30° was greater than usual in the midband but showed a more uniform trend, and this was confirmed by trial listening with the speakers deliberately over-angled inwards.

Swept distortion results at 96 dBA were fine, and this standard was maintained with the 100W pulsed input, with a low 0.2 dB compression at 500 Hz and less than 0.1 dB at 5 kHz.

### Sound quality

On live sound comparisons the speaker confused the panel, as its uneven character suited some sounds very well at the expense of others. Some 'hollowness' and 'box' type colorations were evident, while the presence range lacked integration and 'attack'. Nevertheless it gave a fair impression, and the overall scores were quite good. Bass reproduction was fairly clear with up to 50W average handled without great distress.

Further confusion was encountered on the stereo sessions, where this design pleased some panelists rather more than others. Despite its audible unevenness, the subjective clarity was good, with fair imaging, and a generally acceptable performance for the price.

## Celestion 200

RECOMMENDED

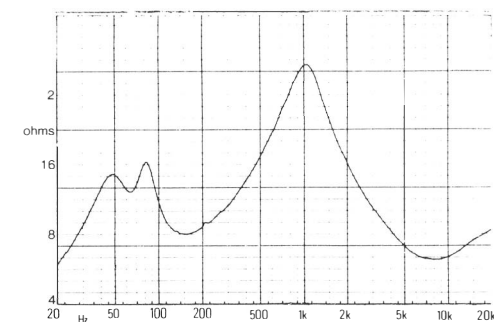
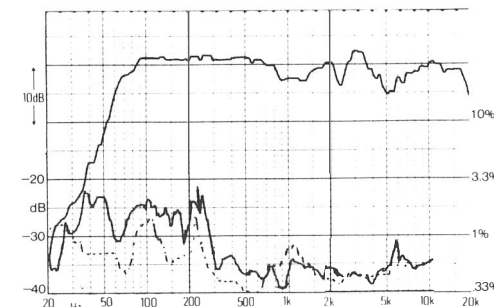
### Summary

While clearly exhibiting some weaknesses, the 200 is a model worthy of audition. The sound is a little better than the arbitrary adjectives in the table might suggest, and technical quibbles apart, the line of rating it achieved justifies the price and merits a recommendation.

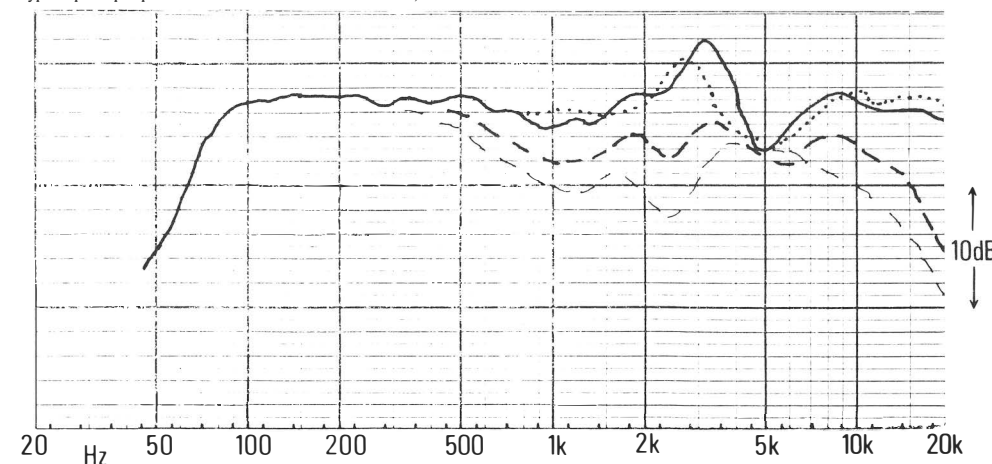
Top: Frequency response, 1 m sine wave, plus 2nd (solid) and 3rd (dashed) harmonic distortion (@ 96 dB)

Middle: Impedance (modulus)

Bottom: Frequency response, 2 m  $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

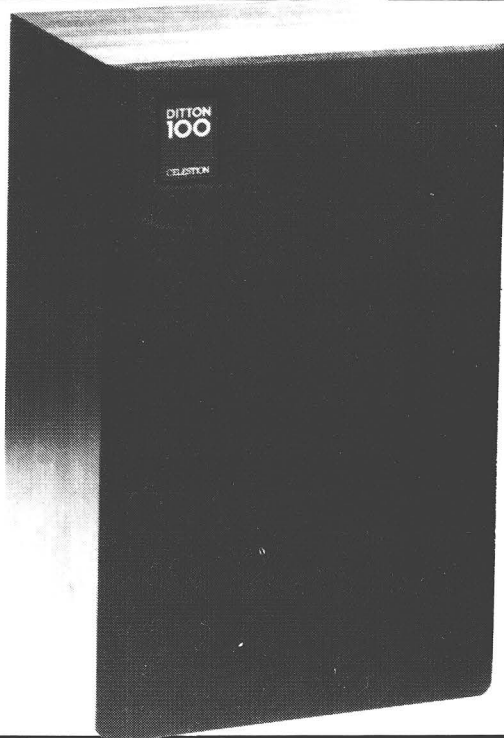


Size (H. W. D).....	60, 33, 26.5 (23.5, 13, 10.5) cm (inches)
Weight.....	12.7 (28) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	15–150W
Recommended placement.....	stand
Frequency response within $\pm 3$ dB (2m).....	70 Hz–20 kHz
Low frequency rolloff (–6 dB) at 1 m.....	58 Hz
Voltage sensitivity (ref 2.83 V, i.e. 1 watt in 8 ohms) at 1 m.....	88.5 dB
Approximate maximum sound level (pair at 2 m).....	104 dBA
Distortion (96 dB at 1 m).....	very good
Distortion (100W peak).....	very good
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	above average
Typical price per pair.....	£185 when reviewed, now £199



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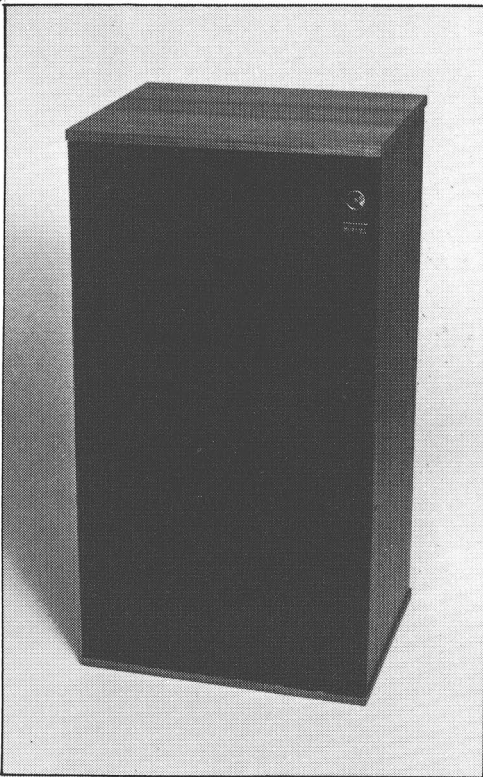
Rola Celestion Ltd.,  
Ditton Works,  
Foxhall Road,  
Ipswich, Suffolk. IP3 8JP  
Telephone 0473 73131



**RECOMMENDED**

## Chartwell PM210 II

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN  
Tel 01-697 8511



### Lab results

As found with the *PM110*, pair matching for the '210 was quite remarkable, being of the order of  $\pm 0.25$ dB over the range. Sensitivity at 85.5dB/W was about average, and the low frequency rolloff was quite well extended at 43Hz.

While the third harmonic distortion levels were fine in the treble, parts of the midrange showed higher values than usual, for example, 1%, 1kHz and 0.5%, 700Hz; however, the low frequency values were normal measuring 0.8%, 100Hz and 3%, 50Hz. Low frequency power handling was undoubtedly good, the system tolerating up to 100W of bass guitar as well as comfortably handling up to 250W of wideband program, with a good 103dBA maximum level. The impedance curve gave some cause for concern however, due to a dip to about 5.5 ohms in the upper treble region, but little programme power will be present here. Below 2kHz the average impedance was about 15 ohms and should present no difficulty.

The frequency response was most impressive on axis at 1 metre, with a 'seamless' crossover region and meeting  $\pm 2$ dB amplitude limits from 50Hz to 18kHz. However despite such accuracy the 300-800Hz range showed a plateau lift of 1-2dB which may be significant. At 2m some integration of the forward response had occurred throwing the mild midrange plateau into relief. In terms of the forward response group this was somewhat emphasised by a degree of energy recession in the presence range from 2-4kHz. The poorest off-axis response was that taken 10° below axis, which indicates that the optimum listener position is on or slightly above the main mid/high frequency driver axis. Nonetheless, despite these criticisms, the characteristic forward responses were undeniably good.

### Sound quality

The score in the live sound comparisons was good, showing a real advantage over its half-size and -price brother, the *PM110 II*. The listening panel described several significant colorations, including 'boxy', 'nasal' and 'slightly muffled' effects, and the bass register was not felt to be particularly natural or detailed, notably in respect of the harmonics lying above the fundamental bass notes.

During the stereo panel tests, the results conflicted slightly, with the standard deviation in the scores being higher than usual. Overall it achieved a 'good' rating - slightly above that for the *PM110*.

Although designs bearing the same name and appearance were included in the previous issues, this is in fact an entirely new model, with a revised 200mm polypropylene copolymer cone and a grille-protected Audax 25mm dome tweeter

The crossover quality and general finish was beyond reproach as with the *PM110*. The '210 enclosure looks larger than other models of comparable volume (47 litres) due to its greater width but reduced depth, the cabinet walls being bituminous-damped and the whole interior foam-lined. A 65mm diameter tunnel port reflex loads the system, the original 200mm unit on a die-cast frame now replaced by one of superior finish and accuracy. An optimal vertical-in-line format is employed for the two drivers and the complex crossover contains 16 elements.

**RECOMMENDED**

## Chartwell PM210 II

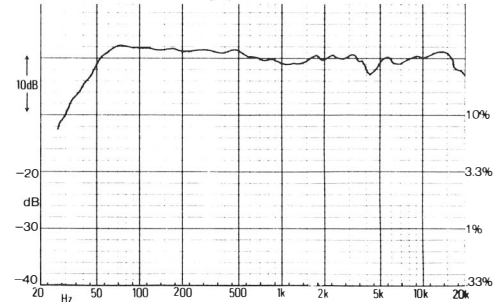
(fully re-assessed)

Stereo imaging was above average with quite good lateral stability and fair depth. The bass gave an impression of being under-damped and 'wooden', and moderate nasality and boxiness was also apparent in the midrange. Similarly the clarity of the system seemed dulled, and accordingly it was marked lower than average for this parameter.

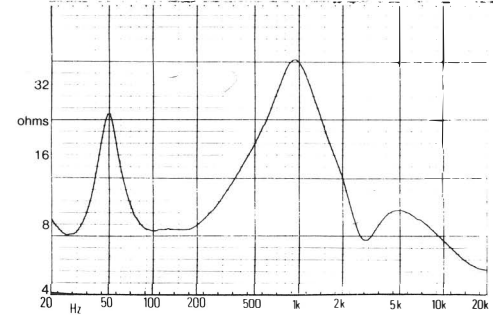
### Summary

Criticised in *Mk I* form, this latest version represents a real improvement in subjective performance, together with a better impedance characteristic, and now qualifies as a recommended model.

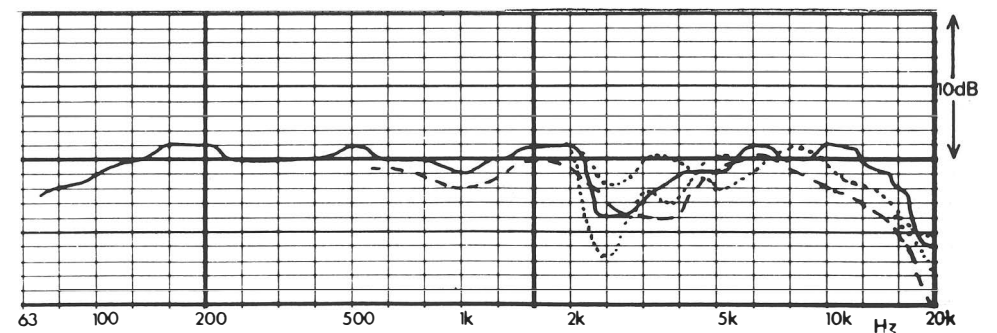
- Size ..... 66(26) H: 34.3(13.5) W: 28.6(11.3) D: cm(inches)
- Weight ..... 15(33) kg(lbs)
- Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) ..... 25-200W
- Recommended placement ..... on stands clear of walls
- Frequency response within  $\pm 3$ dB (2m) ..... 63Hz to 20kHz
- Low frequency rolloff (-6dB) at (1m) ..... 43Hz
- Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) ..... 85.5dB/W at 1m
- Approximate maximum sound level (pair at 2 metres) ..... 103dBA
- Third harmonic distortion (96dB at 1 metre) ..... good  
50Hz-3%, 100Hz-0.9%, 700Hz-0.5%, 1kHz-1%,  
then typically 0.3% in the treble range
- Impedance characteristic (ease of drive) ..... good
- Forward response uniformity ..... very good
- Typical price per pair inc VAT ..... £310



Axial sine wave reference response, 1m



Impedance vs frequency (mod Z)

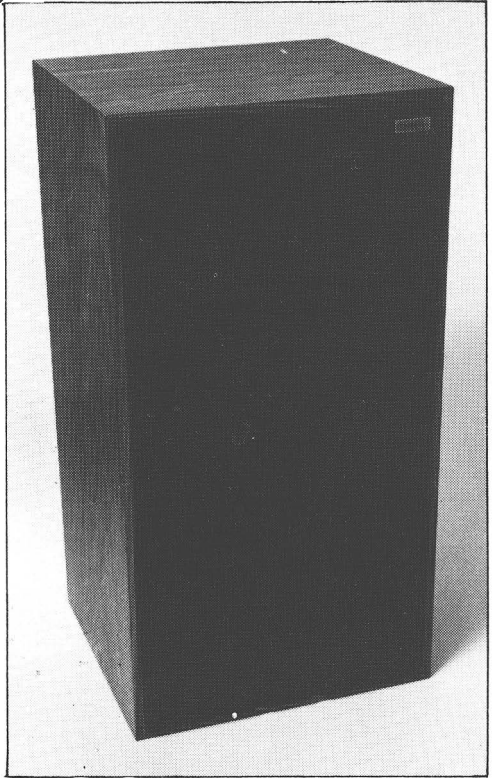


1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

RECOMMENDED

# Harbeth HL1 III

Harbeth Acoustics, 2a Nova Road, West Croydon, Surrey CR0 2TL  
Tel 01-681 7676



Since its introduction the *HL1* has been subject to small detailed improvements culminating in the latest Mk III version reviewed here. We experienced some quality control and consistency problems with earlier models, but happily these now seem to be behind the company, with current review samples showing good matching and agreement with the designer's target specification. In particular, recent improvements have concerned the need for greater low frequency power handling. A 50 litre enclosure reflex tuned by a large 62mm diameter tunnel port, the cabinet is of thin wall high quality veneered plywood, with bituminous panel damping and extensive seam battenning. Front and back panels are well screwed down and a sculptured foam grille improves the cabinet diffraction. An exclusive polypropylene 200mm covers the bass/midrange, and a 25mm Audax soft dome tweeter the high frequencies, with a good

quality crossover dividing the input at approximately 2kHz. Provision has been made for sensible matching of mid and HF using an auto transformer to aid consistent frequency balance.

### Lab results

A useful above average sensitivity of 87.5dB was recorded, which is on target and not compromised by the impedance, which was judged to be a good amplifier load. Typically of the order of 8 ohms, a 6.6 minimum was recorded, and while some high phase angles were apparent (for example 70° at 2kHz) the impedance was substantial enough at these points to avoid censure. The -6dB rolloff point was noted at 46Hz, and with a 100W per channel amplifier limit, a good maximum sound level of 102dBa should be possible in a typical room.

The axial response at 1m was fairly uniform and ignoring the 5kHz notch, met ±3dB limits, 55Hz-18kHz. Third harmonic distortion levels were also very well controlled at 96dB, typically measuring 0.5% or better above 150Hz. The less annoying second harmonic content peaked at 8% around 100Hz, and this might be audible on sustained bass notes. The system fared less well on a diet of 100W pulses despite the low 2Hz repetition rate. Although perfect at 500Hz, a +0.3dB expansion occurred at 5kHz generating 5% of second and 1.8% of third harmonic distortion. Crossover saturation is the probable cause at this equivalent 100W programme level.

Examining the forward 1/3-octave responses at 2m, distinct trends were apparent. The bass region was mildly humped around 100Hz, above which the output rose gently to 700Hz before a trough 2dB deep appeared to 2kHz, the latter an intended design feature. The treble range was more or less level and matched to the midrange, while the off-axis curves can be seen to be very uniform, indicating excellent forward dispersion.

### Sound quality

Designed as a monitor, the *HL1* gave a very good performance when compared with live sounds. In general terms it was clear and low in coloration, and sustained a modest 20W average (100W peak) of bass guitar, providing a fairly even and deep bass register.

On the stereo sessions it was not quite as highly favoured, though it still did well. Vocal lines were clear if slightly 'chesty' and exhibited some sibilance, with an apparent emphasis in the treble

occasionally lending a slightly 'metallic' effect. The bass was also judged a trifle 'soft'. Stereo imaging was quite good with promising depth ambience, but sometimes the treble region sounded displaced from the midrange - a function of the system's frequency balance perhaps?

### Summary

The standards of clarity and workmanship together with the low levels of coloration set this speaker apart from the common crowd, and it continues to maintain its position in the recommended listings. Possessing a fine overall sound quality, it offered an easy to drive impedance and above average sensitivity.

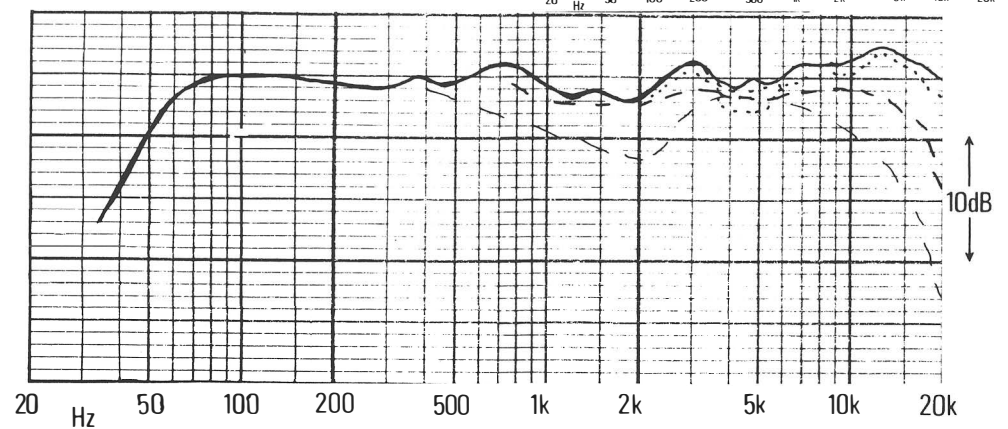
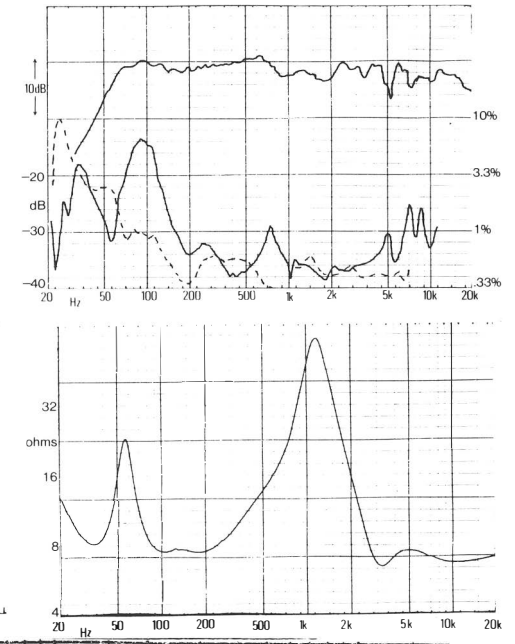
- Size ..... 63.5(25) H; 32.5(13) W; 30.5(12) d; cm(inches)
  - Weight ..... 13.5(30) kg(lbs)
  - Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) ..... 15-100W
  - Recommended placement ..... on stands away from walls
  - Frequency response within ±3dB (2m) ..... 63Hz to 18kHz
  - Low frequency rolloff (-6dB) at (1m) ..... 44Hz\*
  - Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) ..... 87dB/W at 1m
  - Approximate maximum sound level (pair at 2 metres) ..... 102dBa
  - Third harmonic distortion (96dB at 1 metre) ..... v. good  
65Hz-2%, 100Hz-1%, 200Hz-0.2%,  
500Hz-0.35%, typically 0.3%
  - Impedance characteristic (ease of drive) ..... good
  - Forward response uniformity ..... v. good
  - Typical price per pair ..... £300 when reviewed, now £343
- \*Check text

# Harbeth HL1 III

(fully re-assessed)

RECOMMENDED

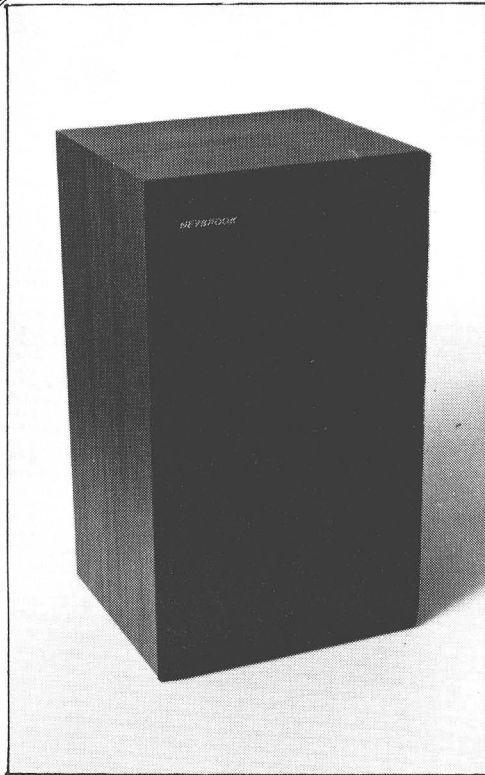
Top: Frequency response, 1m sinewave, plus 2nd(solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



RECOMMENDED

# Heybrook HB2

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



drivers to provide a smooth amplifier load.

### Lab results

Very good pair matching was exhibited with the discrepancies barely greater than the linewidth on a B&K chart. The lab sensitivity was rather low at 84dB/W suggesting a minimum of 30W/channel; with a 100W ceiling, a modest maximum sound level of 96dBA is possible in a typical room. The low frequency rolloff was nominally at 60Hz, -6dB, but some extension to 40Hz was apparent on the axial sinewave curve and this would be present in normal room conditions. Limits of  $\pm 4$ dB were required to contain the sinewave response which was otherwise reasonably uniform.

Subjected to  $\frac{1}{3}$ -octave analysis the response may be seen to elevate by 2dB or so above 500Hz; if referred to the lower level, the bass extension is good for the box size. Around the 3kHz crossover point the same unevenness was present, and the tendency to a loss in output here was exaggerated on the '15° above' vertical response. This speaker should be more or less at ear level for the best results. On the lateral axis the responses were good, and furthermore showed that the most neutral subjective balance will be obtained with the speakers over-angled inwards.

96dB was quite a high level for this box size, and yet the crucial third harmonic distortion was reasonably low until below 90Hz. Second harmonic values were also acceptable at 2.5%, 400Hz and around 2%, 5-10kHz. However the 100W pulsed input caused some problems, for while the 0.2dB compression was slight at 500Hz, 4% of second harmonic distortion was also recorded; fortunately at 5kHz the behaviour was near perfect. With an average value of 10 ohms, the HB2 was considered a good amplifier load, despite the rapidly falling impedance above 10kHz (tapering to below 4 ohms, 30kHz).

### Sound quality

Rated consistently at 'good' throughout the listening tests, the HB2 clearly did well for its price. The bass was plausible if lacking in power on the live comparisons; 60-80W of peak bass guitar could occasionally 'crack' it. The light and open balance suited live percussion sounds, and coloration was low.

On commercial programme stereo imaging was good, with a fine representation of space and depth. Again the bass was more than satisfactory if

British made and designed using French Audax units, the compact HB2 speaker is intended to be unobtrusive when mounted on light stands about 0.5m away from the back wall of a listening room. This is a design showing great attention to detail; for example, the reflex port - a tube 105mm long by 28mm diameter - would be expected to suffer from audible distortion due to its small size, but by locating it on the cabinet rear and damping the exit with a soft foam ring, this is in fact kept to a minimum. The 12 litre braced chipboard cabinet is heavily damped by bituminous pads as well as a thick foam lining. The 25mm soft dome and 160mm bextrene cone drivers are mounted vertically in line behind the acoustically transparent low diffraction grille.

The good quality and complex crossover comprises some 13 elements including resistors, and is described as including phase compensation for the

# Heybrook HB2

RECOMMENDED

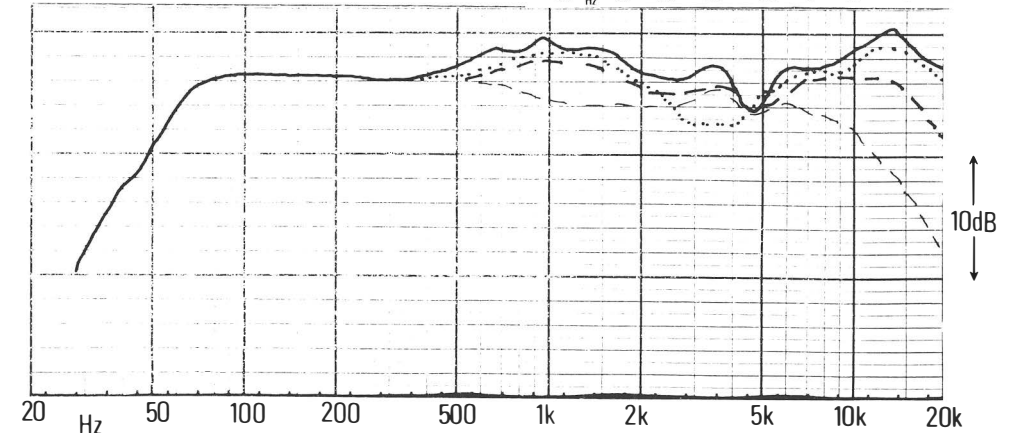
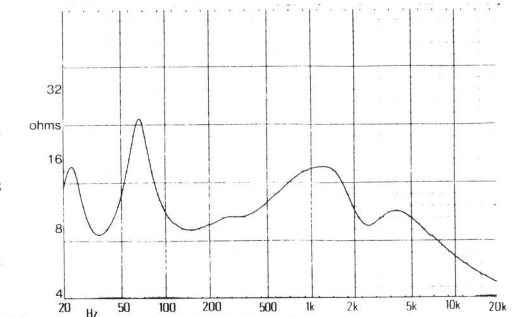
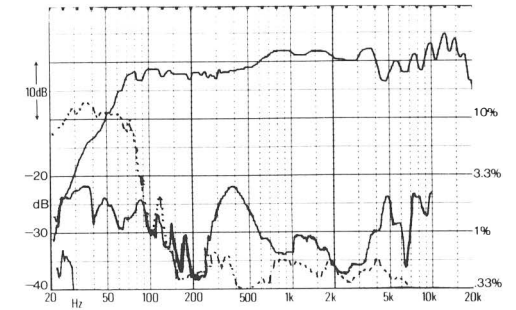
the speaker was not driven too hard, and the balance tended to openness with light sibilance, but in a smooth and acceptable manner.

### Summary

Although possessing a restricted maximum level and power handling, the HB2 was a refined low coloration performer of compact dimensions. It gave a good overall sound quality as well as a consistent character throughout the frequency range, and is undoubtedly worthy of recommendation. This was Heybrook's first venture into the commercial world, and it represents a welcome addition to the market.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m  $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

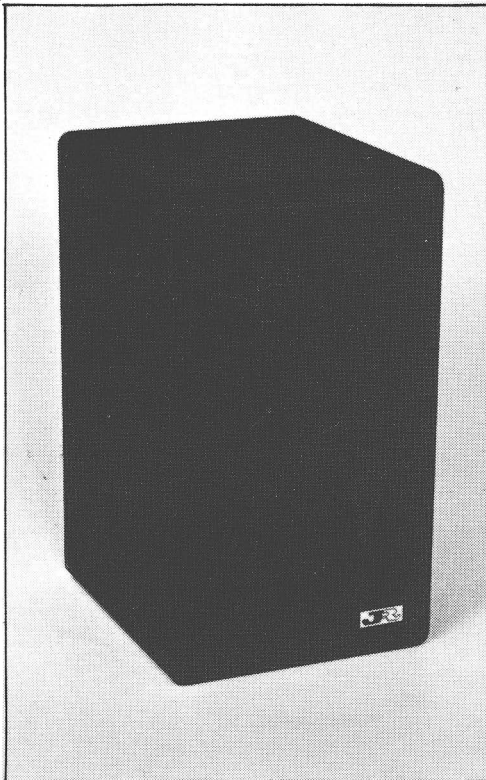
Size (H, W, D) .....	41, 23, 23 (16, 9, 9) cm (inches)
Weight .....	8 (18) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	30-100W
Recommended placement .....	open shelf or stand
Frequency response within $\pm 3$ dB (2m) .....	65Hz-20kHz
Low frequency rolloff (-6dB) at 1m .....	60Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms) at 1m .....	84dB
Approximate maximum sound level (pair at 2m) .....	96dBA
Distortion (96dB at 1m) .....	good
Distortion (100W peak) .....	acceptable
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	good
Typical price per pair inc VAT .....	£170



**RECOMMENDED**

**JR Metro**

Tape Music Loudspeakers Ltd., 114 Ashley Road, St. Albans, Hertfordshire  
Tel (0727) 64337



A true miniature speaker of just 5 litres internal volume, the new *Metro* designed by Jim Rogers is a stylish and beautifully presented example of its kind. Coming with a brown grille and matt *Nextel* cabinet finish in a matching colour, the inert sealed enclosure is made of a new resin fibre which possesses good resonance properties; bituminous damping and foam volume filling is also used. The internal construction is reminiscent of the *LS3/5a* in appearance. It uses a fine six-element crossover (including two resistors). The 100mm bass/mid unit has a rigid pulp cone with a foam roll surround and the 25mm soft dome tweeter is sufficiently recessed to afford some time delay compensation. Overall it is remarkably well made for the price.

**Lab results**

With a predictably low sensitivity of 83.5dB/W the -6dB low frequency point was placed at a high

85Hz, although in practice shelf mounting would improve this to around 60Hz. The 10 ohm nominal impedance classes it as a good amplifier load and it proved easy to drive; the phase angle of impedance averaged 35°, with a worst case recorded at 2kHz (fortunately at a harmless 12 ohms).

Pair matching was very good and generally to within ±0.5dB. With such a small speaker the swept sinewave distortion measurement was made at 90dB rather than the usual 96dB, and this should be borne in mind if comparing the good results for the *Metro* with those for other models. At this drive level third harmonic distortion was clearly well controlled and second was virtually inaudible throughout. The soundness of the crossover design is illustrated by the 100W peak distortion results, where just 0.2dB of compression was noted at 500Hz, and none at 5kHz. With a suggested ceiling of 75W per channel, a modest 97dBA maximum level for a pair should be available in most rooms. This would be slightly improved by shelf rather than open stand mounting and in fact represents two or three dB more than is available from the slightly larger *LS3/5A*.

On axis at 1m the response, while generally smooth and balanced, showed signs of slight lumpiness on occasion, while the low frequency 100-500Hz range was a little subdued - again more suited to shelf mounting. Averaged over 1/2-octave bands the picture changed little. Provided that the crossover has been well designed, such a small speaker should produce excellent dispersion; this was indeed the case with the *Metro*, whose output varied very little over the 60° x 30° forward solid angle.

**Sound quality**

Considering its size the *Metro* did well, attaining 'average' scores, which is creditable as it costs only about one-third of the group average price. Possessing a slightly 'light' and mid-biased balance, a little more presence range energy could have been advantageous, as the reproduction was slightly 'boxy' and 'tubby', albeit less coloured than most. The speaker could only sustain 5W of electric bass guitar before overload, though in practice it withstood acceptable levels of bass input where full range programme was concerned.

The stereo imaging was quite good with accurate positional focus and space. From the characteristic 'small' sound and noticeably restricted bass extension, it was clear to the panel that they were

listening to a 'miniature', but it nonetheless did quite well overall.

**Summary**

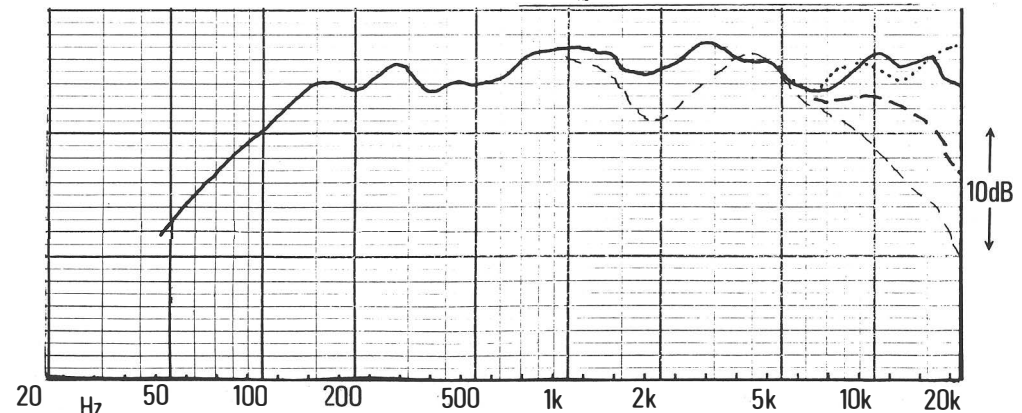
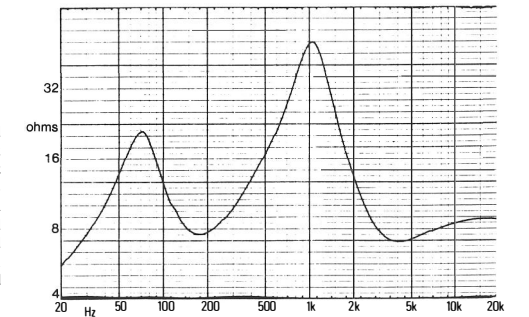
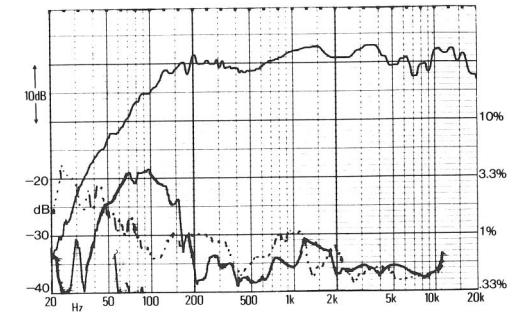
Irrespective of its size the *Metro* has done pretty well at the price, and is a well made and finely finished model, possessing moderate levels of coloration and a natural frequency balance. However its small dimensions do impose significant limitations in terms of sensitivity, power handling, bass response and maximum attainable level, and these preclude 'best buy' status. Conversely because of its size it represents a remarkable achievement, and can be warmly recommended.

Size (H, W, D).....	28, 16, 19 (11, 6.3, 7.5) cm(inches)
Weight.....	4.5 (10) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	30-75W
Recommended placement.....	open shelf or stand
Frequency response within ±3dB (2m).....	120Hz-20kHz
Low frequency rolloff (-6dB) at 1m.....	85Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m.....	83.5dB
Approximate maximum sound level (pair at 2m).....	97.0dBA
Distortion (96dB at 1m).....	good
Distortion (100W peak).....	very good
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair inc VAT.....	£110

**JR Metro**

**RECOMMENDED**

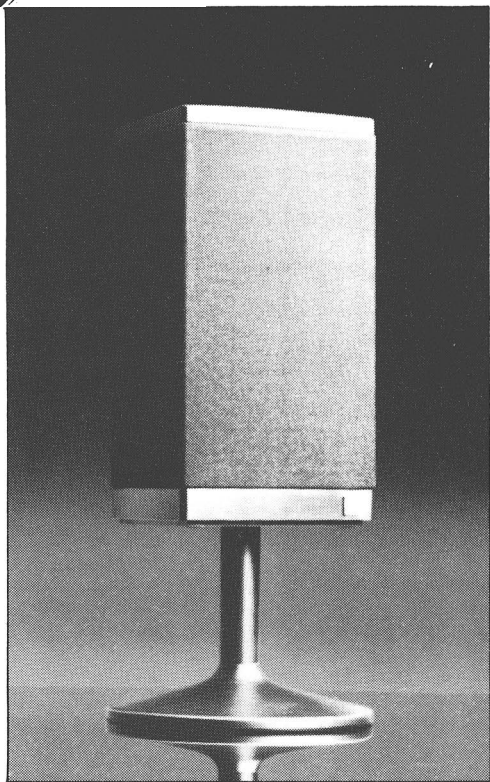
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 90dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/2-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

## KEF Celeste III/IV

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



The original *Celeste* was a slim bookcase model which by today's standards contained the unlikely combination of a *B139* 13 x 9 inch wedge diaphragm woofer, and a version of KEF's still current 52mm high frequency unit. Now in *Mark III* form, the new speaker bears no resemblance to the old, and comprises a vertically oriented enclosure wrapped in black fabric, with a small matt finish plinth which contains the crossover and a special socket for accepting the pillar stand directly. While rather sombre, the whole has a tidy appearance and is well finished, the stand fitting firmly into the special base. Internally the system comprises the grille-protected version of the Audax 25mm soft dome tweeter selected for its efficiency, while KEF's own new 200mm doped pulp cone unit covers the bass/midrange, working in a sealed box volume of about 20 liters. With a

five-element crossover of good quality, the enclosure contained some acoustic absorption material, but no panel damping.

### Lab results

In general the *Celeste* offered an excellent pair match to 4kHz, above which there were 1dB differences of a minor nature. The voltage sensitivity was about average, although usefully above that offered by comparable bextrene types, and in no way compromised by the impedance; never falling below 7 Ohms, this was typically 12 ohms, and thus represented a good amplifier load. The -6dB bass rolloff was measured at 55Hz. Rated as very good on third harmonic distortion — particularly so for a small box — the results were typically in the 0.2-0.3% region, with fine values of 1%, 100Hz and 3%, 65Hz. Power handling was considerable, and up to a 100dBA sound level could be generated, the system accepting comfortably 250W/channel on rock program and some 35W on solo bass guitar.

Measured on axis at 1m, the response met +/-3dB limits from 65Hz-20kHz, though it was not without some mild mid prominence from 250-550Hz, coupled with a presence loss and a rather lumpy treble. Moving out to 2m, the curve showed better integration, though the treble range remained uneven with a prominent 12-16kHz region. The poorest off-axis response was that taken 10° below axis, reflecting a listener position that is unlikely to be adopted with this small enclosure if stand mounted. At 10° above excellent integration was demonstrated on the vertical axis, while the 30° off-axis lateral curve was also good; in fact, the response overall was pretty flat for the price.

### Sound quality

The *Celeste* was promisingly consistent over the range of live sound comparisons bearing in mind the price level involved, and it scored an 'average' rating. Possessing a slightly 'presence dull' and moderately 'boxy' character, coupled with a trace of 'edginess', in practice the panel made only mild criticisms of the sound, while the bass register was felt to be firm and reasonably well defined.

Stereo program with a much wider frequency range resulted in a similar 'average' rating. It scored quite well on grounds of clarity, and while some loss of depth was apparent, most panelists

thought the lateral stereo was to a good standard. Despite characterisations of boxiness, wiriness and a mid emphasis, the sound was not considered unpleasant.

### Summary

Of modern appearance, this compact and well finished speaker offers a clean bass register and good clarity, as well as an easy amplifier load and good dispersion in the forward plane. Maximum sound levels were high, third harmonic distortion very good and although the sensitivity was fairly low, it was nonetheless usefully above average for this size of enclosure. The overall sound quality was essentially average but the price was well below the group mean, and as such, the *Celeste* is worthy of recommendation.

### Update

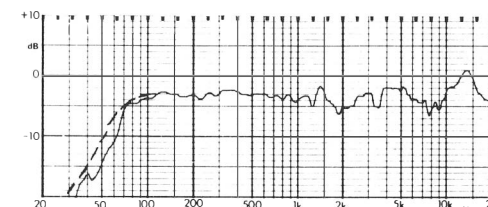
Our comments regarding the sombre appearance have clearly been taken to heart, as the acoustically identical *Celeste IV* has now arrived offering two colours in moulded end plates and no less than seven alternative grille 'sleeves', which may be swapped to match room decor.

Size	..... 50.5(20) H: 26.5(10.5) W: 23(9) D: cm(inches)
Weight	..... kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	..... 15-200W
Recommended placement	..... on matching pillar stands or open shelf
Frequency response within ±3dB (2m)	..... 6.3Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	..... 55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	..... 87dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	..... 100dBA
Third harmonic distortion (96dB at 1 metre)	..... v. good 65Hz-3%, 100Hz-1%, 500Hz- 0.15% 2kHz-0.6%, typically 0.2-0.3%
Impedance characteristic (ease of drive)	..... good
Forward response uniformity	..... v. good
Typical price per pair inc VAT	..... £120

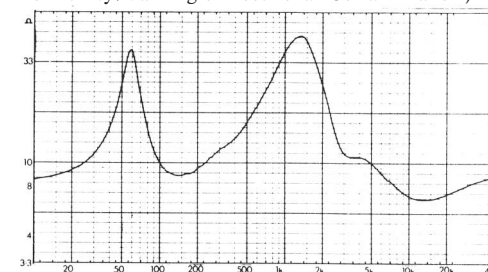
## KEF Celeste III/IV

(revised and reprinted)

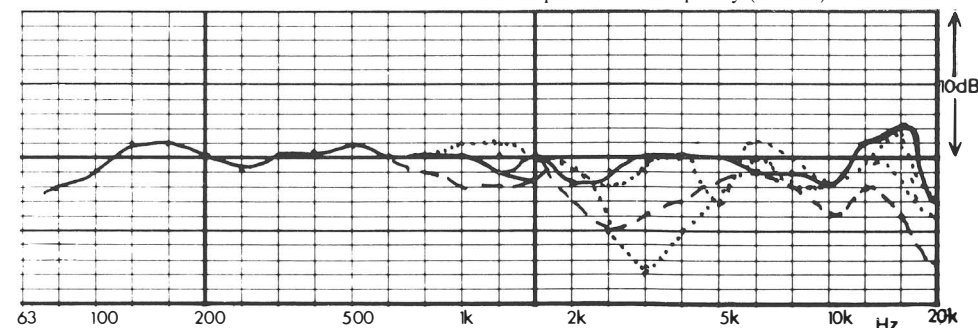
**BEST BUY**



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashed corrects chamber anomalies.)



Impedance vs frequency (mod Z)

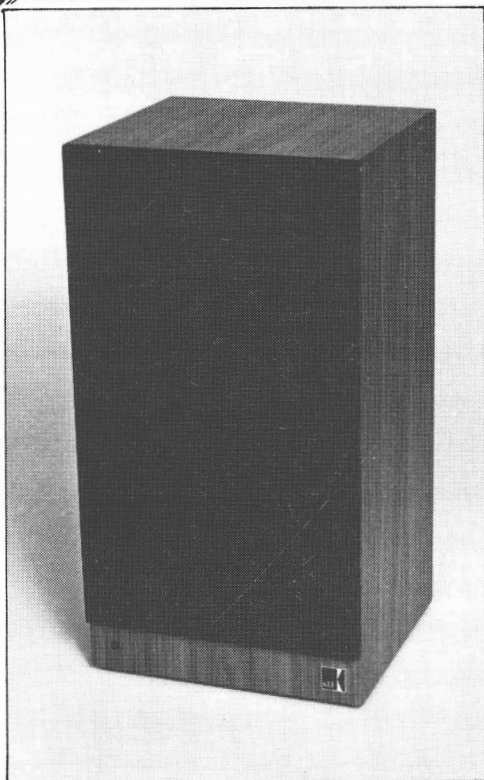


1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

BEST BUY

# KEF R103.2

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



The original R103 was one of the most technically advanced speakers of its time, and still stands comparison with current references. However it was costly and difficult to manufacture, and a new version is now available which is also a two-way compact sealed box system (19 litres). This uses an entirely new high power 200mm bextrene driver for bass/midrange, which possesses a revised profile and trochoidal steel frame designed for balanced anti-vibration mounting to reduce cabinet panel resonance. The tweeter is also a new design from KEF, comprising a 25 mm fabric dome unit.

As with the 101 and 105 a third-order alignment is used at low frequencies, this providing both bass improvement over simple sealed box loading, as well as subsonic overload protection (a series capacitor element). KEF's full electronic overload protection unit (S.Stop) is also incorporated in the complex 14-element crossover, and in common

with all the Reference series speakers, the 103.2 is subject to extensive computer aided tolerancing and matching.

### Lab results

Pair matching was indeed very good, and generally within  $\pm 0.6$ dB up to 18kHz. An average sensitivity of 86.5dB was recorded, which is some 4dB greater than for the original 103. In terms of the size and sensitivity the 48 Hz -6dB low frequency point was quite low, and the sensitivity is in any case assisted by the good amplifier loading offered by the 8 ohms nominal impedance. Fairly high phase angles were recorded - typically 40° with up to 60° at about 2.8kHz (12 ohms modulus) and 40° at 3.5kHz (7 ohms modulus).

At 1m with sinewave excitation the response was unusually smooth and well balanced, meeting  $\pm 2$ dB limits from 58Hz to 18kHz. At a fairly high 96dB sound level, distortion was quite low, with third harmonic well controlled except at 1kHz where a mild rise to 1% was recorded; second harmonic was higher than average at low frequencies, measuring 2%, at 100Hz, though this is pretty innocuous subjectively. Fed 100W tone burst pulses just 0.3dB of compression was noted at 500Hz, with no appreciable increase in distortion apparent, and at 5kHz the results were perfect. This, together with the high bass power handling capacity, means that the R103.2 is judged capable of accepting up to 200W of programme, generating substantial 103dBA sound levels in a typical room.

The very uniform trend exhibited by the 103.2 was confirmed at a 2m measuring distance using 1/3-octave analysis. The dispersion characteristics were very good and a general trend to moderate 'richness' or downtilt in the frequency balance was apparent, more so in fact than for the 105.2, and the grille was found to be partially responsible.

### Sound quality

Scoring average on the live sound comparisons, the system was judged to have a mildly 'thickened' character, exhibiting some 'boxiness', and alternatively described as insufficient openness in the presence range. The bass was however fine with surprising depth and evenness, and it withstood 80W average (200W peak) of electric bass guitar.

On the stereo sessions the panel found the speaker easier to accept and awarded considerably higher marks. It was judged a little 'bland' yet very smooth, with aggressive colorations at a minimum.

# KEF R103.2

BEST BUY

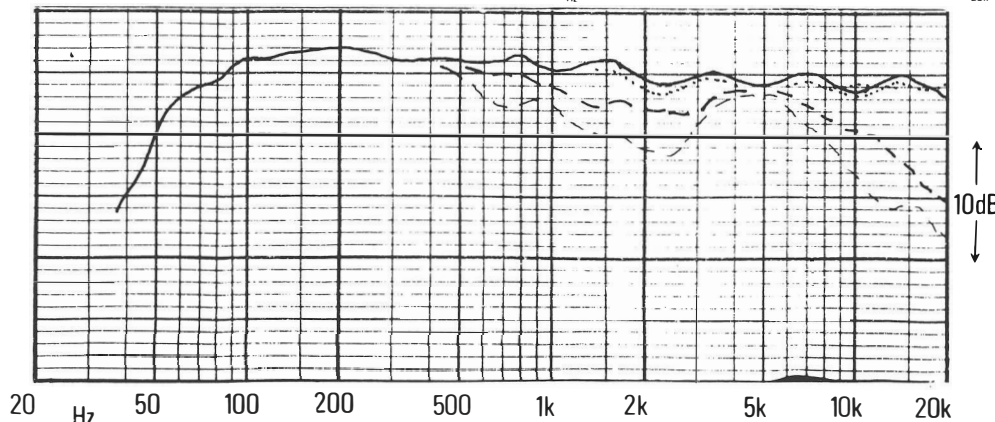
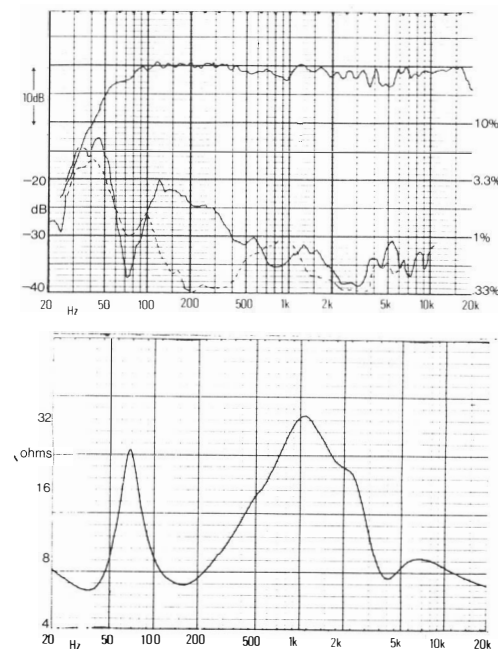
Piano and full orchestra were very well reproduced, and stereo imaging was to a good standard; the speaker tended to 'grow on' the panel slightly during the proceedings, which is an encouraging sign.

### Summary

The R103.2 was a strong performer, taking into account its above average sound quality and good stereo, plus its smooth slightly rich perspective and reasonable sensitivity. It also offered excellent power handling, moderate distortion, and surprising bass for its size. If the very good finish and engineering are taken into consideration as well as the comprehensive electronic protection, this is clearly the recipe for firm recommendation at a typical £250 a pair.

Size (H, W, D).....	50.6, 26.5, 25 (20, 10.4, 10) cm (inches)
Weight.....	8.6 (19) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	25-200W
Recommended placement.....	open shelf or special stand
Frequency response within $\pm 3$ dB (2m).....	50Hz-20kHz
Low frequency rolloff (-6dB) at 1m.....	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m.....	86.5dB
Approximate maximum sound level (pair at 2m).....	103dBA
Distortion (96dB at 1m).....	good
Distortion (100W peak).....	very good
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	very good
Typical price per pair inc VAT.....	£255

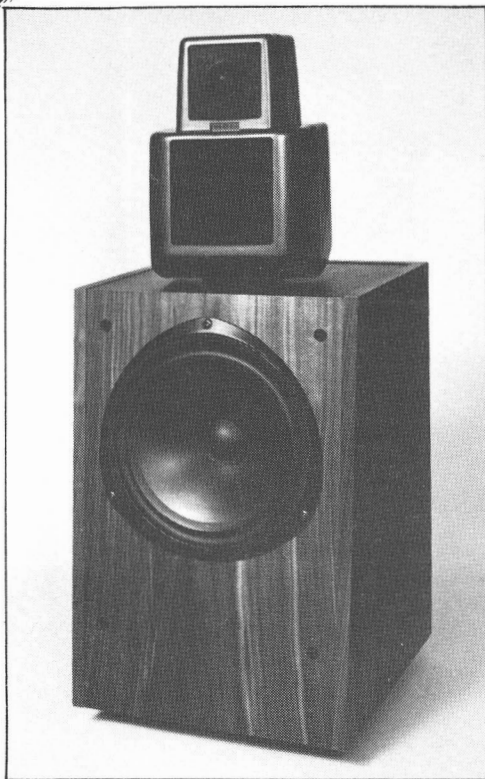
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



RECOMMENDED

## KEF R105.2

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



Tested for the last issue in pre-production form, the Mark 2 *R105* has been completely reassessed this time round, complete with its full grille assembly. This substantial floor-standing three-way system has a bass enclosure which alone measures 70 litres and uses a separate low diffraction moulded 'head' assembly to contain the mid and high frequency drivers; this is adjustable for tilt and lateral angle to aim the optimum axis at the listener without re-orienting the entire speaker. The overall configuration reduces phase and time delay distortion, and accurate driver integration is provided by a complex 24dB/octave crossover (acoustic). All vital components are computer matched to achieve a very close correspondence between the two 'halves' of a numbered stereo pair.

The 305mm trochoidal cast chassis bextrene coned bass unit is aligned to a third order response at low frequencies, and is located on anti-vibration

mounts to reduce cabinet coloration. The 400Hz to 3kHz range is handled by a special 100mm bextrene coned unit, and the treble by a 38mm polyester dome tweeter. Instead of the fuses used in the original *105*, comprehensive electronic protection is now incorporated to cover bass excursion, absolute voltage, and dynamic thermal tracking for each driver. Peak power indicators and test facilities are also provided.

### Lab results

As claimed, the pair matching was extremely good, and the terminal sensitivity was a little below average at 85dB/W. However, the low frequency range was well extended, with a -6dB point at 33Hz (without taking into account the floor-standing position that would normally be encountered).

The swept distortion results at 96dB were good, particularly at low frequencies, but there was a rise to 1% third and 1.5% second harmonic around 1kHz, which was somewhat worse than average. Fed 100W toneburst pulses, a 0.4dB compression was noted at 500Hz though with a negligible increase in distortion, while at 5kHz no compression or distortion was detected.

The sinewave response at 1m on axis was charted with and without the grille in position, and suggests that in the former case a detectable absorption of upper mid and treble energy occurs, placing a slightly rich balance on the otherwise remarkably uniform and extended response ( $\pm 2$ dB limits suffice from 50Hz to 20kHz). At 2m with  $\frac{1}{3}$ -octave averaging (grille on), the marginally attenuated presence and treble range was still apparent, but a notably even and well ordered array of off-axis responses was achieved, confirming the very good driver output integration. By normal standards the speaker is undoubtedly unusually flat in response. The high impedance characteristic presents an easy amplifier load, which helps to offset the low sensitivity; phase angles were held to 40° up to 15kHz, and typically measured 20°.

### Sound quality

The *105 2* did well on live sound comparisons, with the bass range very even and deep, sustaining 150W average or 350W peak of electric bass guitar. Coloration was low, with a trace of 'nasal', 'hollow' and 'boxy' effects, and overall the panel felt that the speaker was somewhat 'duller' than life.

On the stereo tests the imaging was probably the

best auditioned, exhibiting exceptional lateral stability and precision, and with a remarkable realisation of depth and ambience. Overall the sound quality on commercial programme was considered very good, with criticisms confined to a moderate tendency to a 'warm' and 'rich' character, and with a bass that could have benefited from sounding 'drier', in our room at least.

### Summary

Aside from minor quibbles concerning frequency balance, the *R105.2* was an exceptionally well engineered design. It offered an easy load, a wide bandwidth, low levels of coloration, moderate distortion, as well as good power handling. Stereo reproduction was remarkable and full electronic protection was provided. While it may not satisfy those seeking a lively (and possibly exaggerated) sound more suited to loud rock programme, as it stands the *105* is surely one of the most consistently accurate speakers in current production. It should however be noted that the sound is more sensitive to room acoustics than many due to its wide midband dispersion, so where possible a home audition is recommended.

Size (H. W. D) .....	96.5, 41.5, 45.5 (38, 16.3, 18) cm (inches)
Weight .....	36 (80) kg (lbs)
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) .....	25-300W
Recommended placement .....	floor
Frequency response within $\pm 3$ dB (2m) .....	37Hz-20kHz
Low frequency rolloff (-6dB) at 1m .....	33Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	85dB
Approximate maximum sound level (pair at 2m) .....	103dBa
Distortion (96dB at 1m) .....	good
Distortion (100W peak) .....	good
Impedance characteristic (ease of drive) .....	very good
Forward response uniformity .....	very good
Typical price per pair inc VAT .....	£860

## KEF R105.2

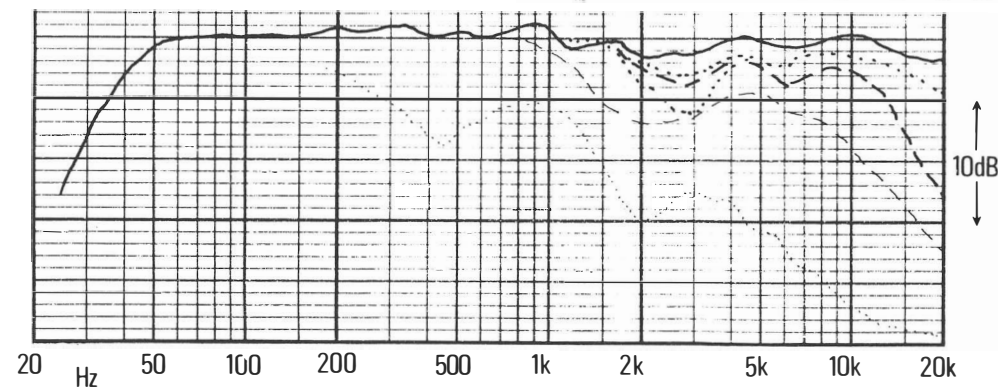
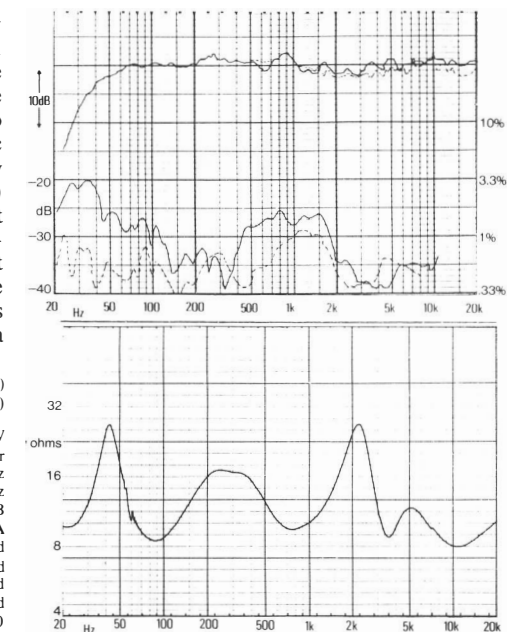
(fully re-assessed)

RECOMMENDED

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB

Middle: Impedance (modulus)

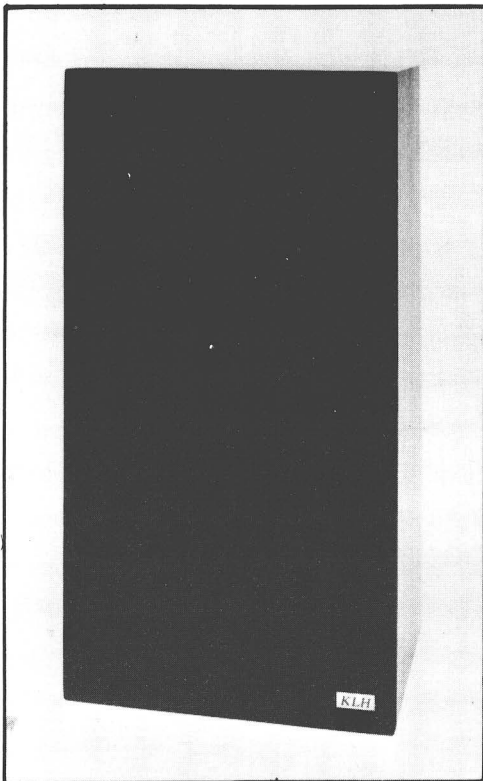
Bottom: Frequency response, 2m  $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

# KLH 317

Webland International Ltd., 4 Cromwell Place, London SW7 2JJ  
Tel 01-584 7735



Although made in the States, the usual transatlantic price penalty does not seem to apply to this two-way sealed box design of approximately 20 litres internal volume. It employs a 250mm pulp cone driver plus a 25mm soft dome Peerless tweeter concealed behind a grille (the latter company is now in fact part of KLH.) While the external finish comprised an attractive vinyl wrap in the form of a hickory print with convincing 'knots' unfortunately the standard of internal construction gave rise to some misgivings. For example, the woodscrews used to secure the drivers had fragmented the inside surface of the baffle, leaving loose woodchips near the bass driver, while the thick grille panel was not chamfered and no panel damping was present, simply a loose Dacron fibre fill. No soldering was employed in the 3-element cross-over, this virtually floating inside the cabinet, the

wires joined by twisting and clamping, using screw-on couplers. However at least it was more complex in terms of its operation than it first appeared, forming a third order high frequency arm and a second order low frequency arm.

### Lab results

Generally good, only a small matching anomaly of 2dB was present at 800Hz, while the sensitivity was high at 89dB/W, with a typical -6dB low frequency point at 55Hz. Rated as very good on distortion, even at the low frequency extreme a 1% figure was recorded, with 0.25% at 100Hz and typical values of 0.4-0.5% over the remaining range. Power handling proved to be considerable, certainly in terms of the high 104dBA maximum sound level, the 317 also coping well with 150W of bass guitar, surviving 250W of full program power. Rated as very good on amplifier loading, the impedance did not fall below 7.5 ohms with a mean value of 10 — clearly the high sensitivity is real enough.

On axis at 1m the 317 met +5, -4dB limits, and although this is not in the 'superfi' class, the curve was still reasonably tidy. At 2m on axis, with 1/3-octave band averaging, the system showed an upper mid plateau from 500Hz to 3kHz, although this was somewhat broken up when measured off-axis. The (dotted) 1.6kHz dip refers to the 10° below vertical axis and the 4kHz dip to the 10° above response, some energy loss being apparent from 3-6kHz, with the treble output a trifle prominent around 12kHz. Overall, however, the characteristic responses were pretty good.

### Sound quality

When compared with live sounds, the 317 did remarkably well, its bright clear balance, fine bass guitar performance and high power handling all proving definite assets here, and comments of coloration were relatively few, relating to some hardness and boxiness.

The 317 did not fare quite so well on the stereo tests, with the wider band and more complex program sequences, and yet a 'good' ranking was still indicated, which is fine at the price. All the panelists were impressed by its clarity, and this helped to reinforce the stereo imaging which was ranked above average. Criticisms included a touch of fizz, brittleness, hardness and boxiness,

**BEST BUY**

# KLH 317

(revised and reprinted)

but these comments still did not deter listeners from marking it favourably.

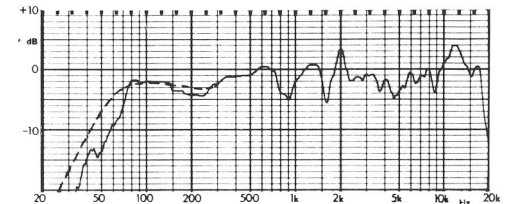
### Summary

This is one of those fascinating systems which according to precedent, ingredients and 'rules' of design, might not have been expected to have performed as well as it did. However the lab results are in the main very praiseworthy, and the listening test results exceptional for the price.

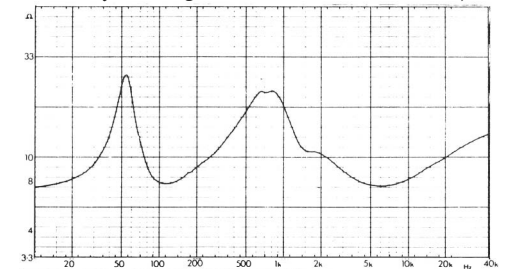
Essentially the 317 offered trim dimensions, a good appearance and high maximum levels, as well as usefully high sensitivity and a very good amplifier loading. The sound was generally neutral and relatively free of coloration, with clean, powerful bass and low distortion — all at attractive price. The 89dB/W sensitivity means that money can be saved on the matching amplifier as 30W per channel will bring over 100dB from each speaker!

A strongly recommended model. If prospective buyers can believe their ears and if a good consistency is maintained, then the KLH should sell in large numbers — however, the manufacturers should tighten up the internal construction quality.

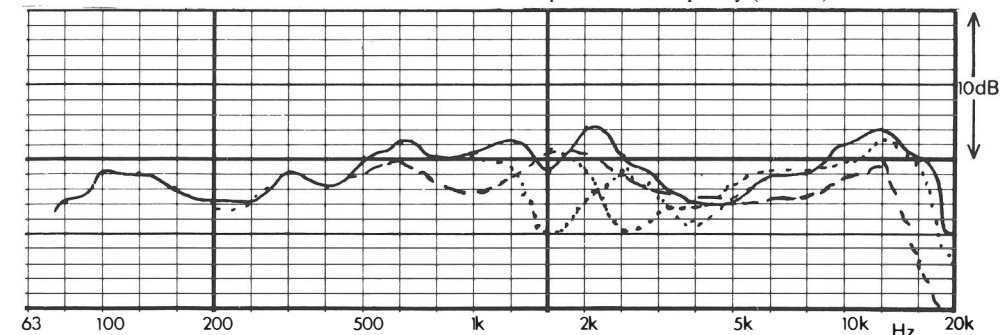
Size .....	58.5(23) H; 30.5(12) W; 25(10) D; cm(inches)
Weight .....	13.2(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	10-100W
Recommended placement .....	stand or open shelf
Frequency response within ±3dB (2m) .....	80Hz-18kHz
Low frequency rolloff (-6dB) at (1m) .....	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) .....	89dB/W at 1m
Approximate maximum sound level (pair at 2 metres) .....	104dBA
Third harmonic distortion (96dB at 1 metre) .....	v. good
66Hz-1%, 100Hz-0.25%, typically 0.5%	
Impedance characteristic (ease of drive) .....	v. good
Forward response uniformity .....	good
Typical price per pair inc. VAT .....	£150



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)



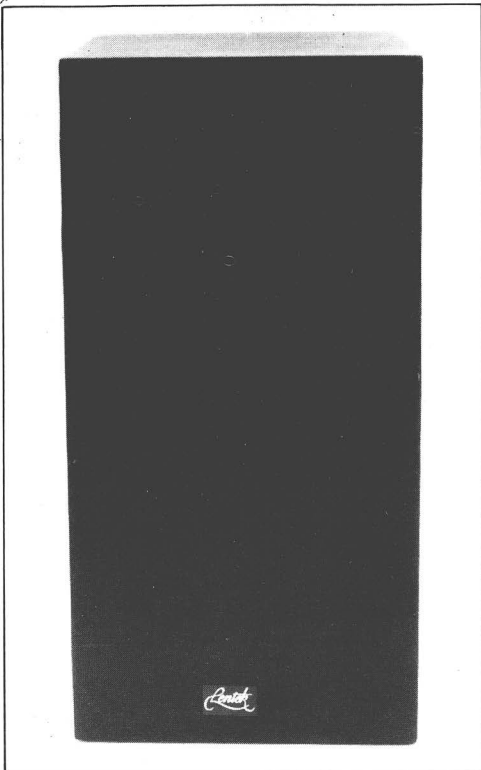
1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal



RECOMMENDED

## Lentek S4

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambridgeshire PE17 4LE. Tel (0480) 62225



On first appearance this small UK built loudspeaker may seem rather expensive, but a closer look indicates that more than usual care is taken in its manufacture, and this is naturally reflected in the price. Specialist stands are available to position the speakers at the optimum height, and a useful instruction book is also provided. The superb finish is in American walnut, and the Company offers a 3 year guarantee.

### Technical details

The S4 is a two-way sealed box, again using drive units from Son Audax. A 200mm bextrene cone bass-mid range unit (specially modified) operates up to 2.5kHz, with a selected 25mm fabric-dome tweeter continuing the range to 20kHz. A complex 10-element close-tolerance crossover divides the signal spectrum with 18dB/octave slopes. The

enclosure is rigidly constructed and carries damping panels.

### Lab results

An excellent pair match was demonstrated, within 0.5dB throughout. Sensitivity was comparatively low at 84.5dB, with a -6dB, 47Hz LF cut off, the latter corresponding with the fairly high 65Hz system resonance. Driven to the full 96dB test level, and despite the high power input this required, the third harmonic distortion remained at the 'excellent' level over the whole range above 80Hz. More usual figures were recorded at lower frequencies; for example, 3% at 50Hz.

With an impedance value of typically 9 ohms, which never fell below 7, the S4 is classified as easy to drive. At 1 metre, under sine wave drive, it demonstrated a very even response, which met +1, -3dB limits, 50Hz-20kHz.

At 2 metres a small hump at 700-800Hz was evident, but apart from this, the forward dispersion characteristic was commendably uniform, with excellent integration demonstrated over the 30° lateral and 10° vertical off-axis curves. The output rolled off a little above 13kHz; for example, at 30° off-axis the 20kHz point was 8dB down. The LF characteristic was very even and reasonably extended for this size of enclosure.

### Sound quality

This model's basic neutrality and lack of distinctive character (in the most positive sense), made it a logical choice for one of the control checks used for frequent repetition in the test sequence. Throughout, it consistently ranked 'above average' overall.

Its strongest performance was during the stereo tests where imaging was highly rated both for its depth and for its precision. Its mild failings were classed as 'sibilance', a degree of 'hardness', 'wiry' and 'reedy' effects, plus a mild mid-prominence and a lightish balance.

On live comparisons the colorations seemed to be slightly accentuated, and some mild buzzes could be heard on moderate levels of electric bass guitar. However, the S4 withstood the full peak output of the 500 watt stereo amplifier without breakup, reaching a fair 99dBA, although the mid frequency

sounds were rather hard at this volume. Generally speaking, in comparison with live sound, it was a trifle bright.

### Summary

This design packs an attractive performance into a small box. The clean and consistent lab results and above average structural quality indicate skilful production engineering, and while it is incapable of very high sound levels, at volumes within its compass a clean, wide-range sound is produced. It clearly gains a recommendation, albeit at a price.

### Note

As we went to press we received samples of a modified S4, which gave greater transparency and less coloration, but at a higher price of £295 typical. Tentatively, and in the absence of full test data, the price rise would appear to be justified, and the design should continue to merit recommendation.

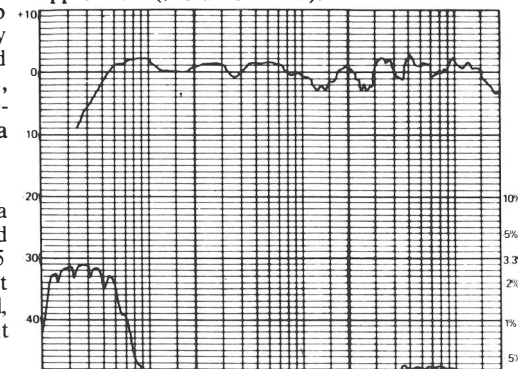
Size	49.5(19.5) H; 25(9.75) W; 25.5(10) D; cm(inches)
Weight	11.7(25.7) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	47Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc VAT	£295

## Lentek S4

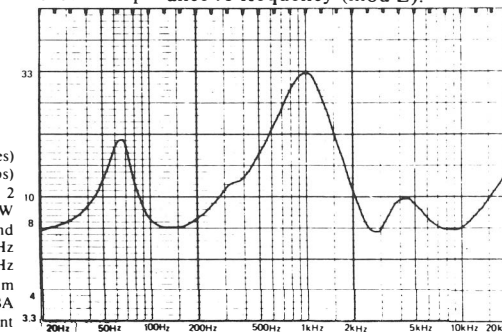
(revised and reprinted)

RECOMMENDED

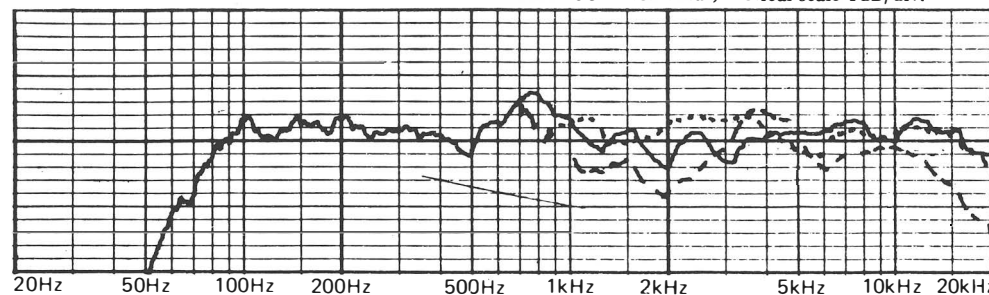
below: upper curve 1m sine wave reference;  
lower curve 3rd harmonic distortion ref  
upper curve (% scale ref OdB).



below: impedance vs frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



20Hz 50Hz 100Hz 200Hz 500Hz 1kHz 2kHz 5kHz 10kHz 20kHz

# HEYBROOK makes more music...



## TT2 Turntable

This record deck incorporates in one elegantly-styled unit the best features of both the solid plinth and suspended chassis designs.

The massive plinth is 72mm thick and constructed from four laminated layers of high density material. It is extremely inert and resistant to all types of feedback.

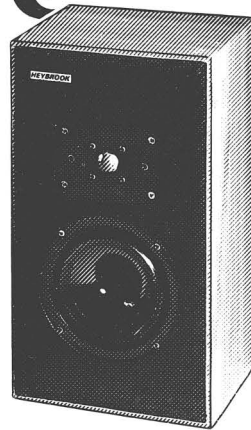
Within this plinth a mild steel sub-chassis is suspended on a dynamically balanced, acoustically isolated three-point suspension which further eliminates feedback. The heavy platter assembly gives excellent speed constancy and is driven by a precision rubber belt. This finely machined platter rotates on a close tolerance hardened steel bearing. Thus all parts in the record playing assembly are closely coupled to effectively dissipate and control resonances. This process is further enhanced by firmly fixing the arm-board to the sub chassis. Speed change from 33 to 45 is effected manually.

The resulting sound is clean and lively, with satisfying solidity and weight. Detail resolution is very good and stereo imagery is precise and with good depth. The high quality of its performance makes the TT2 a first class match for the very best equipment, while the value-for-money price (£195 inc. VAT) means that at last the full potential of all good quality systems can be realised for a reasonable outlay.

## hear them at . . .

Aberdeen Holburn Hi Fi  
Ashford Photocraft Hi Fi  
Bagshot Surrey Audio Consultants  
Bangor (N.I.) LP Hi Fi  
Bath Paul Green  
Belfast Lyric Hi Fi  
Birmingham Five Ways Hi Fi  
Bolton Clearstone Hi Fi  
Bradford Erricks  
Brighton Brighton Hi Fi Centre  
— Jeffries Hi Fi  
Bristol Radford Hi Fi  
Burton-on-Trent Hills Hi Fi  
Cambridge University Audio  
Cardiff Houlden Hi Fi  
Castleford Eric Wiley  
Chandler's Ford Hampshire Audio  
Chester New Dawn Hi Fi

Colwyn Bay Electrotrader  
Croydon KJ Leisuresound  
Darlington Gilson Audio  
Derby Graham Nalty  
Eastbourne Jeffries Hi Fi  
Edinburgh Russ Andrews  
Exeter Gulliford House  
Gateshead Lintope Audio  
Glasgow James Kerr  
Gloucester Robbs  
Guildford Unilet  
Harrow KJ Leisuresound  
Highbridge FF & F Audio  
Huddersfield Huddersfield Hi Fi  
Inverness Nairn Music Shop  
Leeds Audio Projects  
Lincoln Critics Choice  
Liverpool W A Brady & Son  
London S.E. Billy Vee Sound Systems  
London E.D & J Electronics



## HB2

The immediately striking thing about the HB2s is that they sound big. . . . Bass is amazingly extended. . . . The other aspects is the coherent and natural imagery produced.

In fact the large and spacious sound stage the HB2s project remains satisfying after a period of listening.

**Hi Fi Answers, July 1979**

A firm, detailed perspective with good imagery indicated fine integration of the two units. . . . Treble is lively and well controlled. Ambience is well preserved and gives a depth and coherence to the sound. . . . should be heard by anybody in the market for a pair of speakers to see what can be accomplished for £185 per pair.

**Popular Hi Fi, November, 1979**

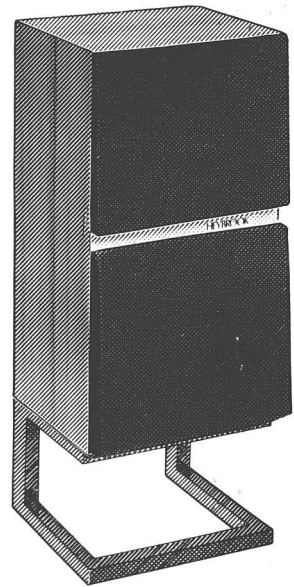
They possess that effortless sound quality which at first was almost impossible to believe.

Detail and subtlety of voice and instruments are also excellent and quite the best I've heard for a long time.

The design as a whole is a success because coloration is remarkably low. Just listen to them and you'll forget all about size and costs! **Practical Hi Fi, November, 1980**

The Heybrook HB2 has little competition, there being few compact speakers capable of its detailed performance, mid definition and bass content.

**What Hi Fi, August, 1981**



## HB3

. . . The HB3s produced an exceptionally detailed, dynamic and uncoloured sound. Imagery was sharp and positive with a clear, open sound-stage, showing good dispersion and integration of the drive units even when sitting off-axis.

**Hi Fi for Pleasure, December, 1980**

. . . The bass is one of the smoothest and least coloured I have encountered. . . . stereo is very good. . . . information and detail equals or betters anything in its price class. One of the great strengths of the model is its ability to remain very convincing at very low levels, although the high sensitivity permits generous sound levels to be achieved. . . . I am already convinced that this is an important model and it may well prove to be a classic. **Subjective Sounds (Hi Fi News) Feb. 1981** £385 per pair

. . . The Heybrook is one of the few speakers to convey a feeling of power where appropriate to the music.

Its realism in setting up a performance in the living room is uncanny, not because it's so precise, but because it's so solid. Dynamics were notably well handled without any feeling of holding back or being unable to cope with the climaxes.

. . . The Heybrooks are in my opinion among the best few speakers in their class.

**Hi Fi Answers, March, 1981**

# made for music by MECOM (ACOUSTICS) LTD.

Knighton Hill, Wembury, Plymouth, Devon. Phone (0752) 863188

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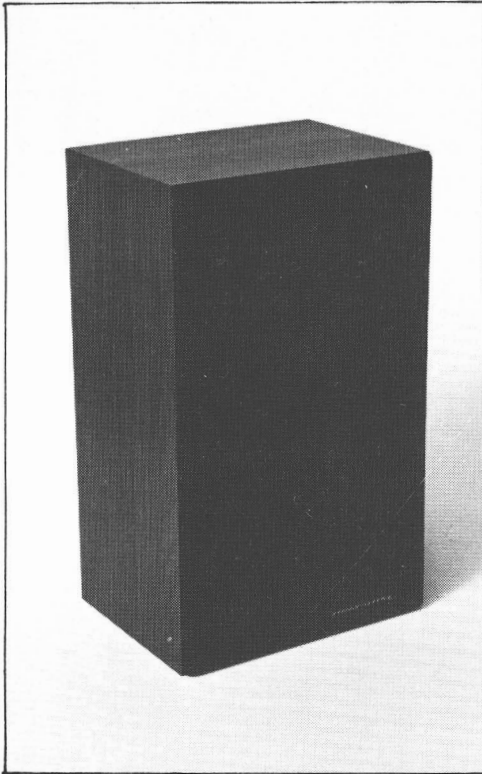
TT2 Turntable  
HB2  
HB3

Please tick

RECOMMENDED

## Marantz SP445

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



Marantz have in the past shown a talent for producing good value products from what appear to be superficially unpromising constituents, the **HD445** proving just such a case in point. A European model, it is designed and manufactured in Belgium, and comprises a sealed box design of some 20 litres volume. Essentially intended for shelf mounting, if positioned on stands a little below ear level it also gave good results.

Three drivers are used, namely a 200mm pulp cone bass/midrange, a 100mm pulp cone upper-mid, and a Peerless soft dome tweeter, all light enough to be secured in position by woodscrews rather than bolts. Exhibiting quite good component quality, the simple crossover possesses six elements and the light vinyl covered cabinet contains some fibre absorption, but (not unexpectedly) no bracing or damping.

### Lab results

Pair matching was pretty good up to 4kHz where a small 1dB imbalance in the treble range was noted. The grille was found to dramatically affect the response, attenuating the 4–8kHz range by 2–4dB, while the upper treble was also depressed. The grille-off results were preferable, and something should be done about this. Sensitivity was high at 90dB/W, and this is assisted by the good 8 ohm nominal impedance, which presents a decent amplifier load with low phase angles throughout. Generous sound levels could thus be attained – 105dBA in a typical room, comparable with much larger systems. The system resonance was rated at 65Hz with an accompanying –6dB response rolloff at a fairly high 72Hz; in practice shelf-mounting would augment this by some 10–15Hz.

The second and third harmonic distortion at 96dB was very good – a not uncommon result for a high sensitivity speaker – but this result was somewhat marred by a rise in third to just over 1% at 700Hz. The 100W pulsed input was a tougher test and perhaps unfair since it produced a whopping 110dB s.p.l. at 1m. Crossover saturation occurred at 500Hz with 2–3% distortion and 0.3dB of compression, but at 5kHz the correspondence was near perfect.

On axis the 1m response using the critical sinewave input was clearly mid-biased but relatively uniform; this was confirmed at 2m with ½-octave analysis. However this uniformity quickly disintegrated laterally off-axis, while the 15° vertical response was none too even either. By implication the drive units were not very well integrated, and serious phase and diffraction anomalies made the off-axis sound quality unpredictable.

### Sound quality

This speaker scored a rather consistent ‘average’ throughout, which was most promising in view of its low price. Compared with live sounds some coloration was observed including ‘nasal’, ‘boxy’, ‘hard’ and ‘hollow’ effects, plus a dulling of the upper treble, and the design did not appear to be particularly subtle. It could however be driven quite hard in the bass, to produce well controlled results with levels of up to 100W peak input on electric bass guitar.

On the stereo sessions the imaging was found better than anticipated and proved good for the price. Sounding fairly lively on most commercial programme, it exhibited a slight ‘loud’ and

‘forward’ tendency, but most panelists found it surprisingly plausible.

### Summary

In real terms this speaker had few faults. At a low cost it offered a high sensitivity plus a good amplifier load, as well as high sound levels, a pleasantly balanced subjective response, and low distortion. It can be seen as a worthwhile if contrasting alternative to the low sensitivity, low coloration models, and is worth recommending. A better grille and a touch of improvement to the off-axis response, and, who knows, ‘best buy’ status might be achieved!

Size (H, W, D) .....	49, 29, 22 (19.3, 11.4, 8.7) cm (inches)
Weight .....	8.8 (18) kg (lbs)
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) .....	10–100 W
Recommended placement .....	stand near wall or open shelf
Frequency response within ±3dB (2m) .....	90Hz–20kHz
Low frequency rolloff (–6dB) at 1m .....	72Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms) at 1m .....	90dB
Approximate maximum sound level (pair at 2m) .....	105dBA
Distortion (96dB at 1m) .....	good
Distortion (100W peak) .....	acceptable
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	acceptable
Typical price per pair inc VAT .....	£100

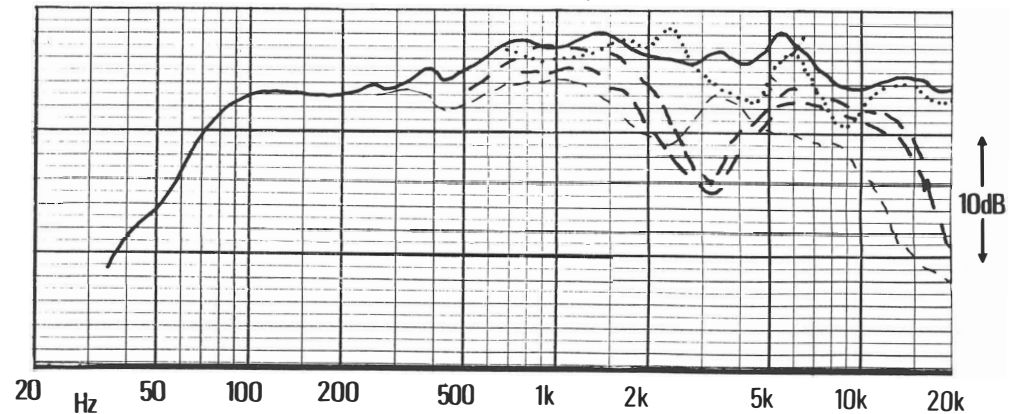
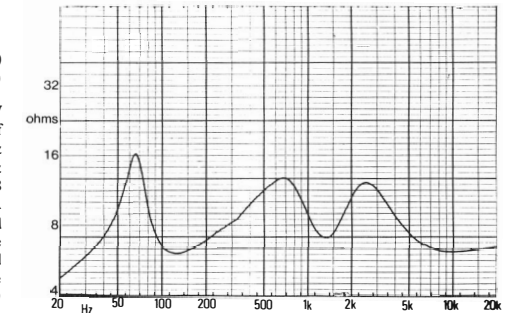
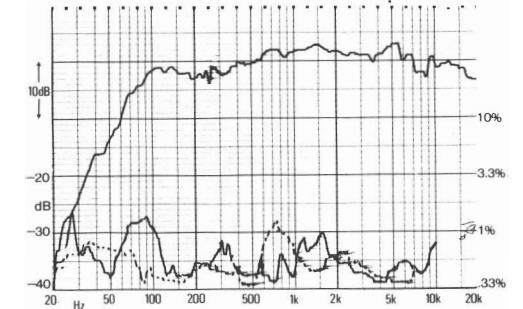
## Marantz SP445

RECOMMENDED

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB

Middle: Impedance (modulus)

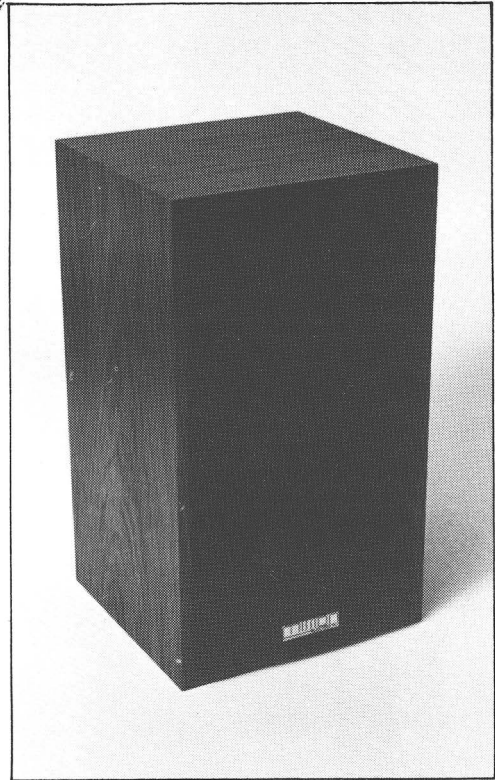
Bottom: Frequency response, 2m ½-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

# Mission 700

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



nonetheless quite 'live' as it contains no damping.

### Lab results

For a budget speaker the pair matching was fairly good, typically to within  $\pm 1$ dB, while the sensitivity was usefully high at 88.5dB/W. Considered a good amplifier load, the 700 generally possessed a 10 ohm impedance with a low point of just under 6.4 at 3kHz, and its sensitivity can thus be fully exploited. The -6dB low frequency cutoff was at a fairly high 66Hz, but this is typical of the box size and sensitivity.

The speaker withstood the full 96dB sound level for the swept distortion test. Third harmonic levels were comparatively low at 1% down to 60Hz, but second harmonic was higher, although still satisfactory at 3% 100Hz, for example. The 100W peak input produced little additional 3rd harmonic content, although some 0.3dB of compression was noted at both 500Hz and 5kHz.

At 1m on axis the critical sinewave analysis showed a well balanced and controlled characteristic, though with some phase cancellation anomalies around the 3kHz crossover region. The response fell off sharply below 70Hz and above 15kHz. At 2m with 1/3-octave averaging the axial irregularity at 3kHz was resolved into a trough 3-4dB deep and about an octave wide, while good vertical integration was demonstrated by the 15° vertical response (taken 'below', and hence nearer the tweeter axis). Interestingly the 30° lateral off-axis curve showed the 3kHz problem as almost resolved, so our recommendation is for an 'over-angled inwards' presentation to give the best all-round results, particularly in regard to stereo imaging. Overall the responses do show a tendency to mid-forwardness from 750Hz to 1.5kHz.

### Sound quality

Scoring 'average' on live sound comparisons, the 700 was judged as offering a pleasant treble balance but with a loss of presence as well as a degree of 'boxiness' and midrange coloration on voice. The bass was reasonably good, and although 50W average on electric bass guitar was sustained before serious overload, some port 'chuffing' was apparent at 12W average, and fundamental bass notes were inevitably attenuated.

On the stereo tests it was more successful, ranking high in terms of stereo image precision and depth. The overall sound quality outperformed many larger and more costly models though it

Mission has been active in the speaker market for several years now, but this is the first review in *Choice* of one of their less expensive models, the new 700 model costing around £110 a pair.

A two-way reflexed system of 22 litres internal volume, the attractively finished driver panel is unusual in that the high frequency unit is located beneath the bass/mid driver. This means that the latter will be at ear level if the speaker is positioned on an open stand or low shelf, and the acoustic centres of the two drivers will be the same distance from the listener to compensate for the usual time delay difference when mounted on a plane baffle. A simple three-element plus one resistor crossover divides the input at about 3.5kHz, the bass driver being a special 200mm plastic doped pulp cone, and the treble a 19mm soft plastic dome from SEAS. A simple foam grille minimises diffraction problems, and while the well finished veneered chipboard enclosure is acoustic foam lined, it is

**BEST BUY**

# Mission 700

exhibited a slightly 'thin' subjective balance. It was considered quite clean and notably transparent, and was liked by almost all panelists.

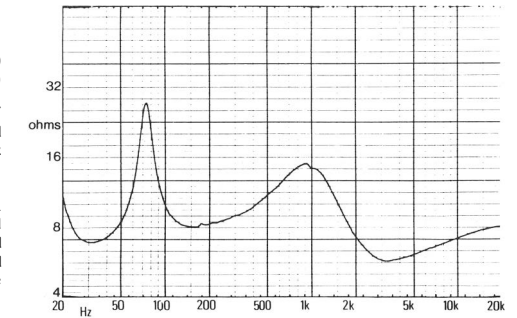
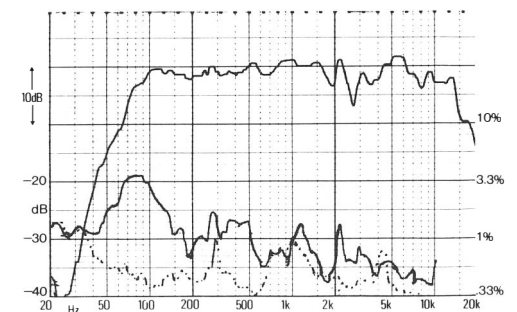
### Summary

When the modest price is taken into account, this compact speaker can clearly be seen to have done very well, particularly as regards the stereo tests. It proved quite sensitive and easy to drive, and gave moderate distortion performance and quite good power handling. Unquestionably it rates as a best buy, and shows that Mission is capable of producing quality models at widely differing price levels.

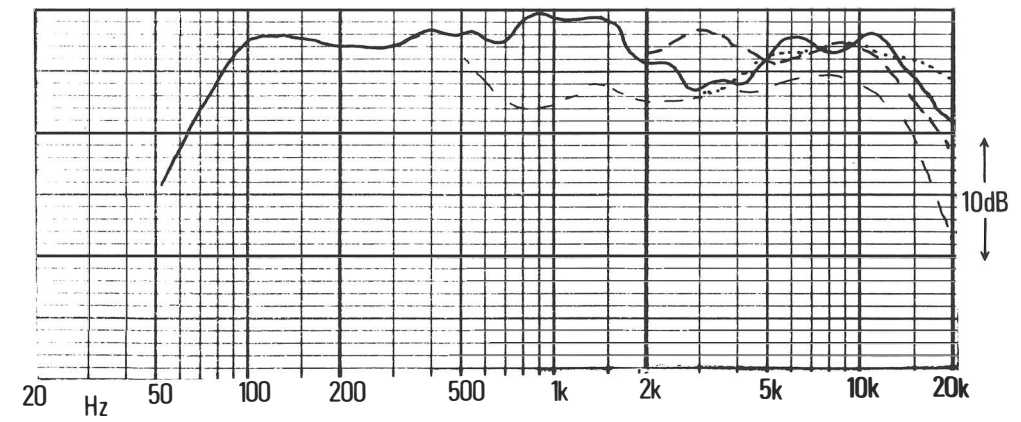
### Update

Detail improvements to materials, components and packaging have been made including the current use of the ferro-fluid damped version of the SEAS tweeter.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



Size (H, W, D).....	46, 26, 25 (18, 10.2, 9.8) cm(inches)
Weight.....	6.5 (14) kg(lbs)
Recommended amplifier power per channel (for 96dB per pair at 2 metres minimum).....	15-100W
Recommended placement.....	open shelf or stand
Frequency response within $\pm 3$ dB (2m).....	80Hz-18kHz
Low frequency rolloff (-6dB) at 1m.....	66Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms).....	88.5dB
Approximate maximum sound level (pair at 2m).....	103dB
Distortion (96dB at 1m).....	good
Distortion (100W peak).....	good
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	above average
Typical price per pair.....	£110 when reviewed, now £119



**RECOMMENDED**

## Mission 770 II

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



Begun initially as a retest to clear up some loose ends remaining from the previous review, Mission informed us during the lengthy preparation of this issue that a more advanced 770 was under development. Accordingly we endeavoured to keep in touch in order that final assessment could be made using the latest model, which fortunately was the case. The data below thus applies to the very latest Mission 770 which incorporates a new bass/mid driver – still polypropylene but with a larger 33mm motor coil. Both thermal and bass excursion power handling margins have been increased, and the high order distortion which we previously noted at low frequencies has been eliminated.

A compact two-way model of 38 litres volume, it exhibits an excellent finish as well as fine construction quality. Reflex loaded by a small 55mm diameter tunnel port, a ferro-fluid damped synthetic

dome tweeter is used for the high frequencies, and a relatively simple crossover of very high power handling capability is used. The foam grille helps to reduce diffraction effects from the cabinet panel.

### Lab results

The sensitivity was higher than before and marginally above average at 87 dB/W. The combination of high power handling and good impedance characteristic which makes for an easy amplifier load permits an estimated 200W peak programme power to be accommodated, enabling a generous 105dBA maximum sound level to be obtained in a typical listening room. The -6dB rolloff was noted at 55 Hz – fairly typical for the size and efficiency, but higher than for the earlier model.

Virtually excellent second and third harmonic distortion results were obtained at 96dB, 1m, and even at low frequencies both harmonics were under 0.3%. The performance was also good on the 100W pulsed input, with perfect correspondence at 5kHz, but a mild 0.2dB compression with an accompanying 3% second harmonic content, but no increase in third harmonic was apparent at 500Hz. With a typical 10 ohm impedance value and a maximum phase angle of 52° at 1.5kHz – a harmless value due to the high 14 ohm modulus of impedance here – the 770 II was notably easy to drive.

The sinewave response at 1m was agreeably smooth and well balanced, but showed a slightly overdamped bass (not such a bad thing where low stand mounting is involved). A slight forward tendency was also apparent in the upper mid and treble, with ±2dB limits sufficing from 65 Hz to 16kHz. At 2m with 1/3-octave averaging the forward characteristic response consolidated, betraying the mild upper-mid bias of the frequency balance. The pattern of forward off-axis responses was very uniform, indicating excellent driver integration, and a good stereo potential.

### Sound quality

Achieving a 'good' rating the 770 bass guitar handling was extraordinary, sustaining 500W peak or 200W average with only moderate aural distortion; slight port chuffing could however be heard above 50W peak. The sound was considered open and explicit but with a degree of 'hardness' and 'sharpness' in the lower treble.

On the stereo sessions the imaging was only a little short of the top category, exhibiting good

depth and excellent lateral image precision. On rock programme the 770 gave sharp definition to percussion and transients, but on classical strings a mildly 'wiry' and 'metallic' emphasis was present, exaggerating older recordings. Because of this panelists' reactions were a trifle mixed, but the overall score was still fine for the size and price of enclosure.

### Update/Summary

This lively stand-mounted system demonstrated a wide dynamic range with outstanding power handling capacity. Coloration levels were moderate, stereo good and distortion very good; Overall the ratings were impressive and generally justified the price. With a more advanced and necessarily more expensive model such as this, personal audition is advisable to assess the particular frequency balance and character, but the Mission 770 II nonetheless continues to be a recommended *Choice* model. A *Mk III* version released in summer 81 incorporates detail changes to drivers, port and crossover.

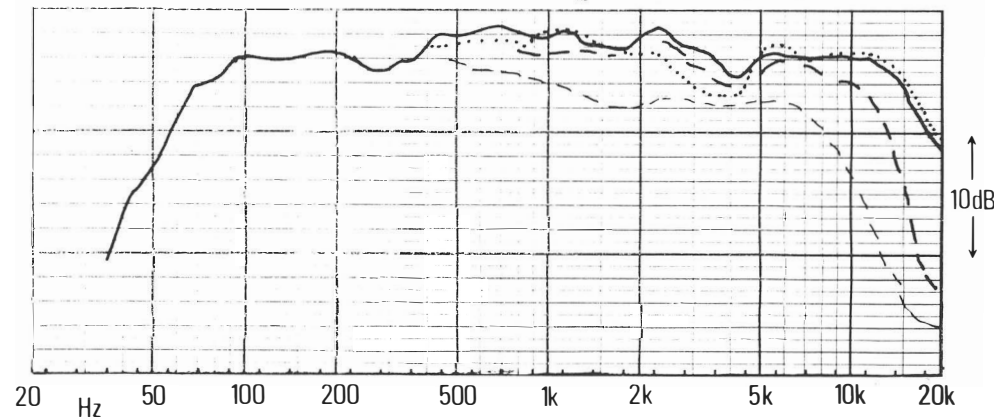
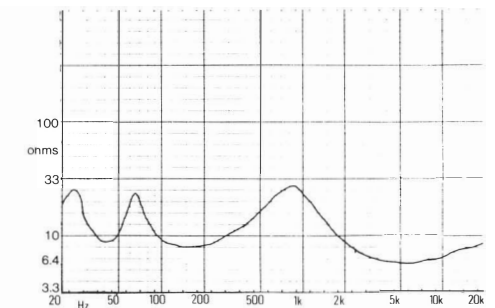
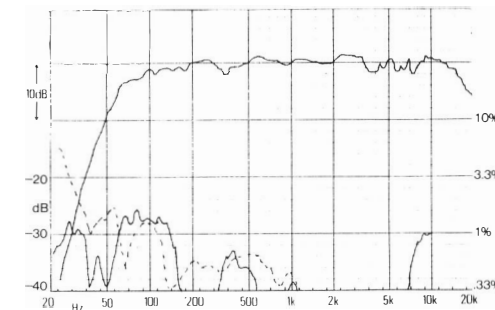
Size (H. W. D) .....	59. 30. 28.5 (23. 12. 12) cm (inches)
Weight .....	12.7 (28) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	20–200W
Recommended placement .....	stands
Frequency response within ±3dB (2m) .....	65Hz–17kHz
Low frequency rolloff (-6dB) at 1m .....	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	87dB
Approximate maximum sound level (pair at 2m) .....	105dBA
Distortion (96dB at 1m) .....	excellent
Distortion (100W peak) .....	good
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	very good
Typical price per pair inc VAT .....	£370 inc stands

## Mission 770 II

(fully re-assessed)

**RECOMMENDED**

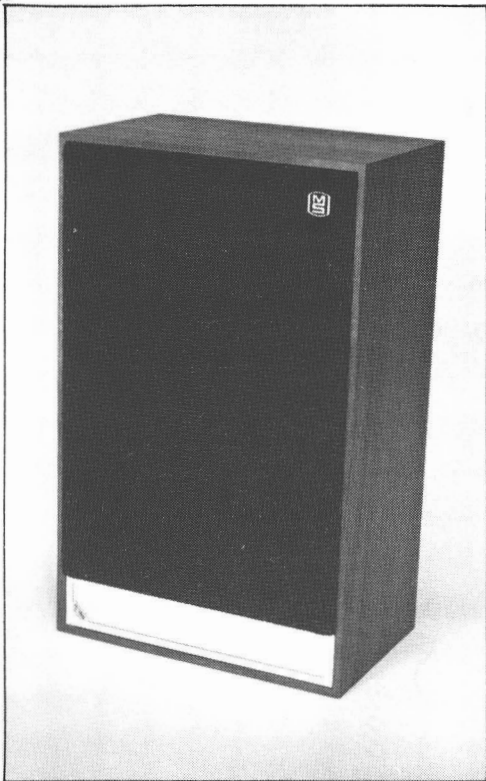
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 0° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

## Mordaunt-Short Festival 2

Mordaunt-Short Ltd., Durford Mill, Petersfield, Hampshire GU31 5AZ  
Tel (073 080) 721



### Lab results

The grille was found to produce a strong effect on the response output, attenuating it by one or two dB throughout the range above 2kHz. However the system is designed to be used with the grille on, and balances well as such. Good pair matching was demonstrated with a terminal sensitivity a little above average at 87dB/W, and as a fine typical impedance modulus of 8 ohms with low phase angles was measured, the *Festival* rated as a good amplifier load. The system resonance was fairly high at 70Hz, with the -6dB low frequency rolloff at 60Hz, but some augmentation will occur with shelf-mounting, which is quite permissible with this design.

Distortion levels at 96dB were reasonable, with third harmonic peaking at just under 2% and 2nd at 2.5% around 1.5kHz. At low frequencies the performance was above average, and the design also coped well with the 100W pulsed input, returning moderate values of compression: 0.3dB at 500Hz and 0.2dB, 5kHz.

The axial sinewave frequency response needed  $\pm 4$ dB limits, but the general trend was quite well balanced and uniform, with a notably well integrated presence and treble range. Averaged over  $\frac{1}{3}$ -octave bands, the forward response was more uniform and well integrated, with the system scoring high marks for dispersion. A listening axis slightly above the tweeter is probably optimum, although this is not particularly critical.

### Sound quality

Scoring 'good' throughout the listening tests, the *Festival's* performance was remarkable for its price. While the low bass notes were deficient with a consequent 'fullness' in the 80-100Hz range, the power handling was fine, the speaker accepting 45W average or 150W peak of electric bass guitar before it 'cracked'. The sound was somewhat 'boxy' and 'wooden' with a mid emphasis, but it proved sufficiently open and clear to give a good score.

On stereo imaging the overall standard was maintained, with good effective lateral localisation but some loss of depth. Criticisms were made of a lightened frequency balance and some 'hard', 'thin' and 'boxy' midrange effects, but these were not too severe.

### Summary

The sound quality was possibly not quite as good as the tabulated results and characterisations sug-

The *Festival 2* comprises a two-way system with sealed 15 litre box loading, and is the middle sized model from an established range of related and compact systems, the others being the *Carnival 2* and *Pageant 2* (see *Summaries*). All share the same doped pulp cone 200mm bass/mid unit, made by Mordaunt-Short, but use different cabinet volumes, loading techniques and HF units. In the case of the *Festival* a 25mm plastic dome tweeter front loaded by a short horn phase correcting assembly completes the vertical driver array.

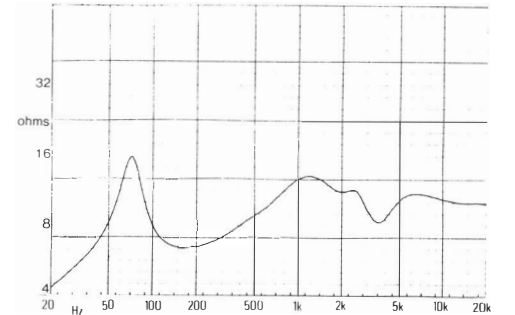
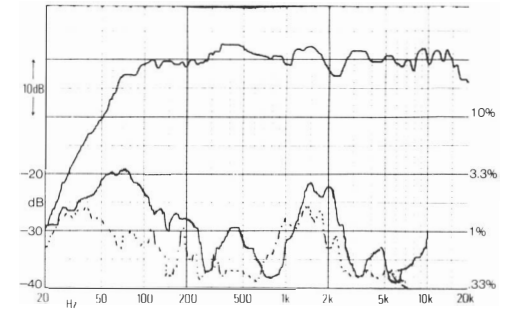
The chipboard cabinet finish was very good, but it is undamped and simply provided with a light filling of polyester wadding for internal energy absorption. A good quality five-element plus one resistor crossover was fitted, forming part of an integral assembly with the rear terminal panel, the latter provided with both DIN and spring clip connections. The unrebated grille was covered in a fairly thick 'furnishing' type material.

## Mordaunt-Short Festival 2

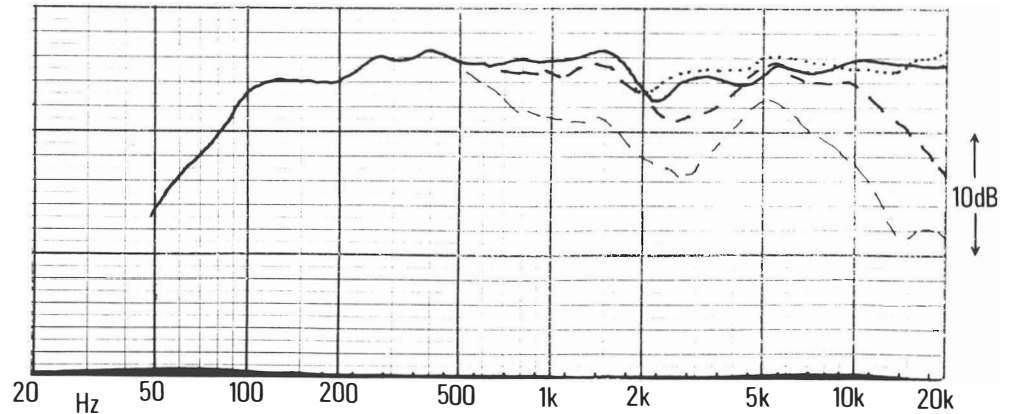
**BEST BUY**

gest, but nonetheless the *Festival* has done very well for its price. It offered quite high maximum sound levels, good amplifier matching and high quality finish (if a trifle old-fashioned looking). While the sound may have been slightly 'thin', it was well integrated and detailed. Taking into account its overall performance the *Festival* has achieved 'Best Buy' status and ranks as fine value for money.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m  $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



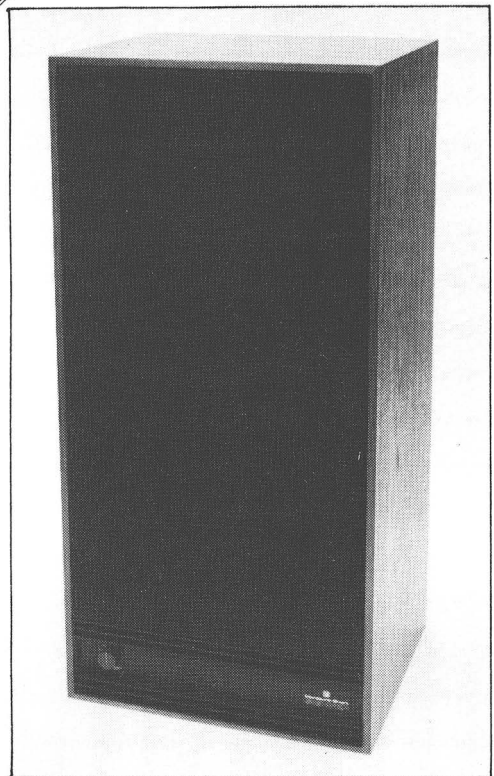
Size (H. W. D) .....	45.5, 28, 18.5 (18, 11, 7.3) cm (inches)
Weight .....	6.4 (14) kg (lbs)
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) .....	20-100W
Recommended placement .....	open shelf or stand
Frequency response within $\pm 3$ dB (2m) .....	80Hz-20kHz
Low frequency rolloff (-6dB) at 1m .....	60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	87dB
Approximate maximum sound level (pair at 2m) .....	102dBa
Distortion (96dB at 1m) .....	good
Distortion (100W peak) .....	good
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	very good
Typical price per pair .....	£135 when reviewed, now £159



RECOMMENDED

## Mordaunt-Short Signifer

Mordaunt-Short Ltd., Durford Mill, Petersfield, Hants. GU31 5AZ.  
Tel: 073 080 721



This recent introduction from Mordaunt-Short represents one of the heaviest models we had to contend with. The *Signifer* — somewhat reminiscent of the Spendor *BC3* in so far as its general size and appearance are concerned — is a stand mounted three-way system employing a new 25mm Isophon soft dome tweeter working above 4kHz. A 135mm diameter treated pulp cone unit handles the midrange; developed and manufactured by Mordaunt-Short themselves, it possesses a special surround termination. They also make the 300mm pulp cone bass unit which completes the vertical-in-line array of drivers.

This 70 litre enclosure is reflex loaded by a 62mm diameter tunnel port, the rear tightly packed against a polyester fibre pad which offers some degree of damping. Of rigid, braced but undamped construction, the cabinet is recessed at the front to accommodate the high power plug-

in crossover, which is equipped with a single five-position control to adjust mid and treble balances in 1dB steps.

### Lab results

An excellent pair match to within  $\pm 0.5$ dB was demonstrated up to 5kHz, holding to a good  $\pm 0.7$ dB at frequencies above this level. Of average sensitivity at 86dB/W, the bass register was well extended with a -6dB point at 33Hz. Generally very good on distortion, for example, 0.15% was recorded at 500Hz with typical values around 0.3%; although a good 2% at 35 Hz was measured, the distortion rose surprisingly to 4%, 93Hz

The *Signifer* was not the easiest loudspeaker to drive, the typical impedance value being 6 ohms with dips to around 5 at important sections of the spectrum, namely 90Hz and 1.5kHz. In fact with the midrange boosted (dotted curve) the 1.5kHz minimum was closer to 4 ohms, and if the model is to be driven hard, a fairly load-tolerant amplifier should be used. Exhibiting excellent power handling, a 105dBA maximum was within the *Signifer's* compass, and it reproduced electric bass guitar very well up to a staggering 250W input level, a similar peak on wideband program causing no problems.

On axis at 1m the response held to within tight  $\pm 2.5$ dB limits from 43Hz-10kHz, although above 2kHz some mild irregularities were present, with a notable peak at 11kHz coupled with a premature HF rolloff thereafter. Out at a more realistic 2m distance, using  $\frac{1}{3}$ -octave averaging, the characteristic response was better integrated and looked good overall, with the exception of a slight prominence in the 12kHz region. The mild dip (dotted) relates to the '10° above' response, which is in any case representative of an unlikely listening axis for such a tall stand mounted model, while at 10° below and 30° laterally off-axis, the responses were excellent to 10kHz — remarkably so, in fact, for such a large, flat baffle design.

### Sound quality

Placed in the top category on the live sound comparisons, the *Signifer* performed well on all sounds, but proved exceptional on bass guitar. Colorations were very slight, including mild 'edgy', 'boxy' and 'fizzy' effects.

The *Signifer* repeated this fine performance on the more complex stereo tests, with stable,

## Mordaunt-Short Signifer

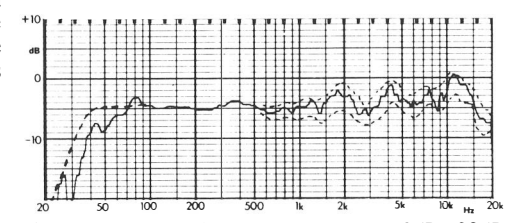
(revised and reprinted)

RECOMMENDED

above average imaging and a good depth presentation. Musical clarity was also to a high standard, and the bass, if slightly boomy, was satisfactorily deep and powerful. Colorations were also well controlled, and mainly confined to a trace of treble peakiness.

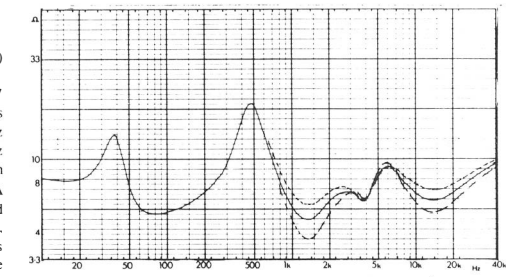
### Summary

With one or two minor criticisms — notably amplifier loading and upper treble balance — this speaker offered a fine performance particularly on bass, power handling, loudness, coloration, distortion and maximum sound levels. Well constructed, with an attractive appearance and producing satisfying stereo, the *Signifer* justified its high price, and thus merits recommendation.

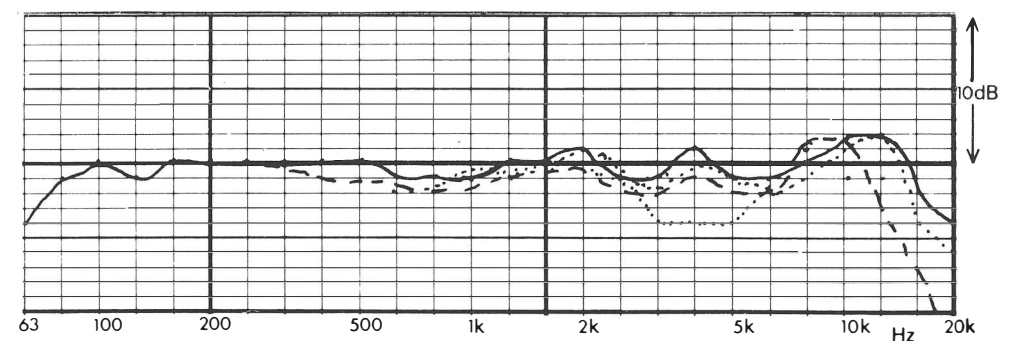


Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)

Size	81 (38) H: 38.5(15) W: 33(13) D: cm(inches)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20-250W
Recommended placement	on M/S stand well clear of walls
Frequency response within $\pm 3$ dB (2m)	63Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	33Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good 35Hz-2%, 83Hz-4%, typically 0.3% or less
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair	£600 when reviewed, now £699 incl stands



Impedance vs frequency (mod Z)



$\frac{1}{3}$ -octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

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Hitachi D45S	Technics RSM270X	P.O.R.
JVC	Technics RSM250	P.O.R.
Mitsubishi	Technics RSM215	P.O.R.
Nakamichi N480	* Trio	P.O.R.
Nakamichi N482	Teac x 3	P.O.R.
Pioneer	Teac x 10	P.O.R.
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Dual CT 1150	P.O.R.	Tandberg TR2045	P.O.R.
Dual CT 1250	P.O.R.	Tandberg TR2060L	P.O.R.
Harman Kardon	P.O.R.	Tandberg TR2080	P.O.R.
JVC	P.O.R.	Teac	P.O.R.
Marantz	P.O.R.	Technics SA202	£139.00
Mitsubishi	P.O.R.	Technics SA303	£169.00
Pioneer SX600	£92.00	Technics SA313	P.O.R.
Pioneer SX700	P.O.R.	Technics STS3	P.O.R.
Quad FM3	P.O.R.	Technics STS7	P.O.R.
Revox	P.O.R.	Trio KT313L	£85.00
Rogers T75	P.O.R.	Yamaha	P.O.R.
Rotel RT1000	£89.90		
Rotel RX1000	£139.00		

**MUSIC CENTRES/MICRO SYSTEMS**

(P&P £4.50)

Aiwa M502	£299.00
Aurex Micro	P.O.R.
Hitachi SDT 400	P.O.R.
JVC M	P.O.R.
Mitsubishi MC 8000	P.O.R.
Panasonic SG3200	P.O.R.
Panasonic SG4200	P.O.R.
Panasonic 2800	P.O.R.
Sharp	P.O.R.
Sony HMK 3000	P.O.R.
Sony HMK 7000	P.O.R.
Technic Z11	P.O.R.
Technic Z22	P.O.R.
Toshiba	P.O.R.
Yamaha Systems	P.O.R.

**SPEAKERS (SP//KITS (K)//(UNITS) (U))**

(P&P £3.95)

AR 18	£83.00	KEF B139 (U)	£28.56
B&W DM12	P.O.R.	KEF B110 (U)	£11.22
B&W DM14	P.O.R.	KEF B200 (U)	£12.75
B&W DM2/2	P.O.R.	KEF T27 (U)	£8.67
Cambridge Audio	P.O.R.	KEF DN12	£9.50
Celestion		KEF DN13	£7.30
Ditton 442	£299.00	Monitor Audio	P.O.R.
Ditton 121	£70.00	Mordaunt-Short	P.O.R.
Ditton 322	£240.00	Richard Allan	P.O.R.
County	£95.00	R Allan Kits S/Tripie	
Ditton 130	£110.00	Assy (PR) 20W (K)	£110.00
Ditton 150	£140.00	Rogers Studio	P.O.R.
Ditton 200	£186	Rogers LS3/5A	P.O.R.
Chartwell PM55	P.O.R.	Tannoy	
Chartwell PM110/2	P.O.R.	Oxford	P.O.R.
Chartwell MP210	P.O.R.	Dorset	P.O.R.
Goodmans	P.O.R.	DC386	P.O.R.
IMF	P.O.R.	JBL	
JBL	P.O.R.	Wharfedale	
Jordan Watts Module	£20.50	Laser 40	£65.00
KEF Celeste IV	£119.00	Laser 60	£82.00
KEF Concord IV	£199.00	Laser 80	£100.00
KEF 103 2	P.O.R.		

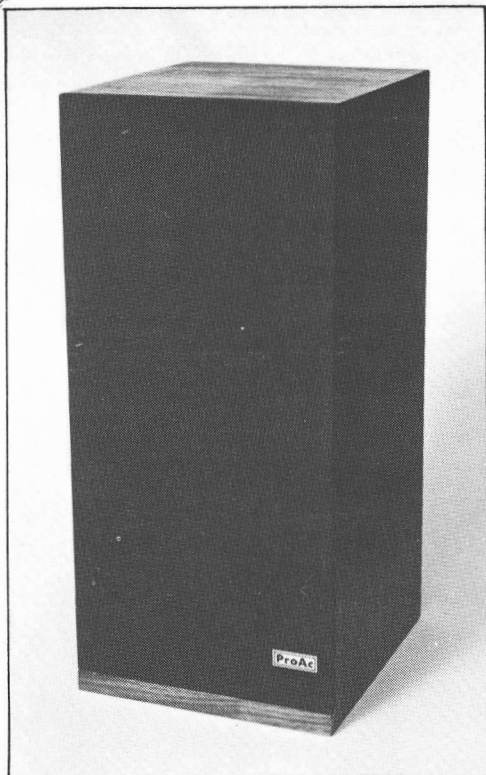




RECOMMENDED

## ProAc Studio 3

ProAc, 30 Lodge Avenue, Elstree, Middlesex  
Tel 01-207 1150



Paul Tyler, the founder of Celef Audio, also designs and manufactures speakers for the up-market ProAc company. The *Studio 3* is their most expensive model to date, and costs around £1,200 a pair.

Externally the speaker does not seem particularly elaborate, vertically aligned 250mm bass unit, 75mm midrange and 19mm tweeter making up the driver complement. The thinwall chipboard carcass has bituminous panel damping and a fairly modest 51 litre internal volume, reflex loaded by a large 75mm diameter 50mm deep tunnel port. However, details are important here, and hold the key to the engineering quality of the '3'. Front and back panels are in costly 19mm multiply, while the high quality 11-element crossover uses close tolerance components of high power handling capacity. All three drive units are unusual. The 19mm soft fabric dome tweeter is a ferro-fluid

cooled version of the Scan *D2008*. The remaining two units are British and are virtually hand-made by ATC. The midrange unit is a large soft dome with a massive magnet and great power handling, and the bass unit has a 75mm coil and an equally large magnet on a die-cast frame, the diaphragm in this case being a highly rigid shallow pulp cone with heavy damping. These very costly units account for much of the system price.

### Lab results

Pair matching was good and the sensitivity was just average at 86dB/W, though the very good power handling capability enables high sound levels of up to 109dBA for a pair, using amplifiers delivering up to 500W per channel. For the overall size the low frequencies were quite extended, with the -6dB point at 42Hz. As with the Celef *HE* the grille was found to exert a significant influence, and the responses through the presence band were marginally smoother with it removed. The axial response was nonetheless well balanced with the grille in position, particularly above 200Hz, although some LF unevenness was also present below 200Hz ( $\pm 2$ dB peak to trough). The excellent and balanced behaviour of the drivers and crossover was confirmed by the fine set of off-axis responses. With such good integration the potential for a fine stereo performance is self-evident.

At 96dB distortions were low, particularly the critical third harmonic which averaged 0.5%. At 100W peak (some 106dB at 1m) these low levels were maintained at 500Hz, although at 5kHz an 0.5dB compression was noted together with a mild 2% second harmonic content. Possessing a 6.4 ohm minimum impedance, the amplifier loading was an easy 8 ohms nominal, with the phase angles held to less than 20° above 100Hz.

### Sound quality

Scoring highly on the live sound comparisons, the ProAc showed a light, airy character sympathetic to the test sounds. The usual 'boxy' 'woodenness' of most conventional designs was absent, and percussion sounds were notably clean but without excessive treble emphasis. The electric bass guitar was also well handled, providing good evenness, depth and great power. The full 500W was tolerated on peaks with an extraordinary 140W average power input.

This model did equally well on the stereo programme sessions. The bass was judged slightly

lumpy but was nonetheless favoured for its power and depth. Imaging was very good, and proved stable with a pleasing perspective and well developed depth, while the whole sound was 'atmospheric' and not concentrated on the enclosures. An 'airy' if slightly 'thin' effect was produced but without any hardness and with very little 'fizz', while coloration was very low by conventional standards. Clarity and detail rendition were also both very good.

### Summary

A compact, high quality speaker with extended bass and exceptional power handling, the ProAc 3 offers a smooth and wide frequency response together with low levels of coloration and very good sound quality. The price is undoubtedly very high, but the performance is exceptional, and justifies recommendation.

### Update

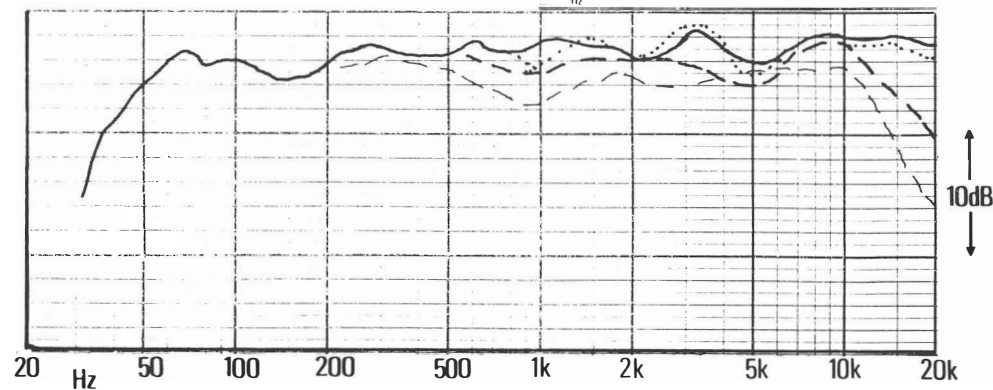
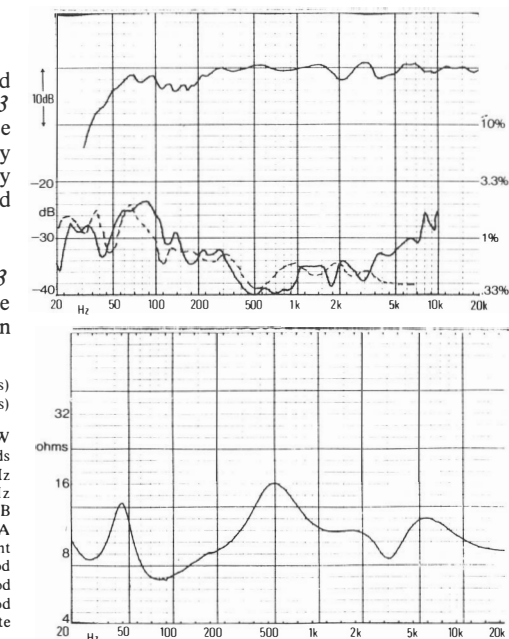
There are now two versions of the *Studio 3* differing only in the magnetic materials used in the mid and bass drivers. The *AlNiCo* magnet version cost £1265; ceramic £977.

Size (H. W. D) .....	68.5. 30.5. 33 (27. 12. 13) cm (inches)
Weight .....	30 (66) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	25-500W
Recommended placement .....	stands
Frequency response within $\pm 3$ dB (2m) .....	47Hz-20kHz
Low frequency rolloff (-6dB) at 1m .....	42Hz
Voltage sensitivity (ref 2.83V, i.e: 1 watt in 8 ohms) at 1m. ....	86dB
Approximate maximum sound level (pair at 2m) .....	109dBA
Distortion (96dB at 1m) .....	excellent
Distortion (100W peak) .....	good
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	very good
Typical price per pair inc VAT .....	see Update

## ProAc Studio 3

RECOMMENDED

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/8-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**RECOMMENDED**

## Rogers LS3/5A

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN  
Tel 01-697 8511



19mm grille-protected dome tweeter. A felt tweeter surround is fitted to reduce diffraction anomalies, and the high quality cabinet is made from fully seam battened plywood with bituminous panel damping.

### Lab results

In the crossover region a mild 1-2dB mismatch between left and right reference traces was noted, but elsewhere an excellent correspondence existed. A low 82.5dB sensitivity was measured with the -6dB point at 59Hz. The system resonance was placed at 75Hz, and the speaker was easy to drive, the modulus of impedance being typically 12 ohms and never falling below 8. Understandably the test level for third harmonic distortion was set at the lower 90dB level, and under these conditions an excellent result from 70Hz upwards was recorded.

At 1 metre the reference curve showed a very uniform midband, 200Hz-3kHz, with an equally uniform HF range, although this was mildly lifted by 1-1.5dB relative to the mid; upper bass was marginally exposed as a +3dB hump.

At 2 metres the characteristic responses were seen to be remarkably well integrated. All curves, 30° lateral and 10° vertical, conformed with that on axis to within 2-3dB throughout the frequency range.

Although smooth, the response was however characterised by a 3dB hump at 150Hz, with a related area of dip at 400Hz.

### Sound quality

The table showed that the sound quality was above average on an overall basis, which is not only a good result for the price, but is also remarkable considering the speaker's diminutive size. No allowance was made for the latter during the listening sessions.

Rated well above average on the live sound comparisons, colorations were only of slight degree, and included 'tubby', 'edgy', 'bright', 'chesty', 'thin' and 'mid-recessed' effects. In general, however, its rendition of the live sounds was very good.

While imaging was very good, the subjective frequency balance would appear to have affected the speaker's stereo programme performance. The panel described slight to moderate 'hollow', 'edgy', 'fizz', 'sibilant' and 'metallic' effects, with a thinned mid-balance, and a light, 'plummy' bass.

Three companies are currently licensed to produce the BBC-specified LS3/5a design, namely Audiomaster, RAM and Rogers (together with the latter's associated company Chartwell). Current production samples from Rogers form the subject of this review, but the other manufacturers' versions should prove very similar. The closeness of the specification and the regular checks made by BBC engineers should ensure that this is amongst the most consistent loudspeakers commercially available.

The 3/5a is a miniature sealed box system of some 5.5 litres volume. An elaborate and costly crossover is employed to equalise and balance the drivers to a strict licence specification, and transformer matching is incorporated for fine control of tweeter sensitivity differences. Two vertically aligned KEF drivers are used, namely a large magnet 110mm bextrene cone bass/mid, and a

## Rogers LS3/5A

(partly re-assessed)

**RECOMMENDED**

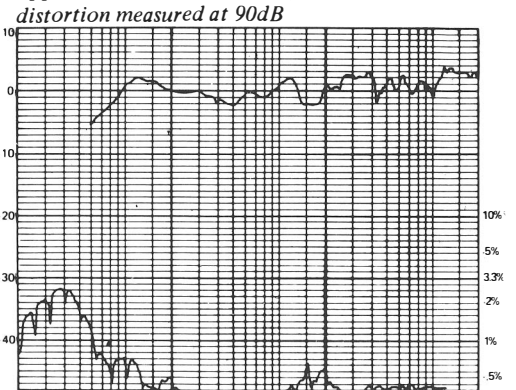
Little bass depth was perceived, although detail and clarity were both of a high order.

A further pair assessed in the last tests have allayed our fears with a better overall balance and fewer criticisms from listeners.

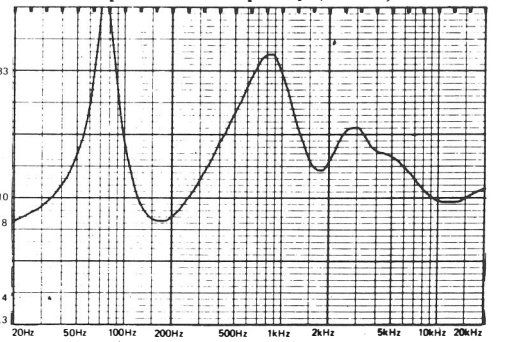
### Summary

The intrinsic quality of this design has well enabled it to maintain its competitive market position, and its reputation as a miniature of monitor quality is undoubtedly justified. Sounding more natural on high stands clear of walls or corners, quite good results can also be obtained in open shelf location. Bearing in mind the limited bass power handling and loudness, the 3/5a may nevertheless be recommended on the basis of its high sound quality for the price.

below: upper curve 1m sine wave reference;  
lower curve 3rd harmonic distortion ref  
upper curve (% scale ref 0dB).

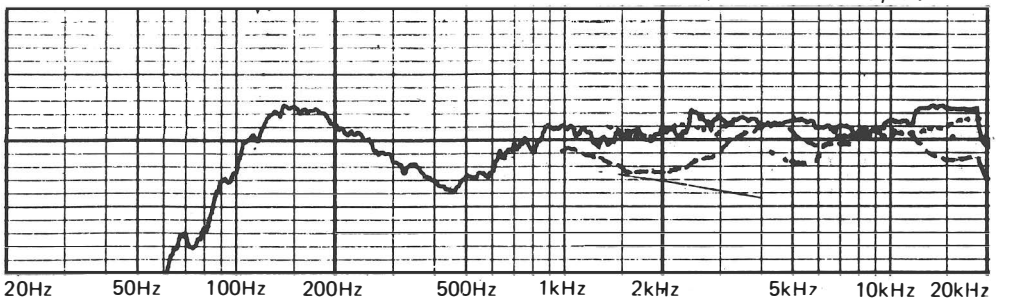


below: impedance vs frequency (mod Z).



Size	30(12) H; 18.5(7.5) W; 16(6.5) D: cm(inches)
Weight	5.5(11.5) kg(lbs)
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	30 to 50W
Recommended placement	high stand (or shelf)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	59Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	93dBa
Third harmonic distortion (90dB at 1 metre)	very good
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair	£185 when reviewed, now £207

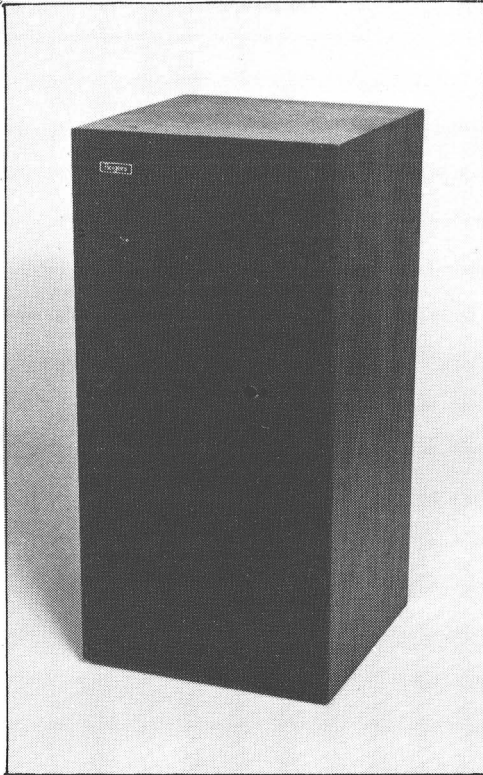
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



**BEST BUY**

## Rogers Studio

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN  
Tel 01-697 8511



Evolved from the Rogers *Export Monitor*, itself a close relative of the original *LS 3/6* BBC design, the *Studio* is designed to meet new targets set by Rogers for this classic and essentially two-way system. As before the main driver is a 200mm bextrene cone unit, the latest version corresponding very closely to the original BBC profile. Built on a cast alloy frame, a high power motor coil and improvements in excursion control and linearity endow it with fine power handling. The 3-13kHz range is allocated to the Celestion *HF1300*, with a KEF *T27* 19mm extending the range through the final octave. A complex high quality crossover integrates the three drivers, and the 43 litre enclosure is reflex tuned by a substantial short tunnel port to approximately 45 Hz. The excellently veneered panels are made from a resin fibre instead of the original plywood, and are damped by bituminous pads.

### Lab results

Sensitivity was an average 86dB/W, which is a little higher than for other similar systems. With an allowable 250W programme maximum, quite high sound levels of 104dBA are possible, while the low frequency rolloff is a respectable 46Hz for -6dB. Pair matching was very good with a slight imbalance above 15kHz, and as a true 8 ohm system the *Studio* should be easy to drive.

Distortion levels were well controlled, exhibiting particularly good results in the midband. Although high values were recorded at low frequencies, they were more than satisfactory at the test 96dB sound level. The good crossover power handling was evidenced by the peak distortion result at 500Hz, with just 0.5dB of compression and 1% of second harmonic; 0.2dB of compression was recorded at 5kHz, but no additional distortion was generated.

On axis at 1m the low frequency range was clearly well tuned and balanced, with an almost textbook response from 55 Hz up into the midband. Mild irregularities were present thereafter, but the essential evenness of the frequency balance was preserved. At 2m with 1/3-octave averaging, the phase notch at 14kHz was shown up for the minor subjective feature it was, with the well balanced and integrated response well charted. Such flatness and dispersion uniformity potentially offers fine stereo.

### Sound quality

Rated in the top class on comparisons with live sounds, the *Studio* was relatively uncoloured, exhibiting a slightly 'light' character well suited to voice and solo instrument reproduction. It was considered to possess good accuracy, while the bass power handling was highly satisfactory, with good fundamental power and quite even tonal differentiation up to an average of 60W (250W peak) on electric guitar.

On the stereo sessions the speaker sounded smooth and transparent, exhibiting a wide, even response and quite low coloration. A slightly 'light' and 'airy' impression was given, not perfectly 'rounded' in balance, and the bass was marginally 'boomy' in our listening room, but the mid and treble were exceptional. Stereo imaging was precise and stable, with good depth.

### Summary

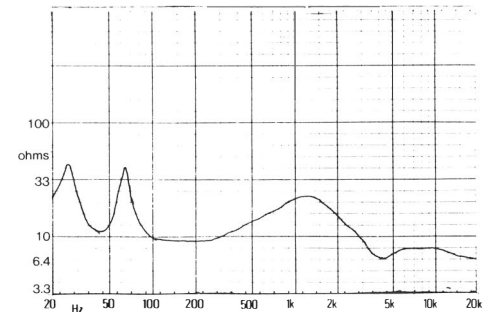
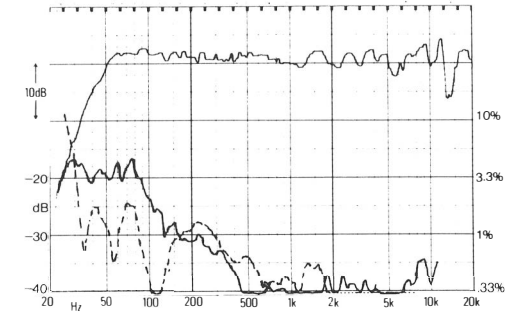
Rogers have succeeded here in refining an established design concept to a level where new

standards of sensitivity, coloration, balance, distortion and power handling are attained using a relatively compact enclosure. Moreover the price has been kept competitive so it is an undoubted 'best buy' and has been shown to merit its 'studio' label.

## Rogers Studio

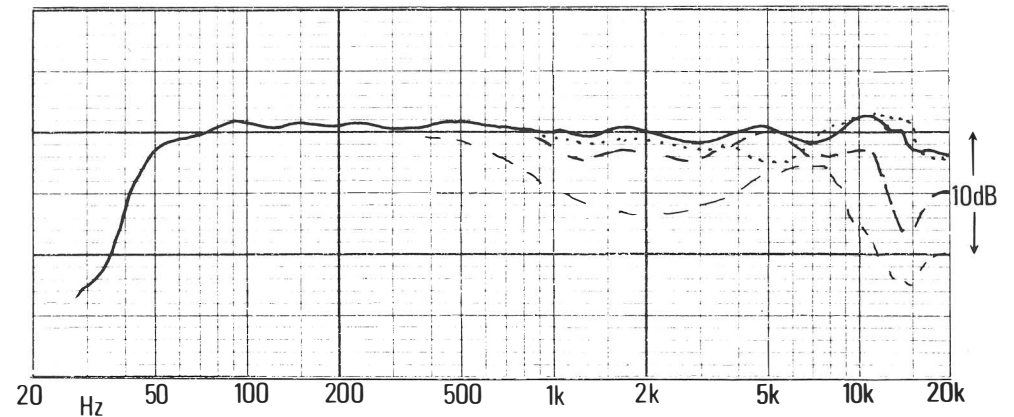
**BEST BUY**

*Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB*  
*Middle: Impedance (modulus)*  
*Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).*



Size (H. W. D).....	63.5, 30.5, 30.5 (25, 12, 12) cm(inches)
Weight .....	14 (31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	25-250W
Recommended placement .....	stands
Frequency response within ±3dB (2m).....	50Hz-20kHz*
Low frequency rolloff (-6dB) at 1m.....	46Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	86dB
Approximate maximum sound level (pair at 2m).....	104dBA
Distortion (96dB at 1m).....	very good
Distortion (100W peak).....	very good
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	very good
Typical price per pair inc VAT.....	£345

\*depends on exact HF axis



# "you read it son... ...we'll play it"



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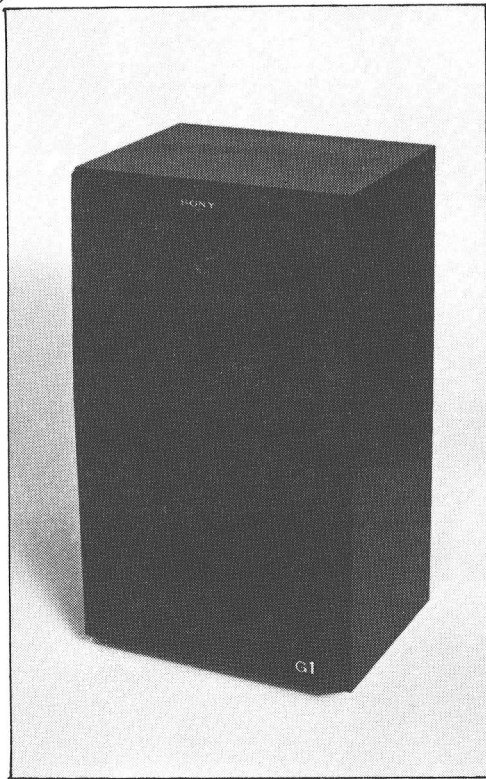
## Superfi

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**BEST BUY**

## Sony SSG1 II

Sony UK Ltd., 134 Regent Street, London W1  
Tel 01-439 3874



In line with the current policy among Japanese hi-fi manufacturers to seek closer ties with their European markets, this new system from Sony is built in West Germany, using special versions of SEAS drive units made in Norway. Finely finished in the Sony tradition the 37 litre enclosure is well veneered in a dark rosewood or equivalent material.

A vertical array of drivers is employed, namely a reflex loaded 250mm bass (carbon fibre reinforced pulp cone), a doped 80mm pulp cone midrange and a 25mm soft plastic dome tweeter. The crossover points, basically 12dB/octave, are placed at 800Hz and 4kHz, and while time-delay-compensate properties are not claimed, the bass unit is in fact brought forward from the front panel on a cast ring mount.

### Lab results

A very good pair match was illustrated to within

0.5dB over the whole frequency range. Claimed at 91dB/W, our estimate for sensitivity was nearer 89dB/W, which is still well above average, while the -6dB bass rolloff was well damped at 50Hz, being typical for the size and sensitivity. (It is in any case amenable to bass lift).

Rated as excellent on third harmonic distortion, values were very low in the bass and quite remarkable in the treble where they measured well under 0.1%.

Rated as excellent on third harmonic distortion, values were very low in the bass and quite remarkable in the treble where they measured well under 0.1%. Scoring average on amplifier loading, largely due to a dip to 5.5 ohms at 100Hz, the remaining range was near to 8 ohms and was notably free of reactive components, helping to mitigate the impedance dip. Power handling was exceptional with the clear and even sound on electric bass guitar sustained up to 200W peak program. While a touch 'hard' on rock program, a very high 105dBA was produced at 250W, with the peak level per channel causing the *G1* little embarrassment.

Using sine wave drive on axis at 1m, the *G1* did not look so promising, with some minor diffraction problems between 5 and 10kHz, increased irregularity from 1.5 to 5.0kHz, and a trough in the 200Hz region.

When averaged in  $\frac{1}{3}$ -octave band (much as the human ear perceives the frequency response), the result was much tidier, in practice meeting  $\pm 2$ dB limits from 63Hz to 14kHz. A mild plateau was evident around 250Hz, while the vertical off-axis responses were a little untidy above 4kHz, the best response being that obtained on axis. Clearly the speaker should be axially aligned to face the listener in the vertical plane. On the lateral axis the results were fine and appeared less critical.

### Sound quality

The *G1* performed very well on all listening test sequences. Rated as 'good' on the live tests, it demonstrated a relatively neutral if slightly hard and forward sound with a trace of hollowness, but its fine bass performance and 'open' clarity were strongly in its favour.

Ranked as 'very good' on stereo programme, the imaging was commended with satisfactory stability and a fair depth impression. Possessing above average clarity, nonetheless it did not escape certain criticisms of coloration, these

mainly concerned with mild 'hard', 'wiry', 'nasal', 'boxy' and 'brash' effects whose subjective importance will tend to vary with each listener.

### Summary

This good looking and well engineered system offered a fine all round subjective performance with firm bass amenable to lift if desired. A very high maximum sound level was attained with high sensitivity, excellently low distortion and an 'average' amplifier rating. Recommendation is clearly in order, but as the *G1* was on occasion a touch aggressive, personal audition would be worthwhile.

### Note:

The *Mk II* version which was fully retested for this edition offers minor modifications to improve the high power durability, but was otherwise very similar to the *Mk I*. It did well on the pulsed power test with a minimal increase in distortion, but performance was better with the grille off, the latter responsible in part for the 3kHz response irregularity.

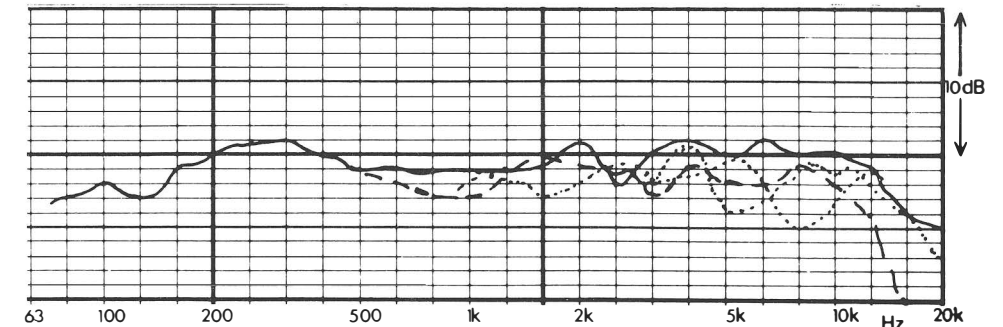
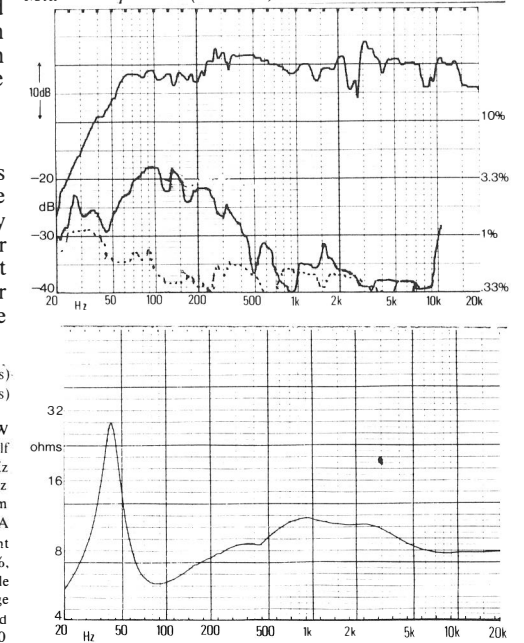
Size	59.5(23) H; 33.4(13) W; 30(12) D; cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10-100W
Recommended placement	stand or open shelf
Frequency response within $\pm 3$ dB (2m)	63Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	excellent
	64Hz-0.8%, 100Hz-0.35%, 500Hz-0.4%, 3.6kHz-0.08%, typically 0.1% in the treble
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc VAT	£210

## Sony SSG1 II

(fully re-assessed)

**BEST BUY**

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)

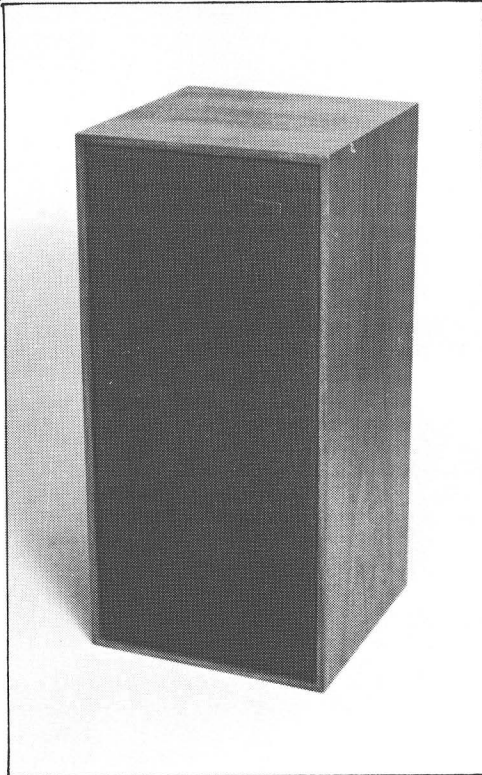


$\frac{1}{3}$ -octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

**BEST BUY**

# Spendor BC1

Spendor Audio Systems Ltd., Unit 12 Station Road Industrial Estate, Hailsham, Sussex BN27 2ER. Tel (0323) 843474



First produced in the late 1960s the *BC1* has long been used as a reference by *Choice*, and as such its review is periodically updated by reassessing new production samples. In fact, the overall sound quality and perceived balance has changed comparatively little over the years, but significant improvements have been made in power handling.

Basically a two-way system comprising a high quality bituminous damped plywood cabinet of some 44 litres volume, the main driver is Spendor's own highly refined 200mm bextrene cone built on a die-cast frame. The treble is covered by a selected Celestion *HF1300*, whose design origins are in fact twice as old as those of the *BC1*, while the final octave above 14kHz is allocated to a 19mm dome unit from Coles (the latter originally marketed by STC). The complex high power crossover filters and equalises the input power with provision for precise treble level matching. A simple 50mm port reflex tunes the bass, the opening being foam-lined

to reduce turbulence noises from heavy bass outputs.

### Lab results

Excellent pair matching was recorded, with minor differences at 10 and 15kHz, but the sensitivity was fairly low at 84dB/W with the -6dB cutoff at 48Hz. Suited to amplifiers in the 30 to 125W range, the *BC1* was capable of a sufficient 98dBA maximum sound level in a typical room without distress. Rated as 'good' on amplifier loading, the minimum impedance was a harmless 6 ohms, 18kHz, and the system was thus easy to drive.

The third harmonic results at 96dB, 1m were very good, particularly in the midband, and although they did increase rapidly at low frequencies, 3% at 50Hz is still fine in subjective terms. Rather more second harmonic was however recorded, with an isolated peak of 2% at 3kHz - very close to the crossover. It proved happy on the 100W pulsed input showing a moderate 0.3dB compression at 500Hz and just 0.1dB at 5kHz, with no additional distortion.

On axis at 1m a phase notch effect was present at 13kHz - the upper crossover - and some minor irregularity was also evident at the lower crossover point of 3.5kHz. A mild upper bass suckout was evident tending to isolate the bass as a prominence around 100Hz. At 2m with 1/3-octave averaging, the output showed excellent integration, smoothness and balance, with the off-axis curves demonstrating a close correspondence with those on axis, thereby confirming the good dispersion.

### Sound quality

Rated 'good' on live sound comparisons some 'boxiness' was apparent in the lower midrange with a 'thickened' and 'nasal' effect higher up, but neither was judged very serious. The vocal balance was very good with accurate sibilants, and acoustic guitar was also well handled. By current competitive standards the bass power handling was judged just moderate, with up to 40W average or 125W peak input allowed before 'cracking'. Bass notes were well differentiated in timbre, but the output was a trifle lumpy.

Overall the stereo programme performance was judged 'very good'. Imaging was laterally stable and precise, with fine depth resolution, while detail was well defined and without the exaggerations in frequency balance so often encountered. Its scoring was one of the best regardless of price,

particularly when heavy rock programme is excluded.

### Summary

The *BC1* continues to be a well engineered, fine sounding and accurate loudspeaker, offering very good value for money. Few models come close to it even now as regards its midrange performance, and a 'best buy' rating is applicable. However, the high level rock enthusiast should note that the design is somewhat limited as regards bass power handling and consequently in terms of the maximum sound level it can attain, and in general terms the bass does seem subjectively somewhat poorly controlled.

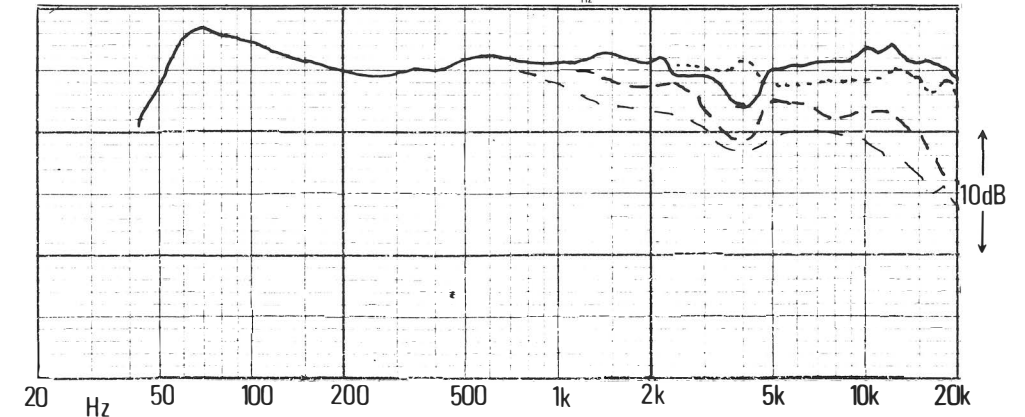
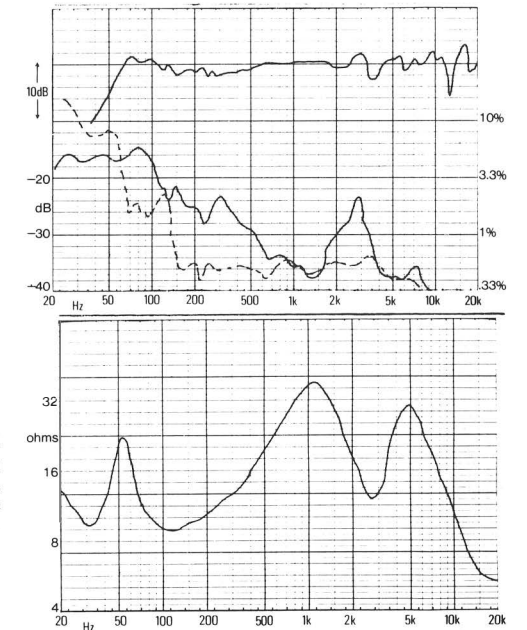
Size	63.5(25) H: 29.8(11.7) W: 30.5(12) D: cm(inches)
Weight	14(30.8) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 125W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	very good
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair	£325 when reviewed, now £362

# Spendor BC1

(fully re-assessed)

**BEST BUY**

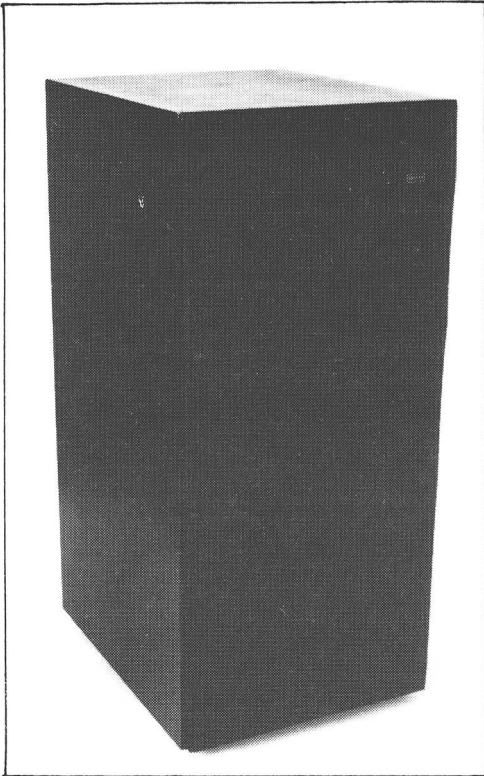
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



RECOMMENDED

# Spendor SA3

Spendor Audio Systems Ltd., Unit 12 Station Road Industrial Estate, Hailsham, Sussex BN27 2ER. Tel (0323) 843474



First seen in prototype form early this year, the SA3 was designed in response to a requirement for a high sound level alternative to the BCI for use in broadcast monitoring in West Germany, and is still a rarity in UK shops. Spendor possessed the necessary technology to produce a wide frequency range 305mm bextrene cone driver capable of the required acoustic power, and this design was further developed for use in the SA3, working up to 2kHz. The range above is covered by a high power 34mm soft dome tweeter, a recently refined model from Audax.

The large 120 litre enclosure is intended for stand mounting and is fitted with a minimal diffraction foam grille. The system is reflex loaded by a large 80mm diameter short duct port. This review essentially covers the active prototype version which employs a 100W bass and 50W treble amplifier with an electronic crossover, the

electronics built in to a removable tray at the rear of the speaker. A passive version of very similar performance will also be available at around £750 a pair. Possessing a nominal 88-89dB/W sensitivity, it can be updated to active drive at a later date.

### Lab results

A low -6dB point of 33Hz was charted showing the bass extension expected of such a large loudspeaker. The power headroom settings showed that a high maximum level of 110dBA should be available from a pair under normal conditions (and working on an estimated 200W programme handling capacity for the passive version, this should be capable of 108dBA but without the sizeable subjective overload headroom of the active model).

The distortion at 96dB 1m was judged excellent, with admirably low levels of third harmonic. While not strictly applicable, the pulsed distortion test was tried at two sound levels, namely 108dB and 98dB. At the former no distortion was detected, although a significant 0.6dB compression was measured at 5kHz and a negligible 0.1 dB compression at 500Hz. Reducing the s.p.l. to 98dB gave a minimal 5kHz compression of 0.1dB.

On axis at 1m the response on the sinewave met close ±2.5dB limits from 35 Hz to 16kHz. A touch of depression in the presence band, 1.5-2.6kHz, was apparent and was consistent in the 2m 1/2-octave characteristic, but a remarkable feature was the very good integration exhibited by this model despite the use of a 305mm bass unit, the diffraction slot in front of the latter believed to be partially responsible for this performance. However the upper treble did fall off a little earlier than usual at 30° of axis, due to the tweeter's larger than usual radiating diameter.

### Sound quality

Rated as very good throughout the listening tests the prototype SA3 confirmed its pedigree. A trace of mid 'richness' - almost 'plummy' effect - was noted, but the general accuracy and balance versus live sounds was highly rated. In our room the 60-80Hz range seemed a little heavy, but the bass was well differentiated and extended, as well as powerful and free of spurious noises.

Stereo imaging was very good, with high lateral precision and good depth ranging. Experience showed us that imaging continued to improve with distance, and we regard 3.5 metres as about the

# Spendor SA3

RECOMMENDED

closest a listener should sit. The treble was exceptionally sweet, clear and transparent, while the midrange set high standards in terms of coloration and accuracy of balance.

### Summary

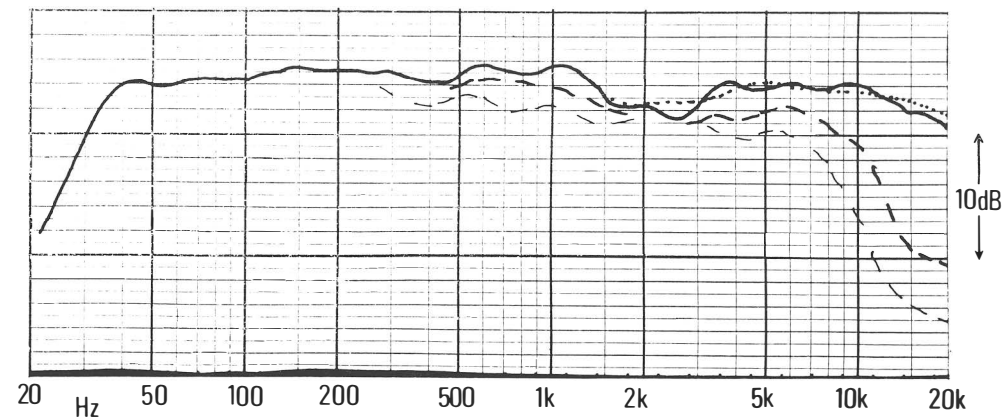
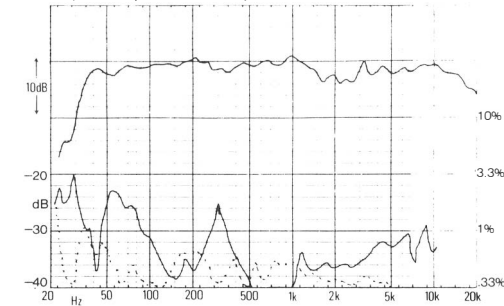
Joining that select group of accurate high performance systems, this fine and powerful loudspeaker intended for professional duties will, I am sure, find great favour on the domestic market as well. While in objective terms it does not quite possess the same midrange subtlety as the BCI, the system offers greater power handling, extended bass, superb dynamics, and a top-class treble. Voiced and balanced in the conscientious Spendor tradition, it is virtually handcrafted throughout and is highly recommended.

Production models in both active and passive configurations were auditioned just before press date, and these more than confirmed the exceptional promise indicated by the pre-production samples which we had fully assessed.

Size (H. W. D) .....	85, 38, 46 (33.5, 15, 18 cm/inches)
Weight .....	41 (90) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	stand
Recommended placement .....	stand
Frequency response within ±3dB (2m) .....	33Hz-20kHz
Low frequency rolloff (-6dB) at 1m .....	33Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms) at 1m .....	variable
Approximate maximum sound level (pair at 2m) .....	110dBA
Distortion (96dB at 1m) .....	excellent
Distortion (100W peak) .....	very good
Impedance characteristic (ease of drive) .....	active
Forward response uniformity .....	very good
Typical price per pair .....	£1656 active, £890 passive (not tested).

Prices were anticipated at time of review.

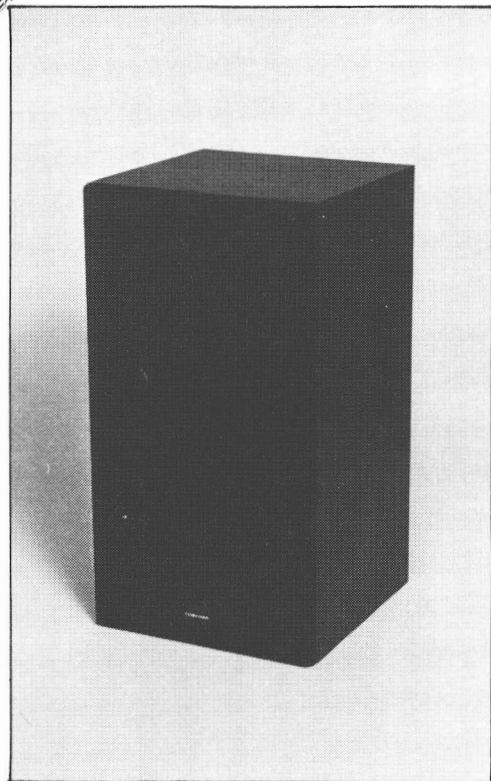
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Bottom: Frequency response, 2m 1/2-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



**BEST BUY**

## Toshiba SS50GB

Toshiba House, Frimley Road, Frimley, Camberley, Surrey GU16 5JJ  
Tel (0276) 62222



by 1.2dB above 1.5kHz, and also increased the severity of the plotted response irregularities. The sensitivity was 2dB above spec. at a useful 88dB/W with a reasonable -6dB LF rolloff at 55 Hz. The 50W maximum power handling limit permits a fair 100dBA to be obtained from a pair under domestic conditions. Although specified at 8 ohms impedance we did not quite agree with this figure, rating the '50 as an average amplifier load, with a midband minimum of 5.5 ohms, 800Hz.

On axis at 1m our sample showed signs of a uniform and well balanced response marred by an energy loss near the upper crossover at 2.5kHz. When averaged by 1/3-octave analysis, the speaker showed good dispersion characteristics, well controlled driver integration and a generally good mid-treble balance. The 2kHz trough remained however, and during the preparation of the review we queried this with the manufacturers. They informed us that in the designer's opinion this was unusual, that the 10dB depth we found was more typically 3-4dB, and that steps would be taken to maintain this better performance.

Driven to 96dB at 1m the distortion characteristics were satisfactory; the weakest third harmonic results of any significance were 1.5% at 800Hz and just under 1% in the 200-500Hz range. Second harmonic distortion was rather poorer, reaching 3% at 1.3kHz, 300Hz and 80Hz. Conversely it survived the 100W peak inputs at 500Hz and 5kHz with little complaint, exhibiting negligible compression or additional distortion.

### Sound quality

Rated 'average' on live sounds, the Toshiba was considered rather 'boxy' and 'nasal' with a 'thick' tendency, probably due to the measured loss in the presence band. Up to 50W of electric bass guitar was tolerated with fair evenness.

On stereo programme the ratings improved to 'good' and were most promising for the price. Imaging was laterally stable, with reasonable depth and quite good detail despite the loss of presence, and while it was judged a little 'dull' on balance, most panelists felt that at the same time it sounded smooth and pleasant.

### Summary

This is a surprisingly civilised three-way system with a good all-round performance at a competitive price. We have only slight hesitation in awarding it a 'best buy' rating, the reservation relating to the

The *SS100GB* has been inexplicably withdrawn since its fairly good showing in last year's *Choice*, only to be replaced by the *SS50GB*. In the event the *100s* performance was more or less matched by this smaller and less expensive model. A sealed box system of 28 litres internal volume, this system uses three drivers, namely a 200mm damped pulp cone bass unit, a 90mm damped pulp cone midrange and a 25mm grille-protected soft dome tweeter. All the drivers come from Audax, and indeed the system design originates from that company's UK subsidiary. A good quality 10-element crossover divides the range at 700Hz and 3.5kHz, and although a vinyl print synthetic veneer is used, it is quite presentable.

### Lab results

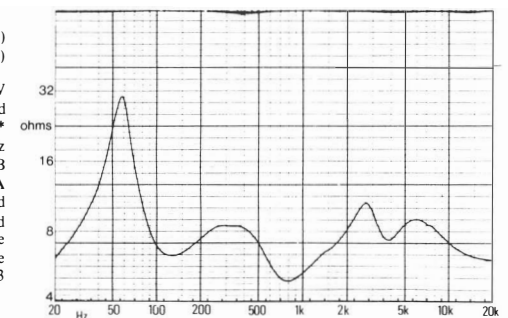
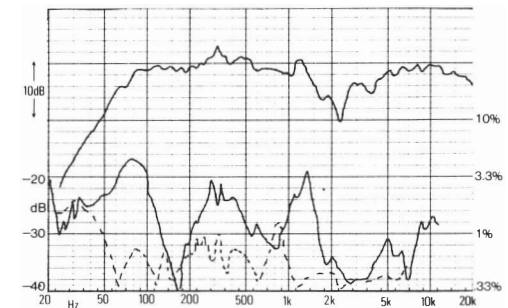
The pair match for this system was satisfactory within  $\pm 1$ dB, but the grille attenuated the output

## Toshiba SS50GB

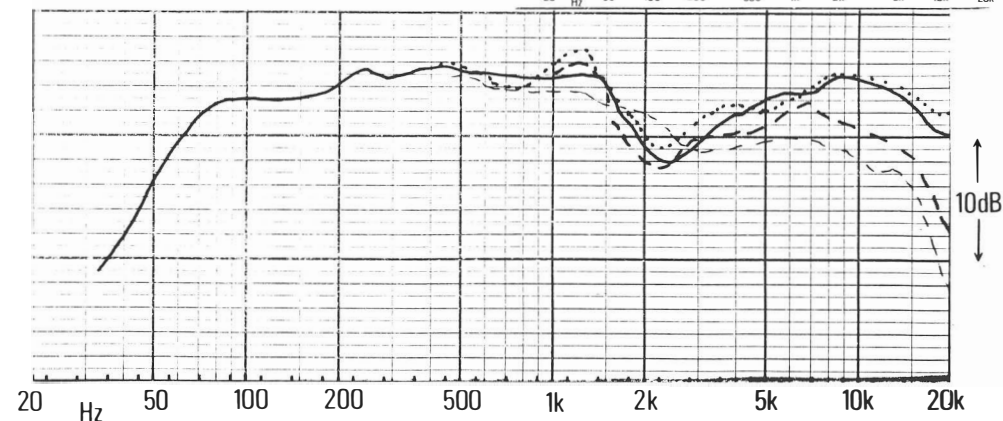
**BEST BUY**

frequency band notch. But if this was atypical as the designer promises, then normal production with a shade better presence band should be even better.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB  
Middle: Impedance (modulus)  
Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).



Size (H. W. D) ..... 53.3, 28.6, 28.7 (21, 11.3, 11.3) cm (inches)  
Weight ..... 11.3 (25) kg (lbs)  
Recommended amplifier power per channel  
(for 96dBA per pair at 2 metres minimum) ..... 15-50W  
Recommended placement ..... open shelf or stand  
Frequency response within  $\pm 3$ dB (2m) ..... 65Hz-20kHz\*  
Low frequency rolloff (-6dB) at 1m ..... 55Hz  
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m ..... 88dB  
Approximate maximum sound level (pair at 2m) ..... 100dBA  
Distortion (96dB at 1m) ..... good  
Distortion (100W peak) ..... very good  
Impedance characteristic (ease of drive) ..... average  
Forward response uniformity ..... above average  
Typical price per pair ..... £130 when reviewed, now £153  
\*on best axis

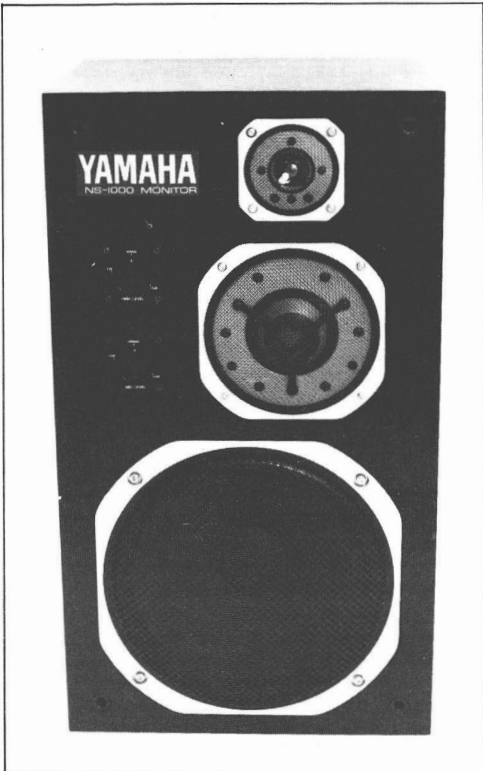




RECOMMENDED

# Yamaha NS1000M

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middx.  
01-863 8622



A relatively compact loudspeaker that can be used on stands or on a substantial open shelf, it is very sturdily constructed. While tests were conducted with the controls set 'level', we subsequently came to the conclusion that the '10 o'clock' position for the mid control gives the most pleasing balance, and that the listener should be on the mid axis, as an above axis position imparts a response suckout in the presence region.

### Technical details

A sealed box design, a 300mm bass driver operates up to 500Hz crossing over to a 85mm beryllium-dome mid unit with a hollow pole piece and an absorbent chamber. At 6kHz another beryllium driver takes over — a 30mm unit with a phase correcting assembly.

### Lab results

Pair matching was excellent at 0.5dB up to 12kHz, and within 1dB beyond. A high (particularly for a sealed box design) 90dB sensitivity was recorded, with the -6dB LF point at an early 50Hz, despite the system resonance being placed at 40Hz. (This proves that the low frequency end is overdamped, and permits bass lift to be applied.)

A minimum impedance of 4.8 ohms was recorded at 120Hz, the typical value being 6, and with low reactive effects the system gained an 'average' loading classification. Above 200Hz the distortion on the third harmonic readings was below threshold. It rose gently at the lower frequencies to a still fine 0.6% at 100Hz, 1.2% at 50Hz and a maximum of 3% at 30Hz.

The 1 metre sine wave response was very even from 60Hz to 16kHz, but showed a mild mid prominence (this controlled by the 10 o'clock mid setting), with the early but slow low frequency rolloff clearly visible.

Out at 2 metres the 10° above response showed why the mid unit should be at ear level, or at least angled towards it. A mild hump at 300Hz was visible on axis, together with a slightly prominent 500Hz to 12kHz range. The HF was uniform to 16kHz, rolling off slowly beyond, but on the 30° lateral axis, the uniformity was fine, showing excellent integration in this plane.

### Sound quality

The NS1000M matched its previous high quality ranking, even if it has not achieved quite the same level of commendation. Overall a 'very good' sound quality was denoted, going a long way towards justifying the high price.

It performed best on the live sound comparisons, reaching a high 107dBA, and accepting a 500W peak input without audible breakup. It showed excellent power handling on electric bass guitar, with up to 75 watts average tolerated without distortion, and while the bass character was lacking some warmth on the 'E' string, an even and powerful output was obtained. The mild colorations noted were 'dull', 'hard', 'tizz', and 'middy', together with a 'thin' balance.

Scoring 'above average' on the stereo sessions, this Yamaha exhibited fine imaging

and excellent rendition of musical detail. Some panelists were sensitive to a mid prominent hardness and brittleness which is a known feature of the NS1000M, and cannot be wholly alleviated by adjusting the mid control. Colorations were more readily perceived under these conditions, and included mild 'cup', 'nasal', 'hard' and 'presence dull' effects, with slight 'tube' and 'fizz' comments also apparent. One panelist felt that it might prove fatiguing.

### Summary

The NS1000M is clearly a fine if expensive loudspeaker. It gains a recommendation despite its price, but with some reservations concerning its potential hardness and fatiguing properties — not severe, but sufficient to excite comment by one or two panelists. It can offer high volumes, with very clean if overdamped bass, and is both beautifully engineered and constructed.

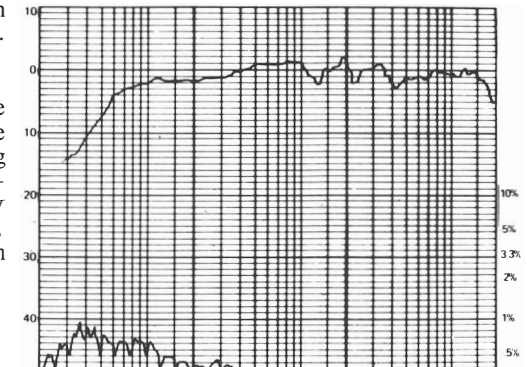
Size	67.5(26.5) H; 37.5(14.7) W; 32.6(12.8) D; cm(inches)
Weight	31(68.2) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 200W
Recommended placement	high or tilted stand
Frequency response within ±3dB at (2m)	80Hz to 16kHz
Low frequency rolloff (-6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	107dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good* (see text)
Typical price per pair	'M' £550 (£800) when reviewed, now 'M' £500 (£850)

# Yamaha NS1000M

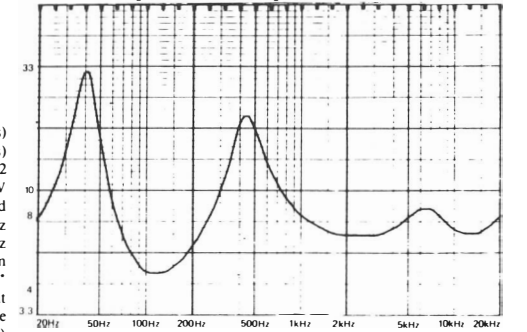
(revised and reprinted)

RECOMMENDED

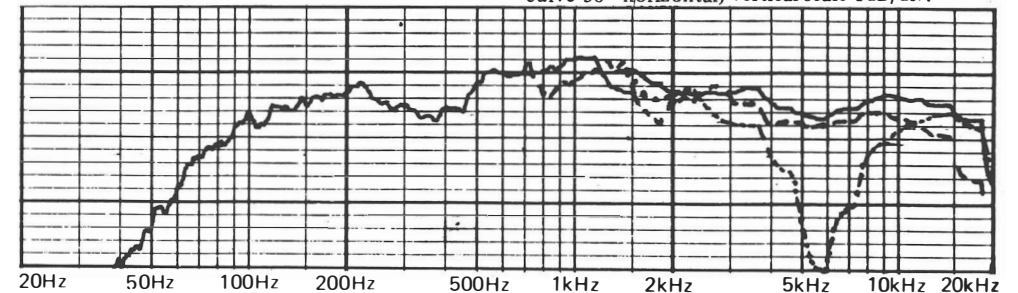
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



below: impedance vs frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



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Max Power input 40 watts programme peak.  
Sensitivity 85dB/watt @ 1 metre.  
Nominal Impedance 8 ohms.  
Units 5in polypropylene cone bass/mid range unit; 1in fabric dome HF unit.

Price, Teak & Walnut £173.00 per pair + VAT.

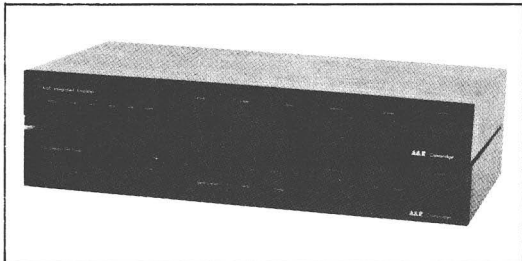
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# CASSETTE DECKS

## Compact Cassette History

Tape recorders built around the Philips patented and licensed Compact Cassette came onto the market in the mid sixties. These machines offered only low fidelity sound and at the time few people saw the impact this medium was to make in the home entertainment market in the fifteen years following its introduction.

Looking at the cassette itself it is important to realise that it contains parts of the transport mechanism and the pressure pad that on a reel-to-reel tape deck are part of that machine's costly mechanics. Looking into the tape opening of a cassette you can see the three cutouts, reading from left to right, for the erase head, record/replay head and for the capstan and pinch-wheel drive. Behind the tape in the centre slot is the sprung pressure pad and magnetic shield. The spine of the cassette has small plastic lugs which can be broken out to prevent the tape being erased as these are sensed by a probe once the cassette is inserted into the player. Alongside these lugs are additional cutouts to enable another sensor, fitted to some decks only, to check on the type of tape contained within the cassette and then to switch the bias and EQ from normal to chrome or metal as required.

The magnetic tape itself carries four tracks some 0.6mm wide as two pairs of stereo twin tracks separated by guard bands. The tape moves over the heads at a much lower speed than with a reel-to-reel machine (4.8cm per sec as opposed to 19 or 38cm per sec). In addition to the problems of slow tape speed the cassette medium has to cope with a tape only half the width of reel-to-reel tape at 3.7mm wide.

## Tape recorder basics

Magnetic tape recording is unique as a medium for the domestic storage and replay of music in that it offers the potential to recording and re-use. Radio and disc obviously do not have this flexibility. The magnetic tape is a plastics base covered with a magnetic layer of fine particles of metallic oxide or more recently pure metal or metal alloy particles. Recording consists of passing this tape across a record head which alters the magnetic structure of the tape and encodes an audio signal in that new structure. This signal can be retrieved by passing the tape again over a replay head where the magnetic code generates a small electrical signal for amplification and replay.

These record and replay heads consist of coils wound on iron or other magnetic formers having a minute gap over which the tape passes. When an electrical signal is fed into the coil it generates a magnetic field across the head gap which changes according to the electrical signal being applied. If

the tape is passed across the gap in close contact with the head this changing magnetic field is permanently stored in the changed magnetic properties of the particles in the tape. This replica on the tape can then be passed across a replay head which through its gap senses the magnetic field changes off the tape and creates a signal for replay.

To erase the tape for re-use the tape is passed over an erase head before it reaches the record head. This erase head carries a strong signal oscillating at very high frequencies which effectively randomises the stored magnetic code on the tape. Some of this high frequency erase signal is fed to the record head and is mixed with the audio signal to enable the tape to make a recording of low distortion. This is known as the *bias current* which is required to be set for different tape formulations. The bias current also partly erases the high frequency signals and so considerable electronic boost must be applied by the deck's amplifier on both record and replay to compensate for this loss. This is known as *equalisation* or *EQ*. Both bias and EQ are covered in some more depth in the chapter dealing with *Cassette Tapes*.

## Cassette problems and solutions

The two big compromises brought about by the compact size of the cassette are reduced tape width and slower running speed, this means that there are fewer magnetic tape particles passing the record heads and this accounts for the medium's relatively bad high frequency performance, high hiss level and severely limited dynamic range. These were the limitations that kept the cassette format and the machines built to use it merely toys in hi-fi terms until the advent of noise reduction.

Ray Dolby found a way to overcome these problems by designing noise reduction electronics which could be incorporated cheaply into every cassette deck. The Dolby system is a so-called differential system operating only when the signal is low. During quiet music passages it senses the level and pushes up the signal as it is recorded onto the tape. During loud passages where noise would effectively be masked, the system drops out. During replay the Dolby 'decode' circuitry does the inverse and de-emphasises those low signals to restore the dynamic range but also to push down the hiss level of the tape. The Dolby system is only designed to operate in the high frequencies where hiss is a problem and Dolby encoded tapes played back without Dolby de-emphasis will sound trebly.

Simultaneously with the introduction of Dolby circuitry there came rapid improvements in transport mechanics

and in tape formulations themselves which brings us up to date. Improved noise reduction systems are beginning to be offered: *Dolby C* is effectively a Dolby B encoding of an already Dolbied tape offering good extra performance without sacrificing compatibility with old tapes and without too much extra cost. *Dolby HX* seems to have been left behind in the noise reduction race by Dolby C but it is a headroom expansion (HX) system which is in effect a noise reduction system operating with Dolby B emphasis.

JVC have their own *ANRS* and *Super ANRS* systems with *ANRS* now offering fair compatibility with Dolby B while *Super ANRS*, which operates by reducing high frequency transients on record and expanding them on replay, works on some programmes and not with others. *dbx* noise reduction systems offer startling noise reduction but noise pumping behind the signal seems still to be problematic to some listeners. Toshiba's *adres* system was technically more advanced than the original *dbx* units but suffered from similar problems. The *High-Com* system originally put in a very poor showing but in its *High Com II* form as used by Nakamichi it has proved viable, though Dolby C seems to be sweeping this noise reduction system away as it is all others. Tandberg have their own *Dyneq* system to overcome high frequency compression problems; their work seems to parallel Dolby's own on the HX system, again both being put into the shade by Dolby C on cost grounds.

## Cassette deck features

In using the word *tape deck* we are in this guide referring to a machine primarily designed to interface with a domestic hi-fi system and be connected to an amp or receiver. A tape deck does not include its own power amplifiers and speakers but most have a headphone socket suitable for monitoring purposes. All the decks reviewed are stereophonic, recording two channels of information down one edge of the cassette tape which is then turned over to offer the remaining tape for recording in the other direction. Mono tapes have just two tracks but compatibility is assured as the stereo head gaps both fall within the mono track on the tape and simply feed identical signals to the replay electronics.

The tape is transported from one hub to the other inside the cassette by being pinched between a rotating capstan and rubber pinchwheel in the tape deck. Some machines find space in the tape opening to insert another capstan and can isolate a short length of tape from the vagaries of the cassette's mechanics. These dual capstan decks should offer better transport measurements.

The least expensive cassette decks use 'piano key' actuators on the transport modes (play, record, fast forward, rewind and pause) while the more expensive machines offer solenoid control from touch sensitive micro switches often remote from the transport itself. There are intermediate electromechanical systems.

While the majority of decks are two-head machines with a head for erasure and one for record/replay some of the more expensive models split the record and replay facilities by providing separate or twinned heads. The big advantage is that a three-head machine allows you to monitor the recording a fraction of a second after it is made, making it easy to get everything right first off. Three-head machines also allow instant off-tape comparisons with the source being recorded which can be a great help when setting a machine up for bias and azimuth or checking for compatibility with different tape types. Combined heads for record/replay have to compromise on gap size and this compromise is wiped out with separate record and replay gaps which can be individually optimised to provide better performance.

The problems in adding a third head to the cassette medium were many fold. Finding somewhere to put it was the first problem as the number of apertures in the cassette housing were limited. A third head created additional friction and required transports to be beefed up and their tolerances improved. Misalignment and magnetic interference are other problems that must be solved for a third head to be incorporated successfully.

Tape heads themselves are produced in a variety of different materials often carrying exotic names such as Permalloy, Sendust, Glass Crystal Ferrite. Do not presume that because a tape head is made of a specialist material it is going automatically to perform better, our reviews tell you more about life expectancy, overload, etc.

You of course need to know how much signal you are putting down onto the tape and this is where meters come in. Various types of meters can be provided; the most common is the VU meter with a needle running over a scale. These meters are intended to show the average level during any passage of music but they cannot react fast enough to respond to transient sounds accurately and constantly under-read on such programme. To overcome this peak meters or indicators can be added to the basic VU as the VU meter alone fitted to many cassette decks in no way comes up to the standard laid down for the operation of this type of indicator.

LED, liquid crystal and fluorescent displays are now commonly used, though in many cases even these meters are adjusted inappropriately and may not have a wide enough range even though they act fast enough. Meters should really show the peak level of the incoming signal but some manufacturers find it easier to put the meters after the Dolby circuitry when a compressed/equalised signal is read. This can cause you to record at the wrong level and not utilise the tape to the full. The safest idea is to experiment with metering various programmes at various levels to check out the particular

operation of the meters on your machine. Our reviews comment on the range, speed and adjustment of fitted indicators where it is necessary.

Some machines offer facilities that can help improve the sound quality such as user-adjustable heads which can ensure that the machine is properly aligned to any other tape recorder's azimuth. If you want to use a wide variety of tape brands then a machine with variable bias will be essential. Some machines have automated bias setting which can offer reasonably accurate results after a few seconds.

Electrical interface with your hi-fi system is the last cassette deck hurdle to overcome. First you need to know the amplifier or receiver's input sensitivity and impedance at the tape in /line in or record sockets and the tape output level and impedance. Sensitivities are normally quoted as a minimum while outputs tend to be quoted as a maximum. To match the cassette deck best it should have a slightly higher output than the tape's sensitivity while the cassette deck's input should have a lower figure for sensitivity than the amplifier's tape output. Impedance matching is a shocking tangle and some simple guidance is offered in the chapter *Amplifiers and Receivers* under the heading *Tape Input/Output*. Most cassette decks have both DIN standard and phono sockets for connecting up equipment; as these often work to different standards it is advisable to stick with one type exclusively.

#### Getting the best from a cassette deck

There are three important areas to get right if you want the best performance your particular tape deck can offer. First of all the machine should be accurately electronically adjusted so there are no errors of equalisation of any Dolby tracking errors. This alignment should be done by the manufacturer and referred to a particular type and brand of tape. Alignment accuracy depends on the quality control applied; hopefully our reviews have picked up the instances where this alignment is inconsistent. To check this for yourself ask to use the cassette deck you intend to buy in the shop and make a quick A/B test making a recording from disc say and then playing back the cassette and disc together, switching between them and listening for gross dissimilarities.

You should be prepared to pay for alignment service though many shops which do not offer discount will offer alignment as part of their after-sales service – but don't expect alignment and discount.

The second area is that each machine should be aligned for use with one brand of tape or with a small family of similarly performing tapes. If you choose a machine for a particular feature and wish to use it with your library of tapes which happen to be made on an unsuitable tape then you should have the machine realigned to work best with the majority of your tapes. Check in the instruction manual as to which tape the manufacturer uses for alignment and stick with it. I have certainly found that alignment differences are often bigger than differences between different makes of cassette deck.

Finally maintenance is very much in your own hands. Regular cleaning to keep the heads and tape path free from fluff and oxide particles shed from the tape is essential. I would suggest that such cleaning is done every 20 hours. Cotton wool buds moistened with isopropyl alcohol is the cheapest way but for decks that have difficult-to-access heads then a tape cleaner should be used though often the erase head gets missed.

Additionally one should be prepared to remove the residual magnetism that will build up in the record/replay heads with a device known as a de-gausser. These head de-magnetisers can be either hand-held models or come in the form of a cassette. Follow the manufacturers instructions for use to the letter and regularly de-magnetise the heads of your machine. I find this of benefit every couple of months.

#### REEL-TO-REEL DECKS

The market for budget reel-to-reel tape decks that existed some ten years ago has been completely wiped out by the boom in cassette machines. The reel-to-reel machines on the market today are almost always advanced specification high-quality recorders appealing to the pro and semi-pro musician (and of course the committed amateur) and to those seeking real high-fidelity replay and recording from the tape medium. If you want longer than 45 minutes replay, editing facilities and are not worried by the bulk of a reel-to-reel tape deck then the medium is for you. Cassette, while convenient and of good quality, cannot yet match reel-to-reel in these terms.

#### Reel-to-Reel Best Buys

The following models were all recipients of Best Buy status in Angus McKenzie's roundup of the reel-to-reel tape deck market as published in *Hi-Fi Choice* No. 22. The **Philips N4522** (£850) was considered to offer the finest value being described as a semi-professional recorder at a domestic price and it received top recommendation for its outstanding electronic design and amazing facilities. The **Philips N4520** (£700) received a strong recommendation for its superb electronics, ergonomics and features. The half-track version then shortly to be released was eagerly anticipated.

The high and low speed **Revox B77** (£700) were both recommended for their reliability and ergonomics; they offer the important facility of switchable mains frequency for the user who travels the world with his machine. Other models offering various speed combinations, professional balanced socketry and one including an amplifier and monitor speakers are available. Slide sync and track synchronization can be achieved on some models.

The quarter track **Tandberg TD20A** (£550) gave an overall outstanding performance with no drop outs and a very wide dynamic range potential. The high speed version was also well liked but for the replay clipping margin, though Tandberg promised to improve on this. Both machines can be considered as a first successful entry for Tandberg into the semi-pro reel-to-reel market.

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"The RD80 has come out well in virtually every respect, paralleling and in some areas proving marginally superior to the performance of the recommended Thorens TD160S. As such, it clearly merits recommendation itself, and will happily partner many good quality tonearms costing up to £150 or so."

*HI-FI CHOICE*

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"The BASIK can be recommended, and will win many friends amongst prospective Linn customers, as well as purchasers of other manufacturers' 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."

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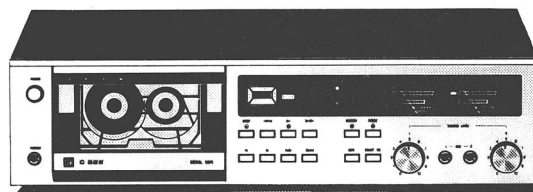
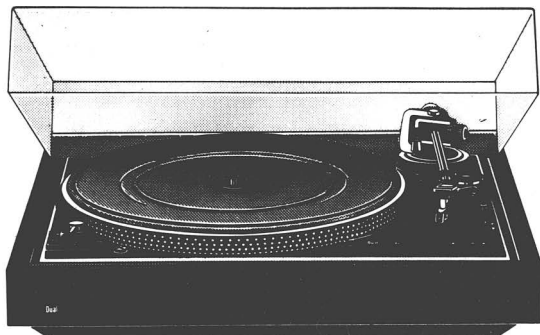
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**BEST BUY**

# Aiwa ADM250

Aiwa House, 30/32 Concord Road, Westwood Park Trading Estate, Western Avenue, London W3 0TH. Tel 01-993 1672



This metal cased deck has just basic facilities, including a record player sync. start socket and switchable mike/DIN and line inputs. The cassette compartment is on the left of this front-loader, and piano key type controls incorporate the usual Aiwa cueing on rewind function and allow transfer from play into wind, returning to play on releasing the wind level. Two levers select ferric, pseudo-chrome and metal bias and equalisations, and a small ganged stereo knob with centre indent provides bias variation for the ferric position only. Push buttons are provided for Dolby in/out and input switching, and a large friction locked stereo record gain control is complemented by a ganged replay one. Two VU-type meters (under-reading quite noticeably) are supplemented by LEDs, coming on at approximately +3 and +7dB ref DL under program conditions. The machine has metal tape capability, and can also be used with ferri-chrome tapes.

The microphone inputs (1/4" mono jacks) are very insensitive and yet the clipping margin was not too good. The 5-pole DIN input was rather better than usual, adding only slight noise, and the replay pins muted on record to DIN standard. The phono line input had average sensitivity, no clipping problem was noted, and input noise was very low.

The phono line-out levels were adequate for interfacing with most equipment, but the replay

gain control did not affect headphone levels: 600ohm models had just adequate volume with a just acceptable clipping margin, while 8ohm models were slightly too loud but with a better clipping margin. Replay azimuth was quite accurately set, but the head guides were slightly too high and the head itself was not quite forward enough. Weighted replay noise levels all measured well, and no replay hum was audible. Replay amplifier distortion measured well at +6dB and the clipping margin was good, but distortion did come in gradually above +10dB, becoming 'hard' at around +15dB.

Maxell *UDXLI* was specified by Aiwa, and the overall MOL performance was excellent, but HF saturation only fair, showing that the tape was over-biased and over-equalised; it also showed a slight positive Dolby error. The response was reasonably flat to 10kHz but the left channel fell slightly faster than the right channel above this, while slight bass loss was noted overall (average -3dB at 50Hz). Overall weighted noise was reasonable, but the Dolby noise reduction was poorer than average at around 9.25dB. Some HF saturation was noted subjectively, but otherwise the overall sound quality was good.

TDK *SA* pseudo-chrome gave good MOLs, and improved HF saturation, the entire programme sounding reasonably well on it throughout, with responses better than on ferric but again showing

bass loss. Only 9dB noise reduction was noted, although the overall weighted noise was reasonable without Dolby.

Scotch *Metafine*, specified insistently by Aiwa, was rather a disaster subjectively with continual dropouts and L/R movement noted. The 333Hz MOLs were just acceptable, but the HF saturation was poor for metal, although better than for TDK *SA*. Ignoring the mechanical tape problems, sound quality throughout, at best, was very good indeed, with very low noise for metal but insufficient noise reduction with Dolby. The left channel was -3dB at 10kHz although the right channel was flat. About 1dB negative Dolby calibration error was noted, and so *Metafine* just cannot be recommended, and despite Aiwa's recommendation, Japanese metal tapes would be much better.

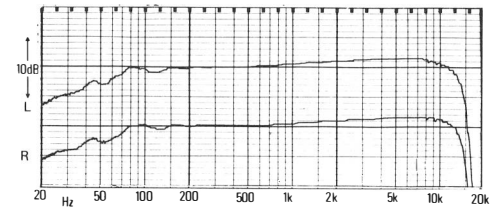
Wow and flutter did not show any subjective problems, although the measurement was only just acceptable. Speed was very accurate and spooling speed reasonable. Erasure was good, and general ergonomics very simple and effective. Spooling torque was about average, but play/record torque slightly low, so some European cassette tapes may not be too suitable. The pause control, when released, caused the tape to be out of azimuth on playback for a second or two, but apart from this tape stability was very good throughout on *UDXLI* and *SA*. Replay azimuth varied a little from time to time, but this was probably a sample fault (*NB* tape guides slightly high).

I feel this machine should be recommended as a best buy, since it should offer not only very reasonable quality indeed on good ferric and pseudo-chrome tapes but was also found to give good performance on Maxell *MX* metal tape, much better than with Aiwa's recommended *Metafine*. Maxell *UD* ferric would also work well with this machine, and would therefore be a good choice for the ferric position. A good but simple deck at a very reasonable price.

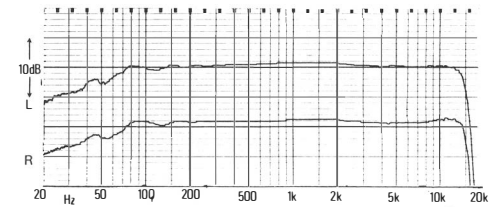
After all the original tests had been carried out, Aiwa eventually relented and suggested that we might try Maxell metal. We managed to find time to do this and found 333Hz MOLs were averaging +7.5dB, 10Hz saturation was -2.5dB, and the response was within 0.4dB at 10Hz on both tracks. No stability problems were noted, and this surely makes the point that manufacturer's recommendations are by no means accurate for best results. This machine only qualified for recommendation until we tried Maxell *MX*.

**GENERAL DATA**

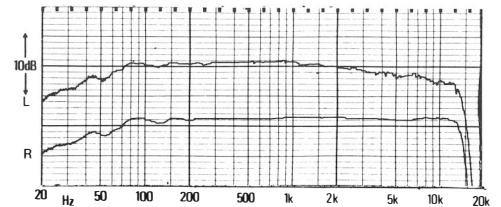
Replay azimuth deviation from average	+26°
Mike input sensitivity/clipping	497µV/16.5mV
Line input sensitivity/clipping	80mV/>10V
Replay response ferric 63Hz av L/R	-0.75dB
Worst audible replay hum component	-63dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-58.2dB
Dolby improvement	-9.6dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-61.9dB
Dolby improvement	-9.3dB
Replay amp clipping ref DL	+15.7dB
Max replay level for DL	580mV
Wow and flutter average (peak weighted DIN)	0.161%
Speed average	-0.25%
Meters under-read	8dB on 64ms
Overall 10kHz sat ferric L/R ref DL	-7.9/-8.6dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+8.1/+8.0dB
Overall 10kHz sat chrome position L/R ref DL	-6.4/-7.1dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.8/+6.1dB
Overall 10kHz sat metal L/R ref DL	-4.6/-4.1dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+6.4/+6.2dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.1/-50.4dB
Dolby improvement	-9.2dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-52.8/-53.7dB
Dolby improvement	-9.1dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-54.0/-53.5dB
Dolby improvement	-9.5dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-78.4dB
Spooling time (C90)	1m 55s
Dynamic range ferric/chrome/metal	66.8/68.3/70.5dB
Noise reduction system	Dolby
Tapes used	Maxell UDXLI; TDK SA; Scotch Metafine
Typical retail price	£105



Maxell UDXLI



TDK SA



Scotch Metafine

Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

# Aiwa ADL300

Aiwa House, 30/32 Concord Road, Westwood Park Trading Estate, Western Avenue, London W3 0TH. Tel 01-993 1672



The ADL 300 has virtually identical facilities to the ADM 250, except that the line/DIN input switch is on the rear panel, a record-mute button is added on the front, and the machine incorporates a music sensor system in addition to the record player sync. start. A front panel lever and a small push button are used to select the search function and the programme item required, the deck then counting the number of gaps between tracks and commencing playback at the required point. This system only works satisfactorily with pop music where there are no very quiet passages during the music! Please see the ADM 250 review for other facilities and comments on the styling.

The mike input sensitivity was again poor, and so quite high output microphones will have to be used to record speech other than very close to the mike; the clipping margin was also very poor. The DIN 5-pole in/out socket gave a very good performance, with almost no input noise degradation, and with replay pin muting on record to DIN specification. The line inputs were of average sensitivity, no clipping problem was noted, and furthermore, input noise was minimal, so interfacing is very effective. The record level metering uses two rows of 12 LEDs which read peaks quite well, no actual meters being included.

The replay azimuth was quite well set, but the tape guides were again slightly too high and the record/replay head was slightly too far back.

Replay noise levels without Dolby all measured extremely well, with hum at a particularly low level which is commendable. In the chrome and metal positions however, Dolby noise reduction was slightly inadequate, hiss on replay only reducing by an average of 9.2dB. Whilst replay amplifier distortion measured very well at normal levels, the replay clipping margin was barely adequate, coming in at around +8.5dB. Adequate volume was available into 600ohm headphones (1/4" stereo jack), but low impedance models were clearly too loud, and headphone volume could not unfortunately be adjusted with the replay gain control.

Maxell UDXL1 was again specified by Aiwa, and the overall response with Dolby extended reasonably up to around 12.5kHz; as with the ADM 250, above this frequency the fixed MPX filter cut very rapidly, and again a bass cut of 3dB was noted at 50Hz. 333Hz MOL and HF saturation measurements showed that the tape was slightly over-biased and over-equalised, although the sound quality was well liked subjectively; distortion was generally low, though slight HF compression was noted at times; overall noise was rather average, and the Dolby improvement was not quite optimum.

TDK SA, used for the chrome position, produced reasonable MOLs and HF saturation measurements. As with UDXL1, the HF response was slightly up on right channel with the left fairly flat

but showing a slight negative Dolby error. The sound quality was thought to be generally very good, and slightly better than with UDXL1. Overall weighted noise was about average, but Dolby improvement was not quite optimised.

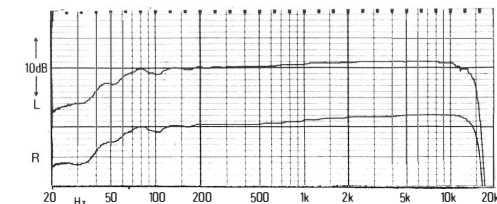
Scotch Metafine was again specified for metal and produced the expected stability problems, but the dropout performance was better than expected. High frequencies were generally a little down subjectively and in the charts, and MOL performance was fair, but HF saturation measurements were not good enough for metal. The overall weighted noise was very good for metal, and Dolby improved noise figures by an average of 10dB, though for some strange reason different noise measurements were found between different tape samples which was very puzzling (even widely differing between tracks). Once again, we strongly recommend a Japanese metal rather than Metafine, and to accommodate these the machine will need readjustment by a dealer.

Wow and flutter received only mild criticism subjectively, and measurements were fairly good in the lab. Speed was slightly fast and spooling average. Erasure was good even on metal, and no serious problems could be found in the machine in any area. All torque measurements were satisfactory, and ergonomically the machine was found easy to use and reliable.

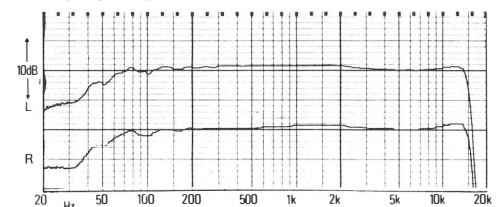
This model can be recommended if the facility for music sensing is considered important, but if this is not the case then the ADM 250 is more appropriate, since it is around £10 cheaper. The performance on Metafine was obviously very disappointing, but Maxell MX or TDK MA would almost certainly be far superior, and the metal performance is certainly better than quite a lot of the competition in two head decks. The reasonable price for the facilities offered allows recommendation, and we particularly commend the excellent DIN and phono in/out compatibility.

**GENERAL DATA**

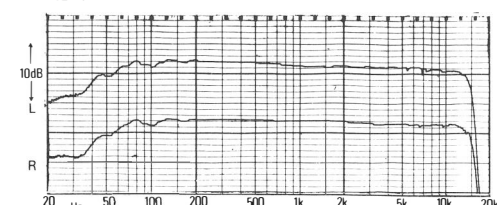
Replay azimuth deviation from average	+13°
Mike input sensitivity/clipping	463µV/17mV
Line input sensitivity/clipping	84mV/10V
Replay response ferric 63Hz av L/R	-0.7dB
Worst audible replay hum component (150Hz)	-69.5dB
Replay noise ferric CCIR/ARM weighted (Dolby out)	-59.6dB
Dolby improvement	9.5dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-63.2dB
Dolby improvement	9.3dB
Replay amp clipping ref DL	+8.5dB
Max replay level for DL	600mV
Wow and flutter average (peak weighted DIN)	0.133%
Speed average	+0.7%
Meters under-read	6dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-7.7/-8.6dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+8.1/+7.7dB
Overall 10kHz sat chrome position L/R ref DL	-7.1/-6.8dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.4/+5.2dB
Overall 10kHz sat metal L/R ref DL	-4.1/-5.2dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+6.6/+6.2dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-48.6/-49.9dB
Dolby improvement	9.4dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-52.2/-53.2dB
Dolby improvement	9.3dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.4/-54.4dB
Dolby improvement	10.8dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-78.6dB
Spooling time (C90)	1m 54s
Dynamic range ferric/chrome/metal	66.6/67.3/71.7dB
Noise reduction system	Dolby B
Tapes used	Maxell UDXL1; TDK SA; Scotch Metafine
Typical retail price	£115



Maxell UDXL1



TDK SA



Scotch Metafine

Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

# Akai CSM 02

Unit 12 Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middx. Tel 01-897 0490



This very inexpensive Akai deck incorporates both phono and DIN inputs and outputs on the rear panel, and has a two-core attached mains lead. Encased in metal, the back panel is hardboard and it is rather inexpensive looking. The front-loading cassette compartment is on the left, and mechanical deck controls allow transfer from play into wind and back again and dropping into record from play. When rewinding the auto-stop takes ages to engage, and winding is noisy. Front panel facilities include a record-mute button, metal/chrome/normal tape select, and Dolby out/in including MPX switching. A friction locked rotary record-gain control incorporates a lever for one channel, but tracking was rather poor. A ganged replay gain control was provided which also adjusted head-phone levels; 600ohm models could not be driven loud enough, but lower impedance models could easily go very loud, and had a good clipping margin. Record level metering is accomplished with two rows of 26 LEDs, but Akai is cheating a bit here since they light up in pairs, so only 13 levels are shown; faster peaks are indicated well. A line/DIN input switch is on the rear panel.

The 1/4" mono jack mike inputs had acceptable sensitivity, but the clipping margin was only fairly adequate. The 5-pole DIN input was virtually useless, the circuit design adding so much noise to a standard DIN input source as to remove any benefit of noise reduction! The replay pins were

also live during recording, which is non-standard. Fortunately, the phono line inputs had an adequate sensitivity, no clipping problem was noted, and input noise was low.

Replay azimuth was rather poorly adjusted, but the head heights were fairly accurate: whereas the erase head guide was correct, the others were a little bit too high. The replay amplifier distortion measured extremely well and allowed a very wide clipping margin, which is excellent. Replay hiss measurements were all very good, but whilst no hum was actually heard, the measurements were only slightly better than average. Whilst the chrome replay response was fairly accurate, the ferric time constant was nearer 95µS, and this had various side effects including only fair overall HF saturations on ferric tape.

Maxell UD was specified for ferric, and was clearly under-biased to give a flat response overall, since 333Hz MOLs were about 2dB below what they should have been and HF saturation received slight criticism. Overall noise measured and sounded well because of the replay error, and overall sound quality was good at best, but would have been better still with a lower recording level. Some distortion was noted at LF and MF, and the bass response showed many bass woodles due to head contour problems. The measured response was reasonably flat overall, but showed a valley around 6kHz which was noticed subjectively.

TDK SA gave reasonable MF MOLs, but again only fair HF saturation; again a replay response error was noted, showing the time constant to be around 60µS. Overall noise measured well and again at best the sound quality was good, though some HF compression was noted. The response seemed marginally up at HF but this is not really a bad thing.

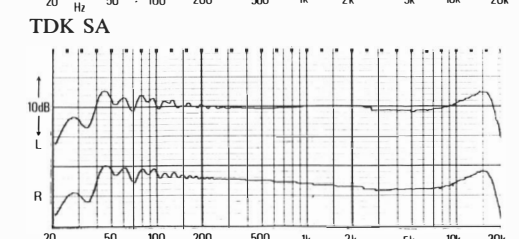
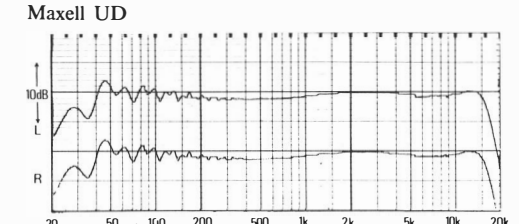
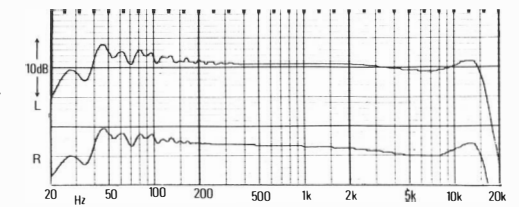
TDK metal gave only adequate MOLs, but the HF performance was very good, especially considering the replay curve error. The response sounded a bit up at EHF, and there seemed to be a valley in the presence region. We suspect that some RF bias was affecting record Dolby processing, thus causing the response valley. Overall noise again measured and sounded well, but the overall sound quality on metal was not really good enough, and pseudo-chrome seemed to give the best subjective results.

Wow and flutter measured quite well and was only very marginally audible. Speed was extremely accurate, but spooling was just a little slow. The play torque was very much on the low side, and we suggest that some makes of European cassette might cause problems, especially if they have too much back-tension. Erasure was very good, even on metal.

Considering its budget price, this model gave an acceptable performance, but its sound quality could have been improved considerably if the replay equalisation had been correct. Because of this error all the cassette tape types either suffered in poor MOLs or from HF saturation reservations, which again would have been less marked with correct replay equalisation. Notwithstanding this, we feel it is only fair to recommend this model, because of its good wow and flutter performance and its capability of giving a good average sound quality if the record levels are watched fairly carefully. Do not even consider it though if you have to use the DIN socket for interconnection!

**GENERAL DATA**

Replay azimuth deviation from average	..... -55°
Mike input sensitivity/clipping	..... 271µV/20.8mV
Line input sensitivity/clipping	..... 109mV/>10V
Replay response ferric 63Hz av L/R	..... -0.9dB
Worst audible replay hum component	..... -60dB (100Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	..... -61.6dB
Dolby improvement	..... 10.3dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	..... -64.1dB
Dolby improvement	..... 9.8dB
Replay amp clipping ref DL	..... +15.5dB
Max replay level for DL	..... 570mV
Wow and flutter average (peak weighted DIN)	..... 0.115%
Speed average	..... +0.1%
Meters under-read	..... 2dB on 64ms
Overall 10kHz sat ferric L/R ref DL @ 333Hz	..... -8.5/-8.5dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	..... +4.3/+4.1dB
Overall 10kHz sat chrome position L/R ref DL	..... -7.9/-7.4dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	..... +6.0/+6.0dB
Overall 10kHz sat metal L/R ref DL	..... -1.7/-1.5dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	..... +6.0/+5.7dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	..... -52.6/-52.8dB
Dolby improvement	..... 10.0dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	..... -54.1/-53.9dB
Dolby improvement	..... 9.8dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	..... -53.0/-53.1dB
Dolby improvement	..... 9.9dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	..... -75.0dB
Spooling time (C90)	..... 2m 18s
Dynamic range ferric/chrome/metal	..... 65.9/69.3/69.8dB
Noise reduction system	..... Dolby
Tapes used	..... Maxell UD; TDK SA; TDK MA-R
Typical retail price	..... £90

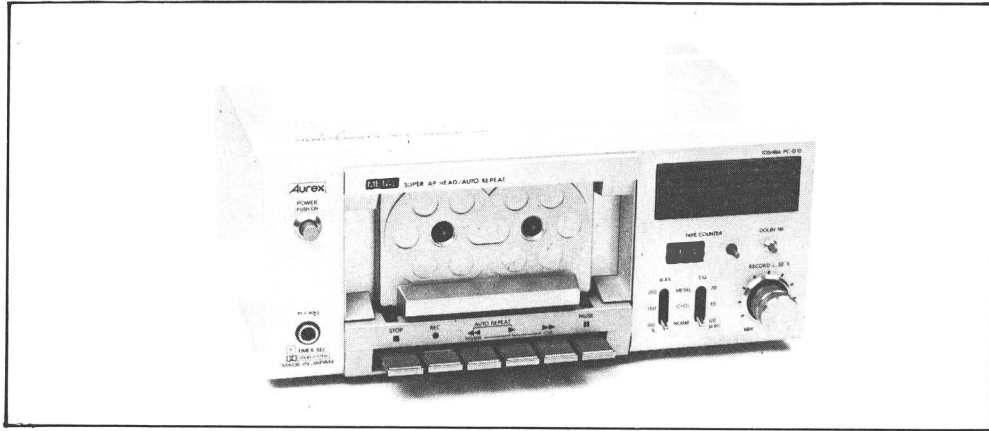


Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

## Aurex PCD10

Toshiba House, Frimley Road, Frimley, Camberley, Surrey, GU16 5JJ. Tel 0276 62222



This deck is unusual in being the smallest non-portable stereo cassette deck that I have yet encountered, and sets an example in miniaturisation that should be noted by all, for the majority of decks are ridiculously large. A front-loader having the cassette exposed without a cover but easily inserted, it has line inputs and outputs, together with 1/4 inch mike jacks on the rear panel, a stereo ganged pre-set replay gain control being positioned near the phono outputs.

The record level control is a dual concentric non-friction locked type. A miniature button switches Dolby in/out with fixed multiplex filtering, and three-position lever switches operate bias and equalisation separately for ferric, pseudo-chrome and metal tapes. The deck controls operate mechanically, and these are slightly stiff, but allow transfer between functions, and also provide cueing. Miniature illuminated barograph metering read transients very accurately, which is commendable. Both 25ohm and 600ohm headphones worked well from a 1/4 inch stereo jack, and the volume is affected by the back panel replay gain control. Whilst the microphone inputs (1/4 inch jacks) were rather insensitive, their clipping margin was excellent; although some hum was noted on the left channel input, hiss was minimal. An earth loop was caused if a stereo mike with a common earth connection was jacked into L and R channels. Insertion of a microphone cuts the phono line input, the latter having average sensitivity, and no noise or clipping problems were experienced.

The replay azimuth was not set very accurately, and slight replay hum was noted particularly on the right channel, some fairly poor measurements being noted in the lab. The hum was not too bad subjectively, and was only noticed in the quietest passages. Replay hiss levels measured well and replay amplifier clipping was at quite a high level, which is good, distortion at +6dB also measuring at a very low level.

TDK AD was specified by Aurex and the overall hiss performance was very good, with a good Dolby improvement. The pen charts showed clear HF lift at 10kHz, rolling off at about 15kHz without Dolby, but with a much greater attenuation rate with Dolby inserted. The overall sound quality was rather bright, but distortion seemed low throughout, and the programme sounded quite robust and clean. We noted a Dolby error of +0.8dB, and it is therefore quite clear that Aurex's recommended tape type is not really compatible; a tape such as Fuji FXI or possibly Maxell UDXL I would have been rather better. Stereo positioning and stability were excellent throughout. A robust sound quality was much liked, and we must admit that AD did produce quite an exciting sound overall which would be welcome, particularly if you like lots of top.

TDK SA (pseudo-chrome) penned a very smooth chart to 10kHz, but was down at 15kHz, any deviations being exaggerated by the 'Dolby in' chart. Subjectively the test programme seemed slightly lacking at EHF, but was otherwise very

## Aurex PCD10

(revised and reprinted)

RECOMMENDED

smooth. Speech reproduced clearly with no trace of 'spitch.' The entire programme sounded very robust and good 333Hz MOLs were measured. HF compression was certainly no worse than average, and indeed the entire programme sounded clean, showing good optimisation for the tape type. Overall noise was average, and note that the figure is virtually the same as that for AD which is fascinating; the noise spectrum however sounded slightly better.

Metafine was chosen by Aurex for the metal position, and responses showed a lift at 10kHz but flat again by 15kHz. These lifts were exaggerated with Dolby in, but subjectively they were not really noticed, possibly due to tape sample variations. The entire programme reproduced extremely well, but distortion was not as good as metal tapes are on some other decks, although no HF compression at all was noted. The overall quality was clearly better than on pseudo-chrome, though, and reproduction had a clarity about it attributable to metal which was very well liked. Background noise measured particularly well, stability seemed entirely dependent upon the tape, and some drop-outs were heard. If the bias was increased, other metal tape types would obviously work well and give better results.

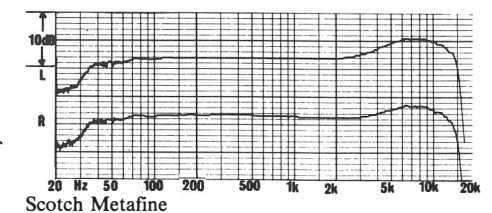
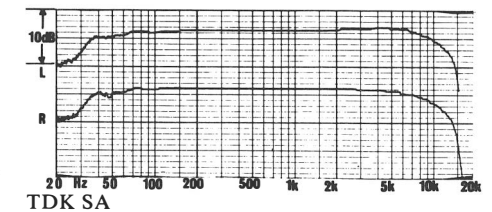
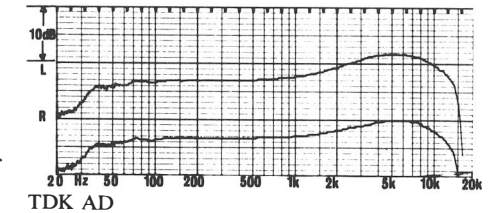
Wow and flutter did not measure too well, although the only subjective comment was that of insecurity on the piano sound, rather than wow actually being heard. Speed was rather fast but not seriously so, and spooling about average. Erase was just adequate but not as good as usual on SA or metal, although crosstalk was good. The review sample was a pre-production model, and perhaps later samples will be rather better on the points criticised.

We all very much admired the miniaturisation, and capability of giving a good overall sound, the measurements showing that fairly modest ferric tapes will perform well on this deck, and that SA gave a very good overall sound, although metal tapes are not really worthwhile. Because of the very good value for money and the machine's basic good capabilities, it is just recommended as a best buy, being one of the cheapest metal capable decks in the survey. Do check the replay hum level though if you intend purchasing one of these decks, for sample variations might be quite marked.

### GENERAL DATA

Replay azimuth deviation from average	-42°
Mike input sens/clipping	280uV/82mV
Line input sens/clipping	95mV/>10V
Worst audible replay hum component	-60dB (150Hz)
Replay noise CCIR/ARM ferric/chrome/Dolby imp	-57.3/-61/9.5dB
Replay amp clipping ref DL	+14dB
Max replay level from DL	590mV
Wow and flutter average (peak wtg DIN)	0.18%
Speed average	+1.35%
Meters under-read	-2dB on 8ms
Ferric DL dist 333Hz/5% point	0.45%/+6.3dB
Chrome DL dist 333Hz/5% point	0.69%/+6dB
Metal DL dist 333Hz/5% point	1.1%/+3.3dB
Overall 10kHz resp ref 333Hz Dolby out ferric/FeCr/chrome/metal	+2/-/-0.5/+1.8dB
Overall noise ferric CCIR/ARM/Dolby imp	-51.8/9.5dB
chrome CCIR/ARM/Dolby imp	-51.8/9.8dB
metal CCIR/ARM/Dolby imp	-54.3/9.3dB
Line input noise floor ref 160mV, DL	-80dB
Spooling time C90	1m 52s
Dynamic range ferric/FeCr/chrome/metal	67.5/-/67.8/68.8dB
Tapes used	TDK AD; TDK SA; Scotch Metafine
Typical retail price	£139

**Update** Some continuing concern regarding sample variability has resulted in rating this model as recommended rather than a best buy.



Overall frequency responses (Dolby in, -30dB ref DL)

# KIMBERLEY'S

**MANOR PARK**  
698 Romford Road, London E12  
Telephone: 01-478 5137

**MAIDA VALE**  
282 Harrow Road, London W2  
Telephone: 01-289 3102

## AMPLIFIERS

Akai AMU11/22/33	P O A
JVC A10X	£58.95
JVC AX1/2/3/4	P O A
NAD 3020	£89.50
NAD 3140	£189.00
NAD 2140	£135.00
NAD 1020	£69.00
Pioneer SA420	P O A
Pioneer SA520	P O A
Pioneer SA620	P O A
Pioneer SA720	P O A
Pioneer A5/A6/A7	P O A
Pioneer A8/A9	P O A
Trio KA300	£46.95
Technics SUV2	£99.95
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Technics SUV8	£199.95
Technics SUV3/5	P O A
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JVC TX6L	£151.95
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Pioneer TX720L	P O A
Pioneer F5L	P O A
Pioneer F7/F9	P O A
Trio KT400L	£49.95
Technics STZ1L	£59.95
Technics STS1L	£819.5
Technics STS3	£99.95
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Technics STS2 4/6	P O A

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Akai AAR21/31L	P O A
JVC RS11L	£107.95
JVC RS11L	£112.95
JVC AU10X	£146.95
JVC RS33L	P O A
JVC RS55L/RS77	P O A
NAD 7020	£179.00
Pioneer SX400L	P O A
Pioneer SX600L	P O A
Pioneer SX700L	P O A
Technics SA202L	£119.95
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Technics SA313L	P O A
Technics SA515L	P O A

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NAD 6140	£175.00
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Pioneer CT320	P O A
Pioneer CT520	P O A
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Pioneer RT707	P O A
Sansui SC3330	£149.95
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Pioneer PL400X*	£109.95
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Pioneer PL6 7 8	P O A
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Technics SL15	P O A

\*Price includes cartridge



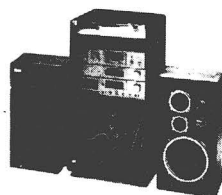
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Sansui A6	£389.95
Sony ZR1	P O A
Sony Z1	P O A

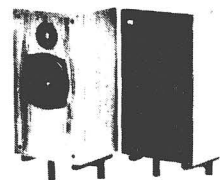
Sony Z2	P O A
Teac ACE 7	P O A
Teac ACE 9	P O A
Technics Z11	P O A
Technics Z22	P O A
Technics Mini	P O A
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Sony SSE30	£59.95
Technics SB3050	£129.95
Technics SBR4	£199.95
Technics SBF 2 3	P O A
Wharfedale L40	P O A
Wharfedale L60	P O A
Wharfedale L80	P O A
Wharfedale L100	P O A
Wharfedale L200	P O A
Wharfedale L400	P O A



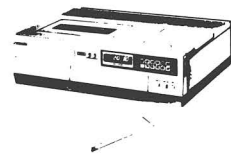
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JVC HR4100	P O A
Hitachi VT8000E	P O A
Hitachi VT8500E	P O A
Panasonic NV2000B	P O A
Panasonic NV7000B	P O A
Panasonic NV7200B	P O A
Panasonic NV3000B	P O A
Sony C5/C7	P O A



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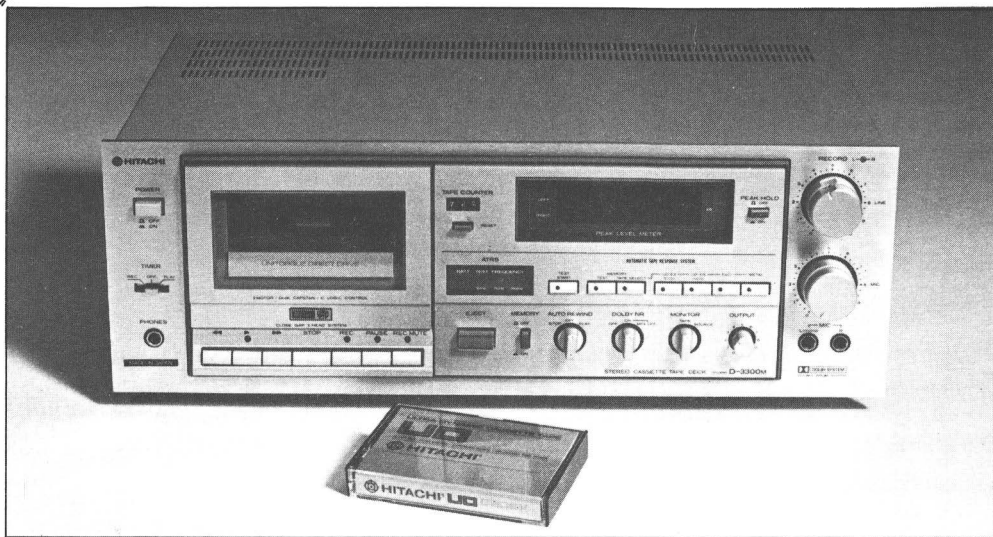
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**BEST BUY**

# Hitachi D3300M

Hitachi House, Station Road, Hayes, Middx. UB3 4DR. Tel 01-848 8787



Essentially a cheaper version of the earlier D-5500, the 3300 is much better than its predecessor throughout, and includes three heads, allowing source/tape monitoring, plus automatic tuning for various tape types, storing the parameters digitally. This front-loading metal-encased deck incorporates line in/out phonos and a recessed 5-pole DIN socket on the rear panel, a remote control socket, and uses a two core attached mains lead. All deck functions are solenoid operated *via* microswitch pushbuttons, which allow neat transfer from play into wind and back again and dropping into record. A switch selects remote timer start on play/record, push buttons select memory counter and metering peak-hold functions, rotary switches select auto rewind, off and play, Dolby on/off with or without MPX filtering, and tape/source monitoring. Basic tape selection is chosen by four push buttons for ferric, ferrichrome, pseudo-chrome and metal tapes, and additional buttons operate auto alignment, memory test, and memory tape select facilities; automatic calibration is achieved fairly rapidly. Two rows of LEDs (14 levels indicated) provide very accurate monitoring of even fast transients, and these were liked. Batteries have to be fitted for the tape memory back-up, and these will last virtually their shelf life. Two sets of rotary record level controls are split concentric but not friction-locked, independent adjustment of mike/

DIN and line input levels allowing mixing. A stereo ganged miniature replay gain control also adjusts headphone levels, giving adequate volume with low and high impedance models.

The 1/4" mono jack mike inputs were rather insensitive but the clipping margin was good. The DIN socket gave no input noise degradation, and replay pins muted during recording to DIN specification. The phono line inputs were reasonably sensitive, but clipping occurred at 4.3 volts input which might occasionally be a slight drawback. Input noise measured at a low level which is very good.

Replay azimuth was a little bit out and the recorded and replayed tracks were slightly at the wrong height, but the tape guides were set very accurately. Replay hum measurements were excellent, and replay noise levels were amazingly good throughout which is most commendable. Whilst the basic replay amplifier clipping margin was reasonably good, distortion started creeping in well before clipping was reached, and third harmonic measured as high as 1.6% on the right channel at +6dB; a second sample was however much better, being about average. Very slight bass loss was noted on replay, averaging 1.7dB down at 60Hz.

Hitachi UDER ferric (Maxell UDXL1) gave extremely good 333Hz MOL measurements, and

surprisingly HF saturation was good as well. The panel thought the sound quality was a little muffled however, and after taking many pen charts these all showed HF rolloff after equalisation, which is puzzling. The panel did hear some distortion develop on the loudest transients, particularly at LF, and I can only put this down to the replay amplifier distortion problem coming in rapidly from +6dB upwards (original review sample); this is poorer than the inherent tape distortion, and limits the capability to replay very loud passages. However at *mezzoforte* sound quality was good, and weighted noise was average throughout.

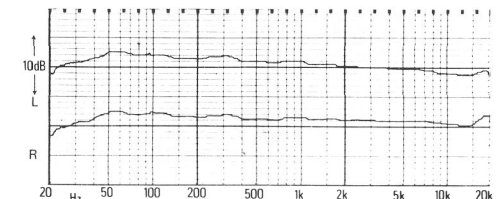
Hitachi UDEX (Maxell UDXL11) also gave good MOLs and HF saturation performance in the lab. This time the responses sounded much flatter, although later in the lab the charts showed a similar HF rolloff, which again is rather a mystery. However, the distortion seemed better somehow than UDER, and at best the sound quality was rather like that of the master tape. Apart from the transient distortion problems, it was very much liked. Overall noise was very slightly better than average for pseudo-chrome.

Hitachi metal tape (Maxell again) gave very good MOLs, and HF saturations were also good, even for metal. The panel thought reproduction was superb throughout, and the machine was clearly one of the best even though the pen charts again showed a shelf down at HF. Overall noise was again slightly better than average for metal, and obviously this machine is truly metal capable.

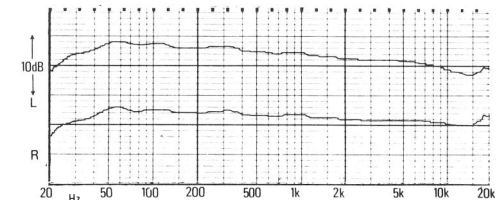
Hitachi's *unitorque* capstan motor and superb tape deck transport produced some staggeringly low wow and flutter measurements of 0.043% overall, and no wow was heard on the test programme. Speed and spooling time were both marginally on the slow side. All torque measurements were normal and erasure very satisfactory.

The machine really was an astonishingly good performer, and my only grumbles are the tendency for the auto equalisation to give a slight overall HF droop, the higher than average distortion of the replay amplifier (on the original sample only), and the bass rolloff on replay, which requires the record amp to boost bass more than usual, therefore adding to the subjective distortion at VLF. If maximum levels are carefully watched, this machine can give superb overall quality, and it is useful to be able to set up different tape types acceptably well. Hitachi have improved their wow and flutter performance dramatically on this deck, so it is not only thoroughly recommended, but is a clear best buy, since it also has automatic tuning and three heads. A winner for Hitachi, which will make some of the competition sit up.

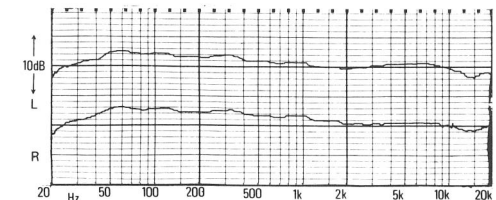
GENERAL DATA	
Replay azimuth deviation from average	-38°
Mike input sensitivity/clipping	450μV/56.3mV
Line input sensitivity/clipping	66.5mV/4.35V
Replay response ferric 63Hz av L/R	-1.7dB
Worst audible replay hum component	-66dB (100Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-63.1dB
Dolby improvement	9.6dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-67.1dB
Dolby improvement	9.0dB
Replay amp clipping ref DL	12.5dB
Max replay level for DL	715mV
Wow and flutter average (peak weighted DIN)	0.043%
Speed average	-0.7%
Meters under-read	2dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-5.3/-5.2dB
Overall distortion ferric L/R for 5% dist @ 333 Hz ref DL	+7.9/+8.2dB
Overall 10kHz sat chrome position L/R ref DL	-5.0/-5.3dB
Overall dist chrome position L/R for 5% dist @ 333 Hz ref DL	+5.8/+5.7dB
Overall 10kHz sat metal L/R ref DL	-1.4/-0.6dB
Overall distortion metal L/R for 5% dist @ 333 Hz ref DL	+9.0/+8.7dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.8/-49.7dB
Dolby improvement	9.9dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-53.5/-53.6dB
Dolby improvement	9.7dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.7/-52.7dB
Dolby improvement	9.6dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-78.2dB
Spooling time (C90)	2m 20s
Dynamic range ferric/chrome/metal	67.8/69.0/72.1dB
Noise reduction system	Dolby
Tapes used	Hitachi UD-ER: Hitachi UD-EX: Hitachi ME
Typical retail price	£309



Hitachi UDER



Hitachi UDEX



Hitachi ME

Overall frequency responses (-23dB, Dolby in)

**BEST BUY**

# JVC KDA 11B

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



The *KDA 11B* is the cheapest amongst the new decks reviewed, and offers just basic facilities including Dolby B processing. Mechanically operating deck controls allow transfer from play into wind and back again, but not dropping into record other than from stop. Line in/out phono are complemented by a 5-pole DIN socket, and a two core mains lead is attached. This metal-encased, front-loader is very light in weight. Switches include a four position tape selector (including ferric, ferrichrome, pseudo-chrome and metal), and Dolby in/out. Although the stereo rotary record level control is friction locked, it is rather difficult to adjust L or R independently, and no replay gain control is fitted. Only normal VU-type record level meters are fitted, and these under-read even 'slow' peaks quite a lot. A stereo jack delivers a good level for high impedance headphones, with a good clipping margin, but low impedance phones tended to clip on loud passages.

The microphone inputs were reasonably sensitive and the clipping margin was adequate. The DIN input worked well with virtually no input noise degradation. The line inputs were just marginally less sensitive than average, no clipping problems were encountered, and input noise was extremely low and much better than usual.

Replay azimuth was very accurately set, and the replay head height was quite adequate, but the tape

guides were very marginally low though this should not be of any concern. A very faint replay hum was noted at high monitoring levels, and measurements showed this was almost equally divided between 50 and 150Hz. Replay hiss levels measured well, and Dolby noise reduction was within specification. The replay amplifier clipping margin was amazing, but amplifier distortion merely good, with Dolby distortion poorer than average, though nevertheless acceptable on a budget recorder.

Maxell *UD* was recommended by JVC for the ferric position, and responses were surprisingly flat across the board on both tracks overall, but we noted that the right track on replay was around 2dB down at 10Hz, so the factory had set the right channel bias a little low for a flat overall response; LF MOLs nevertheless measured well on both tracks, but HF saturation was rather poor on the right channel. At intermediate levels the sound quality was excellent throughout, but some HF saturation was subjectively noted at high levels particularly on the right channel. Overall noise measured well and Dolby improvement was average.

TDK *SA* produced just a 2dB loss at 10Hz overall, and whilst 333Hz MOLs were acceptable, HF saturation was very poor, receiving continual comment from the panel, although the sound was reasonably stable and overall noise was better than average. TDK *SAX* would clearly sound better

overall, and it would suit this model very well, since the reponse would be much flatter and HF compression much less marked, justifying the extra expense.

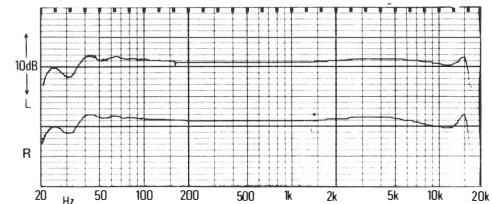
TDK *metal* produced a noticeable but not too excessive HF lift, and whilst MOLs were only adequate for metal, the HF end was sparklingly clear, receiving continual praise. TDK *metal* was slightly underbiased, and if this was corrected or if Maxell metal were used instead, the overall results would be better. In the context of a budget machine, this deck is certainly metal capable, achieving a surprisingly good overall quality and justifying the inclusion of this capability. Tape stability on all tape types was quite reasonable, although several more expensive decks were a little better.

Wow and flutter measured quite well, and was only marginally noticeable in the programme. Speed was slightly fast, and spooling about average. Torque measurements were satisfactory throughout, and erasure, even on metal, was good.

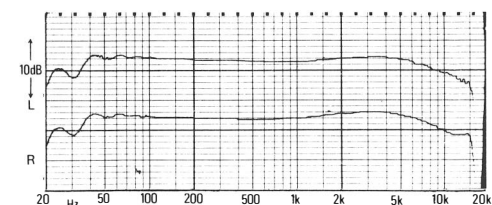
When one bears in mind the very reasonable cost of this deck and the fact that it really is metal capable (rather than this being a figment of the manufacturer's imagination, as occurs all too often), this deck offers a remarkable performance for its cost, and will undoubtedly give a lot of pleasure to its purchasers. Whilst the choice of Maxell *UD* for ferric is sensible, it should really have been properly set up for TDK *SA*, rather than requiring the more expensive *SAX* tape to achieve a flatter response. The input performance was very good indeed, even on the DIN socket, which is particularly commendable, and it should be very easy to interface with all types of domestic hi-fi equipment. The very slight replay hum will only be noticeable at high listening levels on speakers with an extended bass end, and this is small compromise for such a good allround budget model, which not only receives a strong recommendation, but is clearly a best buy.

## GENERAL DATA

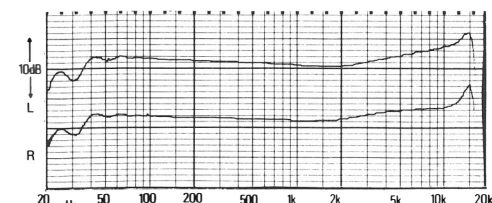
Replay azimuth deviation from average	-14°
Mike input sensitivity/clipping	213µV/29.2mV
Line input sensitivity/clipping	113mV/>10V
Replay response ferric 63Hz av L/R	-0.8dB
Worst audible replay hum component	-62dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-59.1dB
Dolby improvement	9.6dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	63.1dB
Dolby improvement	9.1dB
Replay amp clipping ref DL	+16.1dB
Max replay level for DL	440mV
Wow and flutter average (peak weighted DIN)	0.137%
Speed average	+0.6%
Meters under-read	7.5dB on 64ms
Overall 10kHz sat ferric L/R ref DL	-6.1/-8.8dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+6.3/+5.4dB
Overall 10kHz sat chrome position L/R ref DL	-9.3/-9.7dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.6/+5.3dB
Overall 10kHz sat metal L/R ref DL	-0.1/-1.1dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+6.7/+6.5dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.5/-51.0dB
Dolby improvement	9.6dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-54.0/-55.0dB
Dolby improvement	9.7dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-51.6/-52.3dB
Dolby improvement	9.7dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-82.3dB
Spooling time (C90)	2m 11s
Dynamic range ferric/chrome/metal	65.7/68.6/69.2dB
Noise reduction system	Dolby
Tapes used	Maxell UD; TDK SA; TDK MA
Typical retail price	£85



Maxell UD



TDK SA



TDK MA

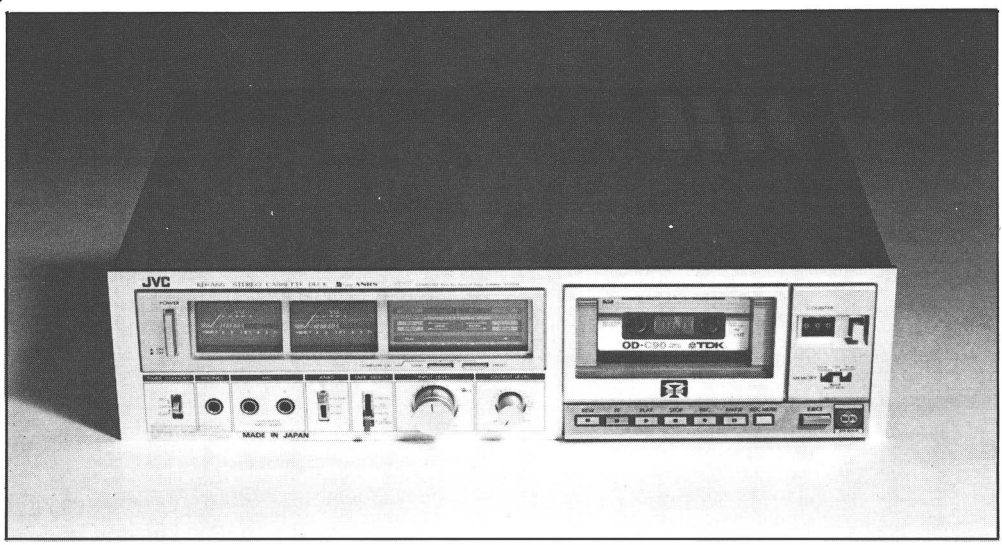
Overall frequency responses (-23dB, Dolby in)



**BEST BUY**

# JVC KDA 66B

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



This development and simplification of the *KA 8* includes *BEST*, JVC's automatic cassette tape setting-up and calibration circuit. The user can choose preset alignment switchable between ferric, ferrichrome, pseudo-chrome and metal tapes, or alternatively can press the *BEST* button, in which case the tape is reasonably well optimised automatically after 20 seconds or so, after much shuttling backwards and forwards (the deck just having two heads). Just line in/out phonos are fitted on the rear, and a two core mains lead is attached. Switched functions on the front panel allow remote timer start on replay or record, memory start or stop from rewind and auto rewind. This deck is microswitch operated and basically has the same functions as the *KA 55B*. The rotary record level control is split concentric and is rather small, making it difficult to achieve independent adjustment of L and R. Switchable *ANRS* or *SANRS* is included. The ganged stereo replay gain control also affects headphone volume, a 1/4" stereo jack providing more than enough volume into high impedance models, and more still into lower impedance ones, although the latter's clipping margin was only just adequate. Two VU-type meters, which under-read marginally less than usual, are complemented by 5 LEDs which read peaks quite accurately.

The 1/4" mono jack mike inputs were rather insensitive, but the clipping margin was better than

usual. The line inputs were slightly less sensitive than usual, but still adequate, no clipping problem was encountered, and input noise was also quite low.

The replay azimuth was quite badly misaligned, and it was difficult for us to adjust it, but head and tape guide heights were very accurately set (the machine using fairly wide replay tracks). All replay noise measurements were excellent, replay amplifier distortion was minimal, and the clipping margin excellent.

Amongst other tapes tried TDK *OD* gave very reasonable overall MOL measurements, but HF saturation was only around average with *BEST*. Overall noise measurements were good and noise reduction worked well. The sound was 'robust', but the HF compression characteristics were perhaps slightly disappointing. Overall responses with *OD* were very flat indeed, which is most creditable, and the machine could cope satisfactorily with budget tapes, which may be very useful.

TDK *SA* was tested subjectively in the preset position, and gave rather a dull overall sound, but TDK *SAX* was marginally up at HF, giving an excellent overall sound reproduction. *SA*, using *BEST*, gave reasonable MOLs and HF saturation in the lab, and overall noise measured well with good noise reduction. TDK pseudo-chromes gave slight but noticeable print-through subjectively: stability was good, but many machines were better.

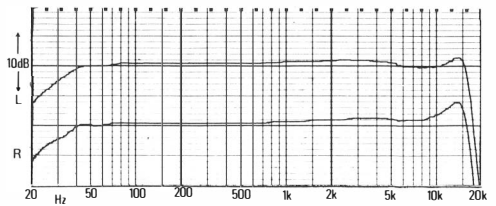
The response pen charts were all very good indeed. TDK *metal* gave reasonable MOLs for a two-head deck, and HF saturation measurements were good. When heard by the panel in the preset position, the overall sound was slightly muffled, although distortion was considered very good and certainly above average, and HF was particularly clean. Overall noise measured well. A second sample was also found to be muffled in the preset position, so clearly one should use *BEST* for all recordings unless in a particular hurry. The response charts on metal were pretty good, although the right channel showed a slight rise at HF.

We listened very carefully to *SANRS*, and felt that whilst the HF end was somewhat clearer than with *ANRS*, because of improved HF compression characteristics, the noise modulation effects on transients sounds such as piano music were clearly not acceptable. Wow and flutter measurements were fantastically good - almost as low as we have ever measured on a cassette deck. However, we all thought we detected some subjectively using *SA*, though this was never noted on other tape types. Speed was very accurate and spooling slightly faster than usual. All torque and erase measurements were very satisfactory. Surprisingly metal and ferric cassettes can be set up in the pseudo-chrome position for a flat response using the *BEST* system, and *SA* did set itself up in the ferric position. Nevertheless it does seem advisable to stick to the rule book!

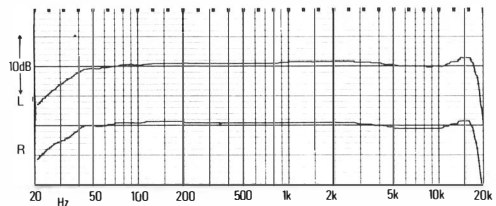
This machine can most certainly be strongly recommended for those who like to try different makes and types of cassette tapes, and the *BEST* system does seem to give reasonable optimisation. However, greater care could have been taken in quality control affecting the pre-set positions (although TDK *SAX* did work extremely well in both preset and *BEST* position). We all liked the ergonomics and the provision of *BEST* very much, and we feel that this is a much better buy than the *KA 8*, which was recommended when it was first reviewed, but which was rather expensive and a bit complicated to use. JVC deserve commendation for the incredibly low wow and flutter figures.

**GENERAL DATA**

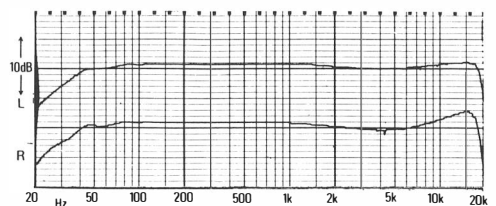
Replay azimuth deviation from average	-87°
Mike input sensitivity/clipping	290µV/47mV
Line input sensitivity/clipping	123mV/>10V
Replay response ferric 63Hz av L/R	-0.9dB
Worst audible replay hum component	-63dB (50Hz)
Replay noise ferric CCIR/ARM weighted (ANRS out)	-61.3dB
ANRS improvement	10.3dB
Replay noise chrome position CCIR/ARM weighted (ANRS out)	-64.8dB
ANRS improvement	10.0dB
Max replay level for DL	670mV
Wow and flutter average (peak weighted DIN)	0.043%
Speed average	-0.2%
Meters under-read	6.5dB on 64ms
Overall 10kHz sat ferric L/R ref DL	-8.3/-8.1dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+7.0/+7.3dB
Overall 10kHz sat chrome position L/R ref DL	-7.0/-7.0dB
Overall distochrome position L/R for 5% dist @ 333Hz ref DL	+6.0/+6.5dB
Overall 10kHz sat metal L/R ref DL	-1.0/-1.5dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+7.0/+6.7dB
Overall noise ferric L/R ANRS out (CCIR/ARM) ref DL	-50.2/-50.4dB
SANRS improvement	10.2dB
Overall noise chrome L/RANRS out (CCIR/ARM) ref DL	-52.7/-53.1dB
ANRS improvement	10.2dB
Overall noise metal L/RANRS out (CCIR/ARM) ref DL	-51.0/-51.7dB
ANRS improvement	10.3dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	77.1dB
Spooling time (C90)	1m 46s
Dynamic range ferric; chrome/metal	66.7 (SANRS); 69.4/69.5dB (ANRS)
Noise reduction system	ANRS/SANRS
Tapes used	TDK OD/TK SA/TK MA-R
Typical retail price	£268



TDK OD SANRS in



TDK SA ANRS in



TDK MA ANRS in

Overall frequency responses (-23dB, Dolby in)

**BEST BUY**

# Nakamichi 480

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow Middx. HA3 7TL.  
Tel 01-863 8624



One of the least expensive of Nakamichi's recently produced decks, the 480 has very basic facilities including only phono line in/out sockets (mike and DIN external adaptors are available as extras). This dual-capstan front-loader is encased in an attractive black metal cabinet, has an attached two-core mains lead, and also includes a remote control socket on the rear panel. The record level controls are separate sideways-acting faders for each channel, and these are placed side by side acting along the same line, which makes stereo fading very difficult. No replay gain control is fitted, and the 1/4" stereo jack provides only just enough volume for high impedance headphones, yet low impedance models could only be described as ridiculously loud. Deck controls are all touch-sensitive microswitch types which were much liked, allowing transfer from play into wind and back again but not dropping into record from play; the pause control stopped and restarted play/record functions. Small square push buttons select memory, MPX filter, Dolby on/off, with the remaining three buttons selecting 70/120µs equalisation and switching for ferric, pseudo-chrome and metal tapes; Maxell or Nakamichi types are recommended by the importers. The two record level meters read slower transients very accurately but fast ones tended to under-read quite a lot; we consider that the metering was better than normal VU-types but not as good as the best peak reading

types, and no supplementary peak reading LEDs were fitted. The basic deck mechanism is very similar to that used on Nakamichi's more expensive models, the hum shield and pressure pad assembly fitted in cassettes being pushed away from the head to improve scrape-flutter characteristics, this being possible because of the excellent tape guide provided.

The line input sensitivity is greater than usual which allows considerable flexibility, and no clipping problem was noted at all. Input noise was exceptionally low, even with volume controls up. The replay head azimuth as set originally showed a surprisingly large phase error at 3kHz, and this was adjusted to be correct in our lab. The record/replay head height was not set very accurately either, and the tape feed guide was slightly too high. Replay hiss levels all measured extremely well indeed, no replay hum was noted subjectively, and the lab measurements were also good. Dolby noise reduction worked well, and the replay amplifier clipping margin was very good. Distortion was much lower than average, and included very good distortion figures within the Dolby de-processing circuitry.

Maxell UD $\bar{X}$ LI penned particularly flat charts, the bass responses actually extending almost flat down to 20Hz, with minimal bass woodles. Subjectively the reproduction was very open and the responses sounded flat, but at times distortion

was very slightly criticised, and we might have expected better from Nakamichi, although the sound quality was still well above average and HF compression characteristics were good for a two head deck. Overall image stability was excellent throughout, and weighted noise measurements were about average because of the extended response; Dolby improvement was virtually ideal.

Maxell UD $\bar{X}$ LII pseudo-chrome did not perform so well, with only average MOLs and HF saturation measurements. But in the listening test, whilst HF compression was noted, overall distortion sounded better than it measured, the double bass recording in particular being better than expected from measurements, possibly due to the even and extended LF response. The pen chart showed that the response was very flat, but just marginally up at HF and not quite as good as the astonishing UD $\bar{X}$ LI charts. Again stereo imaging and stability were superb throughout, and at best the quality was again very like that of the master tape. Overall noise measured very well.

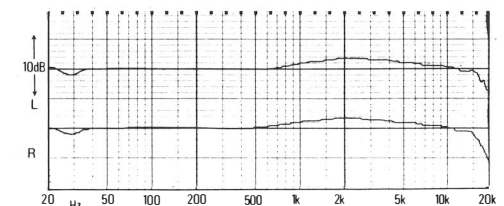
Maxell metal produced some very good 333Hz MOLs and the HF saturation measurements were good for metal. The pen charts were again very good, and the response sounded very flat throughout. The panel praised the reproduction of the entire programme very highly indeed, the word 'superb' occurring many times. The metal tape performance was probably the best reproduction from any two-head deck. Although the background hiss was only average, the astonishing maximum level potential across the board allows a significantly higher than usual recording level, and therefore the dynamic range potential is much better than average.

Wow and flutter was thought to be just barely audible occasionally, and the lab measurement was good rather than the very good it perhaps should have been. Modulation noise was minimal and decidedly better than average, speed was quite accurate, and spooling time was found to be very fast indeed. All torque measurements were found very satisfactory, but erasure on metal tape was only average, though nevertheless adequate.

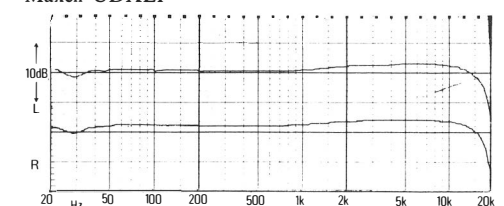
This deck was capable of giving particularly good results for a two head model on Maxell UD $\bar{X}$ LI and MX, but the performance on UD $\bar{X}$ LII was a little disappointing in the lab, though rather better subjectively. The superb tape transport, reliability in operation, and very flat responses are very creditable, so it is only fair to give it a warm recommendation and best buy rating. But before committing oneself it is worth looking closely at the 481, which should offer distinctly better overall performance still, albeit at a significantly higher price. The 481 has three heads to optimise record

and playback performance, but not off-tape monitoring, as found on the still more expensive model 482.

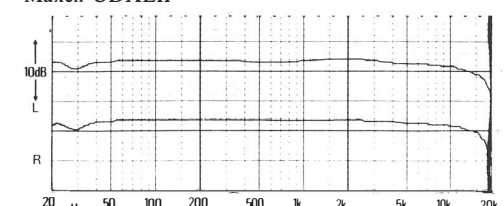
GENERAL DATA	
Replay azimuth deviation from average	+73°
Line input sensitivity/clipping	56mV/>10V
Replay response ferric 63Hz av L/R	-0.5dB
Worst audible replay hum component	-61dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-61.7dB
Dolby improvement	-10.2dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-65.3dB
Dolby improvement	-10.0dB
Replay amp clipping ref DL	+14.3dB
Max replay level for DL	775mV
Wow and flutter average (peak weighted DIN)	0.128%
Speed average	+0.3%
Meters under-read	9dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-5.7/-5.7dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+6.3/+6.3dB
Overall 10kHz sat chrome position L/R ref DL	-7.9/-8.1dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+4.7/+4.5dB
Overall 10kHz sat metal L/R ref DL	-2.3/-2.5dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+9.0/+8.8dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-50.6/-50.6dB
Dolby improvement	-10.6dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-54.8/-55.0dB
Dolby improvement	-10.0dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.4/-52.7dB
Dolby improvement	-9.7dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-86.7dB
Spooling time (C90)	1m 15s
Dynamic range ferric/chrome/metal	67.5/69.0/72.2dB
Noise reduction system	Dolby
Tapes used	Maxell UD $\bar{X}$ LI; Maxell UD $\bar{X}$ LII; Maxell MX
Typical retail price	£220



Maxell UD $\bar{X}$ LI



Maxell UD $\bar{X}$ LII



Maxell MX

Overall frequency responses (-23dB, Dolby in)

BEST BUY

# Nakamichi 582

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow Middx. HA3 7TL.  
Tel 01-863 8624



The 582 is a three-head deck, allowing monitoring and has line in/out phonos in parallel with a five pole DIN, so the latter is completely non-standard, and hopelessly insensitive for inter-connection with DIN sources. No microphone pre-amp is fitted internally, but many accessories are available including microphone and DIN pre-amplifiers. All deck functions use micro switch electronic logic control, allowing transfer from play/record into wind/re-wind and back again; the pause control, when depressed with spooling, also allows cue and review. An additional motor brings the heads up against the tape surface whilst also holding the cassette's pressure pad away from the replay head, thus allowing for good tape/head contact with the superb tape transport mechanism. The stereo ganged rotary record level is complemented with a balance control (both excellent ergonomically), whilst an additional stereo ganged control permits replay level adjustment. Low and high impedance headphones work extremely well, via a 1/4 inch stereo jack, the level being controlled by the replay gain setting. Rotary switches select tape/source, Dolby in/out with MPX switching, RF bias (3 positions for ferric, pseudo-chrome and metal), overall equalisation (120 or 70 uS), 400 Hz/15kHz calibration tones, and timer control with memory. The record level meters (VU type) are basically peak-reading, but under-read slightly. The rear panel includes sockets for remote control and DC output for feeding accessories in addition to the main inputs and outputs.

The line input sensitivity was more than adequate for normal requirements, and the record amp noise was commendably low. The replay azimuth had been mis-set, but after correction overall stability was excellent, user controls allowing record and replay azimuthing as well as head height adjustment. Record cal. pre-sets and bias controls allow separate settings on L and R for the three tape types.

Replay amplifier noise was about average (0.9µ head needs considerable gain.) Slight 50Hz hum was measured on the right track, but was insignificant subjectively. Replay distortion was commendably low, and the clipping margin excellent. (Replay responses were very flat indeed at LF and MF, but a 1dB rise was noted at 10kHz).

The overall responses, after setting up were all very flat indeed with Dolby in or out. (The MPX filter is shown switched in with Dolby on the pen charts opposite, the response still being very flat to 15kHz, above which it is sharply attenuated.) Unusually, the LF responses showed a virtual absence of bass 'woodles', which is commendable. Overall distortion figures were all extremely good, showing them to be virtually completely dependent upon the tape type, and the HF compression characteristics measured far better than usual, allowing optimum performance to be reached on all good tapes.

Maxell UDXL I reproduced our test program with a quality regarded throughout as superb even at higher than normal levels. No 'spitchiness' was

noted on speech, and the quality sounded generally very like that of the master tape, although at normal levels tape hiss was apparent. Overall tape noise measured about average, but Dolby gave a full 10dB improvement. The openness and clarity of the HF end was outstanding.

Maxell UDXL II gave just as good a sound quality, but background noise was 3.25dB quieter, which was again improved in practice by the machine's capability of accepting much higher levels than normal, thus allowing a wider dynamic range to be recorded.

Nakamichi ZX metal tape gave a remarkable overall sound quality, at times almost indistinguishable from the master, but tape noise was about the same as for UDXL II. Responses were again excellent, and distortion levels rather better than UDXL II at middle frequencies and amazing at HF. The program was recorded at +4DB, and distortion was still remarkably low throughout. Maxell MX metal fared even better, allowing a further 2dB recording level, and so the dynamic range was subjectively similar to that of the master, overall results receiving comments of 'superb' and 'indistinguishable from master'. Remarkably, peak recording levels of perhaps 10dB over Dolby level were reached without distress.

Whilst wow and flutter were never noted subjectively, even on piano, the lab measurements were good, rather than very good. No juddering was noted at all. Speed was extremely accurate and spooling was very fast but neat. Erasure and crosstalk were also very good and stereo positioning and HF stability in particular were excellent.

The three micron record head gap must have had a superbly finished trailing edge to permit such high level HF transients to be recorded so faithfully, and no reservations whatsoever on the electronics were noted. The user preset adjustments were easy to use and the built-in MF/EHF oscillator allowed very accurate biasing and responses to be set on any reasonable tape. This deck is clearly in a 'Rolls Royce' class, and results were so good that the machine, quite understandably, is being used in the industry for tape testing. The high price is absolutely justified for a machine which has received such a very strong recommendation for its superb performance and ergonomics.

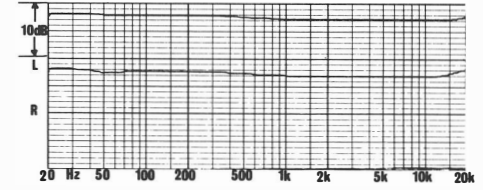
# Nakamichi 582

(revised and reprinted)

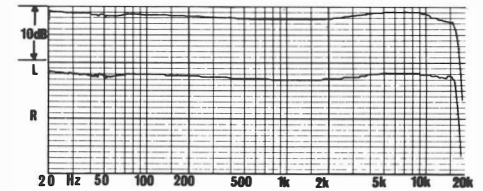
BEST BUY

**GENERAL DATA**

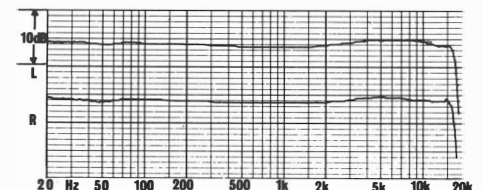
Replay azimuth deviation from average	+75°
Line input sens/clipping	60mV/>10V
Worst audible replay hum component	-68dB (150Hz)
Replay noise CCIR/ARM ferric/chrome/Dolby imp	-56.75/-60.3/10.3dB
Replay amp clipping ref DL	+15.3dB
Max replay level from DL	1.16V
Wow and flutter average (peak wgt DIN)	0.115%
Speed average	0.11%
Meters under-read	-9dB on 8ms
Ferric DL dist 333Hz/5% point	0.38%/+7.3dB
Chrome DL dist 333Hz/5% point	0.82%/+6.7dB
Metal DL dist 333Hz/5% point	0.75%/+8.5dB
Overall 10kHz resp ref 333Hz Dolby out	
ferric/FeCr/chrome/metal	-0.8/-/-0.3/0dB
Overall noise ferric CCIR/ARM/Dolby imp	-48.5/10dB
chrome CCIR/ARM/Dolby imp	-51.8/10dB
metal CCIR/ARM/Dolby imp	-51.5/10dB
Line input noise floor ref 160mV, DL	-79.5dB
Spooling time C90	1m 20s
Dynamic range ferric/FeCr/chrome/metal	65.8/-/68.5/70dB
Tapes used	Maxell UDXL I, Maxell UDXLII, Nakamichi Metal
Typical retail price	£520 when reviewed, now approx £475



Maxell UDXLI



Maxell UDXLII



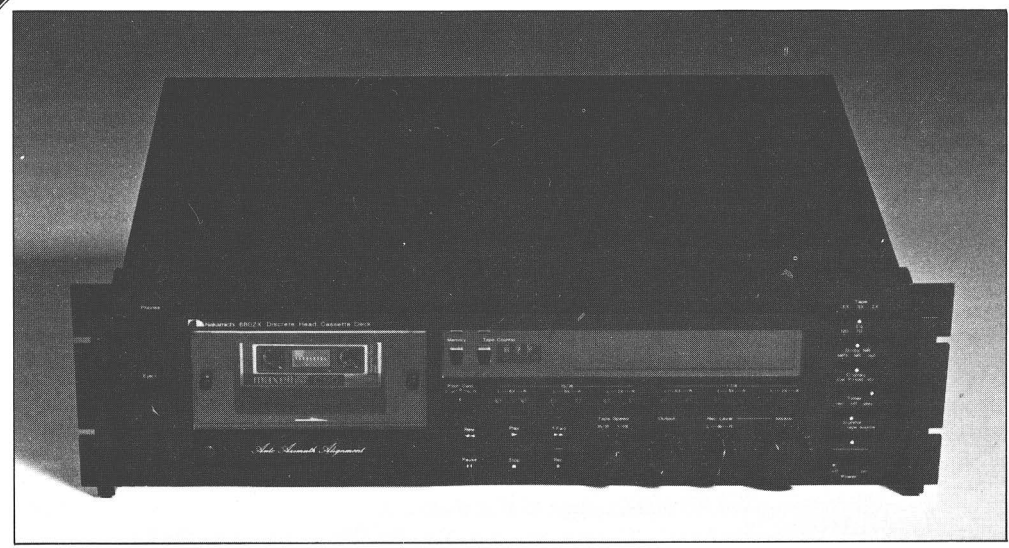
Nakamichi metal

Overall frequency responses (Dolby in, -30dB ref DL)

RECOMMENDED

# Nakamichi 680ZX

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow Middx. HA3 7TL.  
Tel 01-863 8624



The 680ZX is the only deck in the survey which has the extremely useful facility of operating at both normal and half-speed—far more sensible than double speed, as it helps to overcome the basic medium limitation of restricted playing time. This deck is a dual-capstan metal-encased front-loader, with three heads to allow source/tape monitoring. Only phono line in/out sockets are provided, although a special socket on the rear can accommodate Nakamichi accessories, and a remote control socket is also fitted. Deck controls are microswitch operated and allow transfer from play into wind and back again but not dropping into record; the pause control only stops play or record. On the right hand side, slide lever switches select ferric, pseudo-chrome or metal bias, 120/70uS equalisation, Dolby off/on with MPX switchable, VU/peak hold/calibration tone, remote start on play or record, and finally monitor tape/source. A row of twelve presets allow user adjustment of rec/Dolby calibration, for each tape type and speed independently for left and right channels, but the bias presets are awkward to reach since they are inside the machine under the top lid. The memory counter facility can be used to preselect any of eight tracks on a cassette by additional use of the pause control. Record level metering is with two rows of fluorescent LEDs, allowing peak levels including fast transients to be read very accurately. A stereo ganged master record gain control is

complemented by a split concentric rotary for line input adjustment, and a ganged replay control also adjusts headphone levels, a ¼" stereo jack giving adequate volume for low and high impedance models. Finally, a switch selects the alternative tape speeds of 4.8 or 2.4cm/second (1⅞ or 15/16 inches/second).

The phono line inputs had good sensitivity, no clipping problem was noted, and input noise was at a very low level. Replay azimuth was accurately set, as were head and tape guides. Replay hum measurements were satisfactory, but just a slight 150Hz hum was noted on the left channel when replaying loud; replay hiss measurements were all average. The replay amplifier clipping margin and distortion measurements were excellent, and the available output level is slightly higher than usual. Replay amplifier distortion at +6dB measured very well indeed, and replay response seemed excellent using the probe test, the fine replay head gap of around 0.6 microns not really needing any head compensation at all within the audio spectrum.

Maxell UDXLI gave a very smooth overall chart, but some samples tended to show a slight valley at 10kHz. 333Hz MOLs and HF saturation measured amazingly well, and the listening panel found that the overall sound quality was excellent, with particularly good stereo positioning. At half-speed results were still good, although HF com-

pression was rather marked, but if the recording level was reduced, the sound was at least as good as at normal speed on many other decks. Distortion measurements at half speed were equivalent to those of a budget tape at normal speed. Overall weighted noise was marginally worse than average because of the extended responses at normal speed.

Maxell UDXLII at the normal 4.8cm/second again gave reasonably smooth pen charts, and a very good sound quality, with 333Hz MOLs and HF saturation measuring well. There was more of a tendency to a valley at 10kHz on some tape samples, however, and the reproduction was sometimes very slightly muffled. This showed that it would have been helpful if Nakamichi had fitted bias presets to the front panel for user-adjustment, as these are possibly more important than the Dolby record calibration presets thus provided. Overall weighted noise measurements were average. At half-speed the response was curtailed above 10kHz unless bias was reduced, but again the quality was very good, with equalisation at 120uS, although again record levels had to be kept low to avoid HF compression.

Maxell metal at 4.8cm/second performed superbly well throughout. At half-speed results were astonishing, giving a reproduction thought to be better than many medium quality ferrics at normal speed.

Most certainly, the results throughout at half-speed are extremely encouraging, and prove the total viability of a speed which has the advantage of accommodating a complete Mahler symphony on each track of a cassette. Dropout characteristics and stereo positioning received favourable comment throughout, even at half-speed, but we did find it necessary for optimum results to recalibrate azimuth before commencing a half-speed recording.

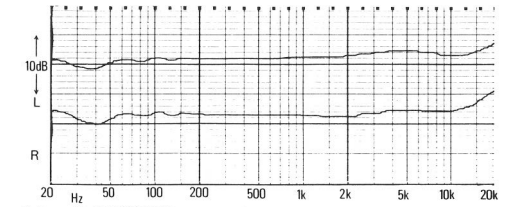
The wow and flutter measurements at normal speed were very good, and none was noted on the programme material; even at half-speed wow and flutter actually measured better than at normal speed on some decks. A speed control allows ±6% from nominal on playback only, the centre indented position being very marginally slow at both speeds (averaging around -0.35%). Spooling was very fast but very neat, no torque problems were noted, and erase was very good.

This really is a marvellous machine, and is obviously suited to the person who does not like to fiddle around with a variety of different tape types, but who values instead the half speed facility. We all liked the ergonomics very much, the metering was excellent and the tape handling superb. It definitely deserves a warm recommendation, but note that the Nakamichi 582 has more facilities

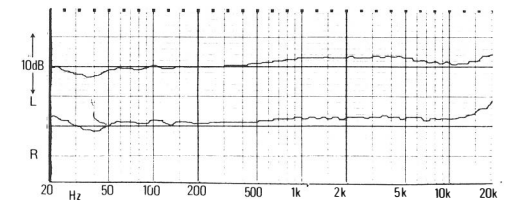
and is perhaps the better buy; though lacking the second speed, in other respects it is a more flexible machine.

### GENERAL DATA

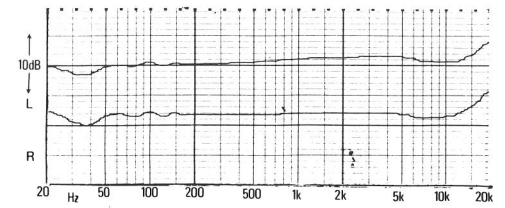
Replay azimuth deviation from average	..... +16°
Line input sensitivity/clipping	..... 66mV/>10V
Replay response ferric 63Hz av L/R	..... -0.1 dB
Worst audible replay hum component	..... -63dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	..... -58.1 dB
Dolby improvement	..... 10.3 dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	..... -61.5 dB
Dolby improvement	..... 10.1 dB
Replay amp clipping ref DL	..... +15 dB
Max replay level for DL	..... 1.08V
Wow and flutter average (peak weighted DIN)	..... 1%:0.1%, 1/16:0.15%
Speed average	..... 1%:-0.4%, 1/16:-0.35%
Meters under-read	..... 2dB on 8ms
Overall 10kHz sat ferric L/R ref DL	..... -1.5/-1.7 dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	..... +6.9/+6.6 dB
Overall 10kHz sat chrome position L/R ref DL	..... -2.4/-2.7 dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	..... +4.5/+3.7 dB
Overall 10kHz sat metal L/R ref DL	..... +1.7/+1.4 dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	..... +9.0/+8.6 dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	..... -48.6/-49.3 dB
Dolby improvement	..... 10.1 dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	..... -52.7/-53.3 dB
Dolby improvement	..... 9.9 dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	..... -51.8/-51.9 dB
Dolby improvement	..... 10.2 dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	..... -79.1 dB
Spooling time (C90)	..... 1m 19s
Dynamic range ferric/chrome/metal	..... 67.9/68.5/72.9 dB
Noise reduction system	..... Dolby
Tapes used	..... Maxell UDXLI; Maxell UDXLII; Maxell MX
Typical retail price	..... £585



Maxell UDXLII



Maxell UDXLI



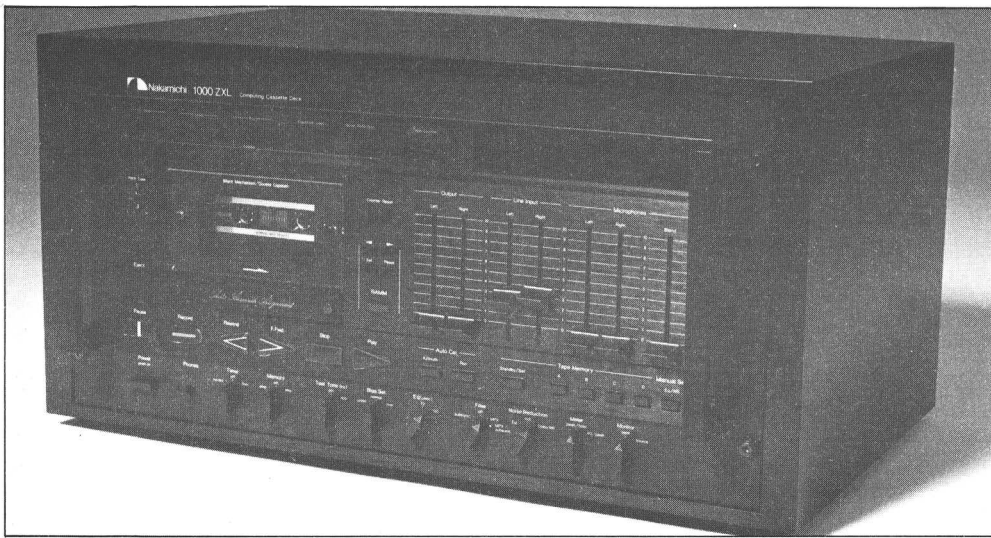
Maxell MX

Overall frequency responses (-23dB, Dolby in)

**RECOMMENDED**

# Nakamichi 1000ZXL

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow Middx. HA3 7TL.  
Tel 01-863 8624



This is the most incredible cassette deck we have ever checked, and it contains just about every facility that one could possibly require, which is hardly surprising at its unbelievable price! It is housed in a beautifully finished (very large) rosewood case, and is basically a dual-capstan front-loader. It has microprocessor control of all the normal cassette deck functions, but does not permit dropping into record from play. Cueing is possible during wind when pause is depressed. A microprocessor memory allows fifteen locations to be selected, and playback of up to 30 commands of various tracks in any order. It is of course a three-head deck with source/tape monitoring, but also has the most superb automatic tape alignment facility, which even includes auto-azimuthing, four stores retaining parameters when required (battery back up is provided). On the back panel are phono line in/out sockets, and eight phono sockets for interconnection with any external noise reduction systems. A captive mains lead is complemented by an earth terminal, and remote control sockets are fitted for both mechanical and tape location memories, for interconnection with computerised programming equipment. Very silky-acting slide faders adjust L/R line in and mike inputs (a third centre-injection mike channel is also provided with a mono fader). Similar replay gain sliders also adjust headphone levels, plenty of volume being

available for all normal types. Many push buttons select all deck, memory and other auto functions, whilst rotary pointer switches provide remote timer start, normal memory functions, test tone on/off, three positions of bias (allowing optimisation for MF, HF or best overall performance), 70/120 $\mu$ S equalisation, a selection of subsonic and MPX filtering positions, external NR or Dolby on/off, metering peak hold or peak etc., and tape/source monitoring. The metering is superb, two rows of fluorescent LEDs showing not only peaks with switchable hold, but VU levels at the same time; these were capable of indicating transients very accurately. The auto-equalisation provision allowed the optimisation of virtually any tape type tried on the deck, with amazing results, even poor tapes usually giving an acceptable overall performance, while good ones were truly exceptional. The 1/4" jack socket mike inputs had reasonable sensitivity, and an amazing overload margin. Line input sensitivity was very adequate and no clipping problem was encountered.

The replay azimuth was surprisingly inaccurate, but is easy to standardise. Head guide heights were satisfactory, but the replay head height was wrong. No hum problems were noted, and all replay hiss measurements were good. Up to 1 Volt output was available for Dolby level and the replay amp clipping margin and distortion measurements were

excellent. The replay response probe tests showed an almost perfect response throughout.

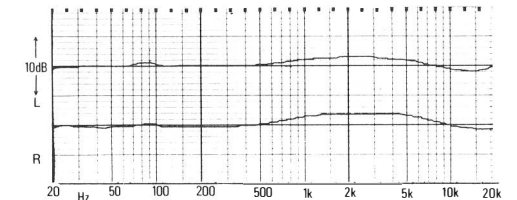
Maxell *XLIS* produced excellent MOLs and a superb HF saturation performance, and frequency responses were also very flat from 20Hz to 22kHz with only marginal deviations occurring with Dolby. The panel thought the quality throughout was absolutely superb, with no criticism whatsoever, the *XLIS* sound being decidedly better than metal tapes used on most decks. Overall basic noise was average, but the dynamic range fantastic, since extremely high levels could be achieved.

Maxell *XLIS*, whilst again giving superb overall results, was actually no better in the lab, noise being quieter but MOLs lower than with *XLIS*. Thus with the recording level slightly reduced, the panel found the quality virtually identical (note the incredible pen charts).

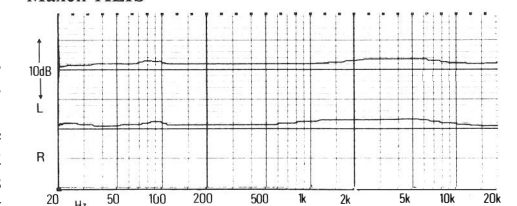
I have already used 'superb' to describe performance on ferric, but Maxell *metal* was even better, achieving +11.9dB over DL at 333Hz, and yet almost DL at 10kHz for saturation. This allowed incredible dynamic ranges to be reached, and even digital master tapes copied through this deck sounded little different on replay unless we A/B switched continuously. Basic noise, however, was average, but with a good Dolby improvement. Stereo positioning throughout was beyond reproach, as was tape stability. The wow and flutter measurements, too, were extremely good, and wow could barely be detected even when comparing with the digital master on piano. Speed was very accurate with the speed control on its centre position (allows  $\pm 6.5\%$  deviation). Spooling was very fast, but not even the slightest damage ever occurred. All torque measurements were excellent, and erasure very good throughout.

I feel I have run out of superlatives for perhaps the first time ever in this review, for there was virtually nothing at all wrong anywhere with this deck, a superb scientific instrument, which produces the finest possible results with the cassette medium. It may well contain some facilities that you would hardly ever use, but it is still tremendous fun having them! Obviously, this machine cannot be recommended as a best buy at around £1,275, but it receives the strongest recommendation that I could possibly give a deck. If you can afford it, you will not be other than delighted with its magnificent sound quality, which at best is almost as good as the better semi-professional reel-to-reel decks using excellent tapes at 19cm/S. Perhaps it is remarkable enough that we actually obtained some very good overall quality from cheap, but good, budget cassette tapes, including TDK *D*, Maxell *UL*, while even Scotch ferric fared well after auto-azimuthing etc.

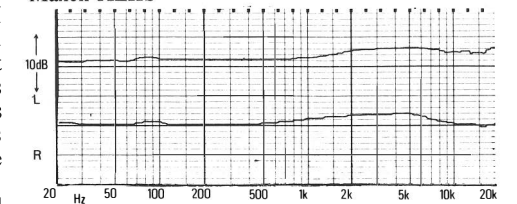
GENERAL DATA	
Replay azimuth deviation from average	+69°
Mike input sensitivity/clipping	193 $\mu$ V/2.4V
Line input sensitivity/clipping	70.8mV/>10V
Replay response ferric 63Hz av L/R	+0.4dB
Worst audible replay hum component	-66dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-58.2dB
Dolby improvement	-10.3dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-61.8dB
Dolby improvement	-10.0dB
Replay amp clipping ref DL	>+16.5dB
Max replay level for DL	1.05V
Wow and flutter average (peak weighted DIN)	0.067%
Speed average	+0.3%
Meters under-read	2.5dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-1.4/-1.6dB
Overall distortion ferric L/R for 5% dist @ 333 Hz ref DL	+7.6/+8.1dB
Overall 10kHz sat chrome position L/R ref DL	-5.8/-4.2dB
Overall dist chrome position L/R for 5% dist @ 333 Hz ref DL	+5.6/+5.9dB
Overall 10kHz sat metal L/R ref DL	-2.1/-1.0dB
Overall distortion metal L/R for 5% dist @ 333 Hz ref DL	+11.1/+11.0dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-50.0/-49.9dB
Dolby improvement	-10.2dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-52.2/-52.1dB
Dolby improvement	-10.1dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-51.5/-51.3dB
Dolby improvement	-10.2dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-81.3dB
Spooling time (C90)	1 m 12s
Dynamic range ferric/chrome/metal	70.1/68.6/73.7dB
Noise reduction system	Dolby
Tapes used	Maxell <i>XLIS</i> ; Maxell <i>XLIS</i> ; Maxell <i>MX</i>
Typical retail price	£1,275



Maxell *XLIS*



Maxell *XLIIS*



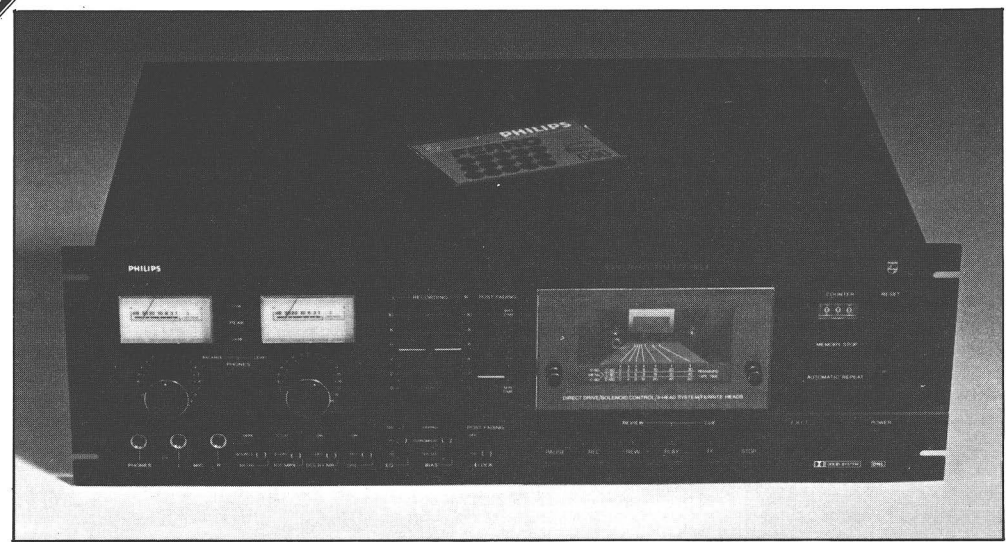
Maxell *MX*

Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

# Philips N5748

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



This three-head, front-loading deck is the most comprehensive that Philips have yet released, and it incorporates some advanced features including direct capstan drive. On the rear panel of the large metal case are mounted recessed phono line in/out sockets, having preset level controls, plus two 5-pole DIN for normal DIN interconnection (the second socket providing off-tape monitoring) and a remote control socket of the DIN type is also provided. The record level controls are two adjacent vertical faders which have a very smooth action; a third fader in conjunction with a spring-loaded switch operates 'post fading', which allows gradual increase of erasure to a section of a previous recording. Switches select tape/source monitoring (the tape position only active on record), MPX filter, Dolby on/off, DNL, and three positions of bias and equalisation separately for ferric, chrome and metal tapes. Small push buttons select counter reset and memory counter for stop or automatic repeat. Deck functions are microswitch solenoid-operating types, allowing transfer from play into wind and back again, but not dropping into record; the pause control stops and does not restart record/play, and the eject mechanism is fairly slow. Independent headphone level and balance rotary controls provide an extremely high volume into headphones (1/4" stereo jack), with a good clipping margin. The two record level meters under-read transients quite a lot, and

also incorporated an HF lift which I do not like, but happily they were supplemented by peak reading LEDs operating at two levels, which read even fast transients very accurately. The first sample supplied had the record head wired out of phase, but the second one was satisfactory.

The 1/4" mono jack mike inputs were reasonably sensitive, and the clipping margin excellent, which is unusual. The 5-pole DIN input had almost no noise degradation and worked well, the replay pins being muted during recording, and a separate DIN socket allowing off-tape monitoring. The line inputs were very sensitive indeed, but unfortunately clipped at 2.54 volts, which might be slightly awkward. Input noise was rather worse than usual and is only just adequate. The deck is claimed to have cueing and reviewing functions, but while this was provided in a mechanical sense, the replay outputs were muted, rendering the facility more or less useless.

Replay azimuth was badly set, a phase shift of about 90° being noted at 3kHz, but head and guide heights were accurate. Replay hum measurements were amazingly good, and replay hiss measurements were also superbly good throughout. The replay amplifier clipping margin was very poor at only around 7dB over Dolby level (Philips please note) and the replay amplifier distortion at +6dB was also very poor.

Philips *Ferro* produced some very good overall

sound quality considering its price, and the pen charts were surprisingly flat. Overall MOL and HF saturation measurements were better here than they were on many other decks using better tapes. The sound quality throughout was excellent provided the record level was reduced slightly, and was at least average at a normal recording level. Overall weighted noise measurements were slightly better than average.

Philips *Chrome* was used at a 2dB lower recording level than usual. The sound quality was rather bright overall, and since no significant Dolby error was noted, pseudo-chrome tape types would require a record Dolby cal. preset internal adjustment. At the lower level, the entire programme reproduced very well, but distortion was becoming audible on extreme climaxes. 333Hz MOLs and HF saturation measurements were actually quite good, and better than some pseudo-chromes on some decks. Even allowing for the lower recording level capability, dynamic range is still considered good throughout, with a good Dolby improvement.

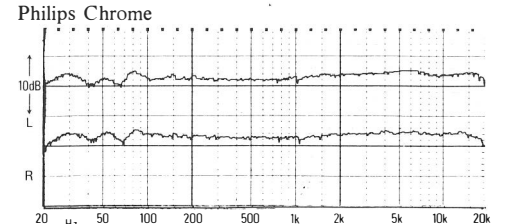
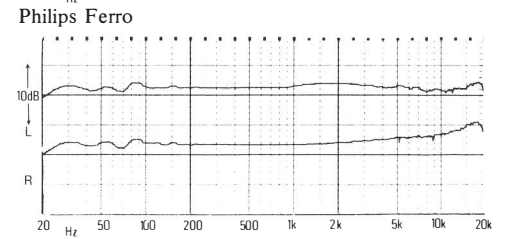
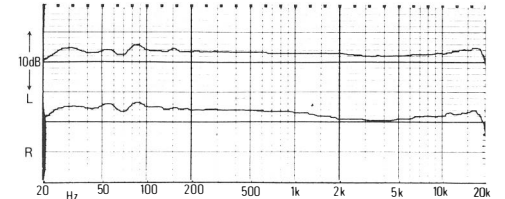
On Philips *Metal* tape, MOL and HF saturation measurements were actually very good for the tape type, but stability was really rather bad, with long dropouts and some level jolting noted. The response pen charts show some head/tape contact problems, and the sound was generally thought bright by the panel. Overall distortion seemed very good indeed to the panel, up to the point when replay clipping occurred; above this, distortion was all too evident, and it is quite clear that tape potential is rather better than that provided by the replay amplifier clipping margin.

Wow and flutter measured very well indeed and almost none was heard on the programme. Speed was extremely accurate and spooling time average. Play torque was fairly low, wind on torque a little high, and at the end of spooling the hold torque before auto-switch-off was excessively high. Erasure was only just adequate on metal tape.

The machine has some excellent points in its overall performance, the audible sound quality being very good indeed, particularly on modest ferric tapes. However, I really cannot forgive the very poor replay amp clipping margin, which means that tapes recorded at a high level on this (or other decks), will be noticeably degraded on replay. The price seems quite reasonable for the facilities offered, so this machine might have been heading for a best buy, but receives only a recommendation with caution.

**GENERAL DATA**

Replay azimuth deviation from average	.....	-102°
Mike input sensitivity/clipping	.....	219µV/82.7mV
Line input sensitivity/clipping	.....	24.2mV/2.4V
Replay response ferric 63Hz av L/R	.....	-0.6dB
Worst audible replay hum component	.....	-67dB (100Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	.....	-62.1dB
Dolby improvement	.....	10.5dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	.....	-65.4dB
Dolby improvement	.....	9.9dB
Replay amp clipping ref DL	.....	7.9dB
Max replay level for DL	.....	1.09V
Wow and flutter average (peak weighted DIN)	.....	0.098%
Speed average	.....	+0.2%
Meters under-read	.....	6dB on 64ms
Overall 10kHz sat ferric L/R ref DL	.....	-6.6/-6.2dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	.....	+5.4/+5.6dB
Overall 10kHz sat chrome position L/R ref DL	.....	-5.6/-5.5dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	.....	+4.3/+4.8dB
Overall 10kHz sat metal L/R ref DL	.....	-1.2/-2.1dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	.....	+7.6/+7.7dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	.....	-50.9/-50.6dB
Dolby improvement	.....	10.3dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	.....	-56.1/-55.3dB
Dolby improvement	.....	10.0dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	.....	-53.3/-53.3dB
Dolby improvement	.....	10.0dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	.....	-68.9dB
Spooling time (C90)	.....	1m 58s
Dynamic range ferric/chrome/metal	.....	66.6/70.2/72.0dB
Noise reduction system	.....	Dolby and DNL
Tapes used	.....	Philips Ferro; Philips Chrome; Philips Metal
Typical retail price	.....	£250

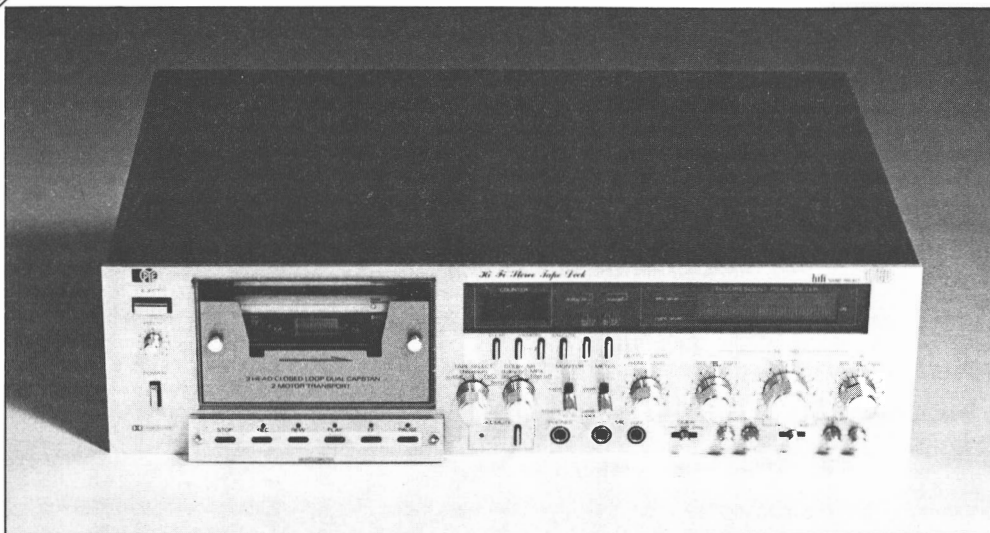


Philips Metal  
Overall frequency responses (-23dB, Dolby in)

**BEST BUY**

# Pye SR 3780

Pye Ltd., 137 Ditton Walk, Cambridge. Tel (02205) 2781



This is a reasonably priced three-head dual-capstan deck housed in a metal cabinet, with microswitch solenoid-operated logic controls for deck functions and extensive remote Play/Record and memory counter facilities. No 5-pole DIN socket is provided, and line in/out phono sockets are on the rear panel with an RIF filter (used for AM radio recording). Deck functions allow transfer from play into wind and back again, the pause control stopping and restarting with a loud, shaking 'clunk'. A pitch control is provided for replay only, varying speed by around  $\pm 11\%$ ; the centre indented position provided was actually 1.5% fast. The tape counter is electronic, which is rather welcome. Two memories are provided, additional buttons controlling auto-rewind and auto-play functions with the memory counter and record mute. Rotary switches select ferric, ferrichrome, chrome or metal tapes, and Dolby off/on with or without MPX filtering. Key switches operate source/tape monitoring and metering (peak or peak hold), and small and extremely inconveniently situated presets are provided for independent adjustment of record Dolby cal. and bias levels (centre indented). Further switches select remote play or record functions and an internal tone oscillator at 400Hz or 14kHz for user calibration. A stereo ganged rotary master record level control is accompanied by split concentric

mike and line input level controls, which are so tightly friction-locked as to be almost impossible to vary independently. The stereo ganged replay gain control also operates on the 1/4" stereo jack headphone output, providing adequate volume into high or low impedance models. Two rows of 36 LEDs give twelve different record metering levels, and peaks were generally read very accurately. The Dolby/MPX knob was incorrectly fitted as delivered.

The mike inputs are 1/4" jack sockets as usual, and had only average sensitivity with a barely adequate clipping margin. The line inputs had average sensitivity, and no clipping problem was noted if the master gain was used in a sensible position. Input noise did not measure too well, although it was adequate.

Replay azimuth was extremely accurately set and head heights and guides were very accurately set throughout. No replay hum problems at all were noted, and the measurements were excellent; replay weighted noise was also excellent, with a good Dolby improvement. The replay amplifier clipping margin was again excellent (the parent company Philips should note this), and replay amplifier distortion measurements were satisfactory.

Philips *super ferro* was specified for the ferric position; 333Hz MOL and HF saturation measure-

the Dolby circuitry).

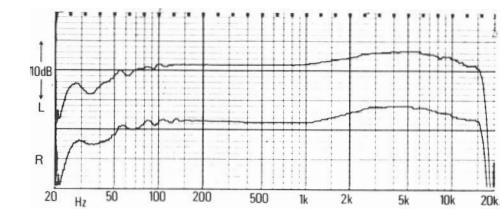
Sony *CD Alpha* pseudo-chrome was frankly a little disappointing, since MOLs were not as high as they should have been and yet HF compression was also mildly criticised at times. This might well have been partly due to the rather muffled HF quality, the pen charts confirming the average 10kHz responses being down by nearly 2dB. This is surprising since we considered the tape to be under-biased, so it is clearly under-equalised on record. Overall weighted noise measured well with a very good Dolby improvement. The sound quality was distinctly better at lower levels.

Sony *metal* gave rather average 333Hz MOLs for a two-head deck, but the HF saturation performance was excellent. Although the overall Dolby calibration was very precise, I suspect that there must have been some bias breakthrough into the Dolby record circuitry, since a pronounced response valley can be seen in the presence region, the panel finding the overall responses on several different metal tape types generally a little muffled. We thought the distortion characteristics were quite reasonable throughout, but because we all expected better from the response, the quality received some criticism. Overall noise measured and sounded at quite a low level, and stereo positioning was found very good throughout all the tests.

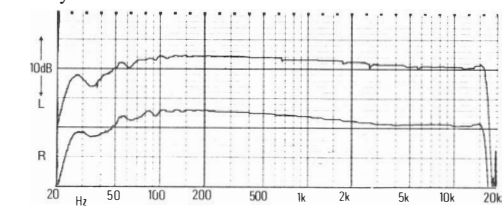
The wow and flutter measurement was only adequate, although in the subjective tests wow only received mild criticism on piano and organ, and if you are not too susceptible to its effects, you should not be too concerned. Speed was only marginally fast and spooling time about average. Play/record torque was just slightly on the low side, but other torque measurements were satisfactory. Erasure, even on metal tape, was very good.

This budget deck has many good points about it, with very low input noise and good clipping margins (other than on the mike input), plus a very acceptable quality at best. Considering its price, it is only fair to recommend it as just within the best buy category, although amongst lower price models one does find slightly greater variation between samples than in expensive machines. If Sony had paid closer attention to alignment, this could have been a firmer best buy, and this deck most certainly shows general improvements at the budget end compared with earlier models.

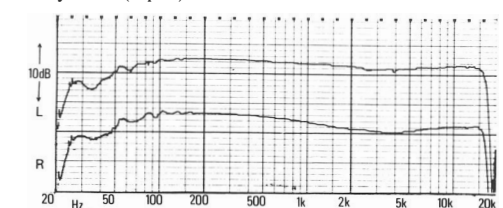
GENERAL DATA	
Replay azimuth deviation from average	-57°
Mike input sensitivity/clipping	242µV/20.2mV
Line input sensitivity/clipping	82.3mV/>10V
Worst audible replay hum component	-0.6dB
Replay response ferric 63Hz av L/R	-57dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-58.5dB
Dolby improvement	10.2dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-62.1dB
Dolby improvement	9.6dB
Replay amp clipping ref DL	+15.3dB
Max replay level for DL	.660mV
Wow and flutter average (peak weighted DIN)	+0.158%
Speed average	+0.6%
Meters under-read	0dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-8.5/-8.2dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+7.6/+7.7dB
Overall 10kHz sat chrome position L/R ref DL	-6.8/-7.2dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+4.9/+5.1dB
Overall 10kHz sat metal L/R ref DL	0/-0.2dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+5.8/+5.6dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.7/-49.9dB
Dolby improvement	10.4dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-53.4/-53.3dB
Dolby improvement	10.3dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.6/-52.6dB
Dolby improvement	10.4dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-82.0dB
Spooling time (C90)	2m 01 s
Dynamic range ferric/chrome/metal	66.9/68.6/69.7dB
Noise reduction system	Dolby
Tapes used	Sony AHF; Sony CDa; Sony Metallic
Typical retail price	£95



Sony AHF



Sony CDa (alpha)



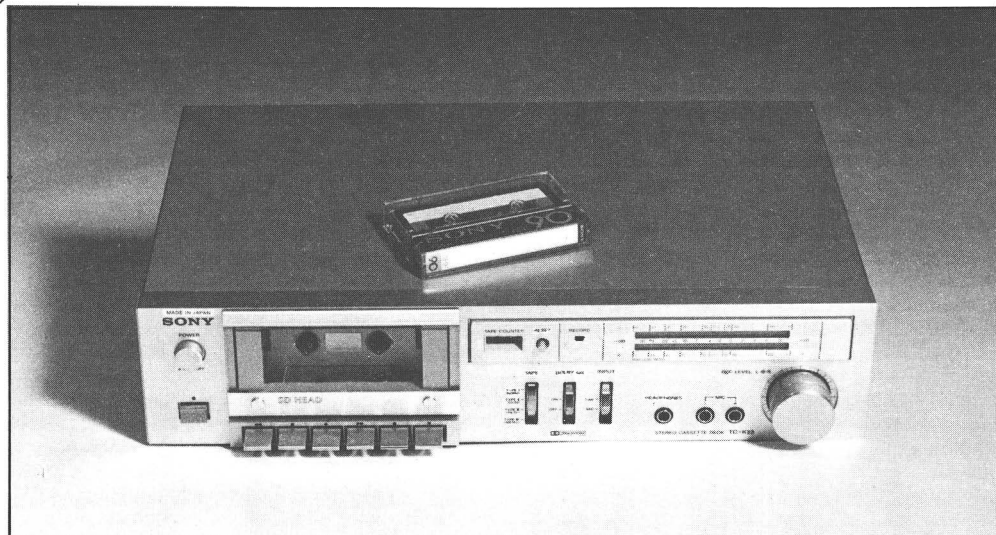
Sony Metal

Overall frequency responses (-23dB, Dolby in)

**BEST BUY**

# Sony TCK 33

Sony UK Ltd., 134 Regent Street, London W1. Tel 01-439 3874



This inexpensive new Sony slimline front-loader has both a captive two-core mains lead and twin one metre line in and out leads fitted with phono plugs; the mains lead itself was fairly short but an extension was actually supplied which could be useful. Deck functions are operated by stiffer than usual piano keys, allowing transfer from play into wind and back, and also dropping into record, the pause control stopping and restarting play/record functions. Front panel switches select ferric, pseudo-chrome, ferrichrome and metal tapes (sensibly also labelled I, II, III, & IV, to the new IEC recommendations), Dolby on/off, and line input/mike select, MPX filtering being permanently in circuit. A rotary friction-locked split concentric record level control was easy to use, but no replay gain control was provided. A stereo ¼" jack socket provides insufficient volume for higher impedance headphones, but low impedance models were about right and had an adequate clipping margin. Twelve LEDs per channel are provided for metering, but the first one is always on. These meters read even the shortest transients incredibly accurately, and must be strongly commended for this.

The ¼" mono jack mike inputs had reasonable sensitivity, but the clipping margin, although acceptable, was not too good, and you must not put higher impedance mikes too close to sound sources.

The line inputs were slightly more sensitive than average, no clipping problem was experienced, and I must particularly commend the superb low noise input circuitry here, which shows a very significant improvement for Sony. Replay azimuth was not too well set, the main head height was slightly in error, and the tape guides were also slightly low.

A slight breakthrough of 150Hz hum was noted on both left and right replay, and this was confirmed in the lab. Replay amplifier hiss levels were good throughout and showed the correct Dolby improvement, while replay amplifier clipping and distortion performances both measured extremely well.

Sony *AHF* was chosen for the ferric position, but we did note a slight positive Dolby calibration error, although the pen charts were reasonably flat and the responses actually sounded flat to the panel. The 333Hz MOLs were very high, but HF saturation was poorer than we might have expected. However, the panel did not find it too marked and indeed commented frequently that the sound quality was very robust and much liked, while HF compression on brass etc. received only mild criticism. The quality at best received some praise, and was thought pleasingly good for a budget machine, but overall weighted noise measurements were only average and slight 'fuffing' was noted on piano (Sony apparently use their own version of

ments were good, and the overall sound quality received moderate praise from the panel provided the record level was watched carefully, distortion creeping in a bit at high levels. The response sounded very flat indeed when bias was increased slightly. When rec/cal was adjusted according to the instructions, a typical positive Dolby error 'hump' could be seen in pen charts which were otherwise good. A slight downwards drift in bias with time was noted, causing an increase in HF level after a while. Overall weighted noise measurements were very consistent and average.

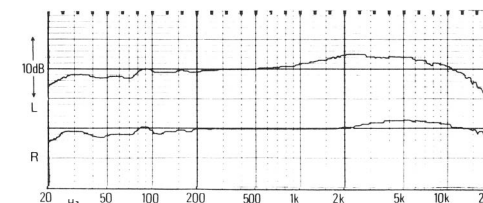
Philips normal chrome tape gave just adequate 333Hz MOLs and HF saturation performances, but weighted overall noise was extremely low so that lowish recording levels are quite viable. Distortion became very apparent at normal recording levels, but when these were reduced the sound quality was very clean throughout, and the responses seemed very smooth. The pen charts showed a tendency to some bass lift with some bass woodles, and a shelf down in responses in the MF and presence regions.

Pye recommended TDK *metal* rather than Philips, and the 333Hz MOLs and HF saturation were quite good. Setting up according to instructions, the overall sound showed considerable brightness, although the sound quality was actually quite liked; distortion was generally less than usual, and the sound at best seemed fairly like that of the master tape. Overall noise measurements were good, and tape stability and stereo positioning throughout were very good with no critical comments being made. The wow and flutter measurements were amazingly good, and not once did the panel notice any even on piano. Spooling speed was grotesquely slow sometimes and also was strangely variable; at worst considerable shaking and rolling noises emanated from the machine. Play torque was normal, but winding torque varied somewhat inconsistently. Erasure was very good throughout.

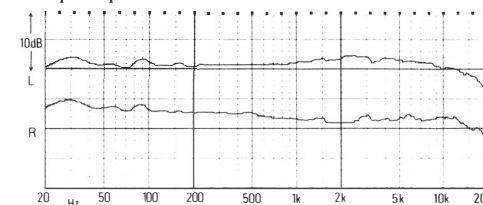
I suppose for political reasons, Pye just had to recommend Philips cassettes for ferric and chrome positions, but sensibly gave up this loyalty for metal! Since you can adjust the deck for much better tapes, it can at least give a very good performance throughout with extremely low wow, which is commendable. However, some of the ergonomics were irritating (too many different types of switches etc). Some very good overall sound quality could be obtained, particularly on better tape types than those recommended, and the package gives quite a lot of facilities for the price, the off-tape monitoring, remote control, and excellent counter functions being very useful. The very low wow and good input and output

performance is a plus point, and so this model really must be classed as a best buy at its very reasonable price, but it must be stated that one will either love or hate the ergonomics!

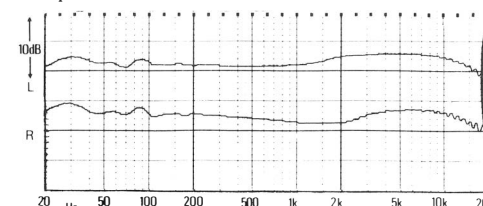
GENERAL DATA	
Replay azimuth deviation from average	-5°
Mike input sensitivity/clipping	301µV/23.5mV
Line input sensitivity/clipping	78.5mV/>10V
Replay noise ferric 63Hz av L/R	-1.1dB
Replay noise ferric CCIR/ARM weighted (Dolby out)	61.3dB
Dolby improvement	10.1dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-65.2dB
Dolby improvement	9.9dB
Replay amp clipping ref DL	+13.8dB
Max replay level for DL	1.16V
Wow and flutter average (peak weighted DIN)	0.061%
Speed average	+1.5%
Meters under-read	4dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-7.4/-6.7dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+5.9/+5.9dB
Overall 10kHz sat chrome position L/R ref DL	-7.3/-6.8dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+4.2/+4.3dB
Overall 10kHz sat metal L/R ref DL	-1.5/-1.0dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+6.3/+7.3dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.9/-49.9dB
Dolby improvement	10.0dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-56.4/-56.6dB
Dolby improvement	9.7dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.2/-52.5dB
Dolby improvement	10.0dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-68.5dB
Dynamic range ferric/chrome/metal	65.8/70.4/70.1dB
Noise reduction system	Dolby
Tapes used	Philips Super Ferric; Philips Chrome; TDK MA
Typical retail price	£229



Philips Superferro



Philips Chrome



TDK MA

Overall frequency responses (-23dB, Dolby in)



RECOMMENDED

# Sony TCK81

Sony UK Ltd., 134 Regent Street, London W1. Tel 01-439 3874



Whilst the *TC K81* has virtually identical micro-switch operated deck functions as the *TC K61* (see also *K61* review), this is a three-head deck allowing off-tape monitoring, and also has Dolby calibration with level and record bias presets, which allow many different tape types to be accommodated. Four positions of equalisation and bias on separate switches allow excellent flexibility. Additional slide switches operate Dolby on/off with or without MPX filter and remote start facilities; memory functions are the same as those fitted to the *TC K61*. The replay gain 5-position switched attenuator also governs headphone levels, a 1/4" stereo jack providing ample volume for all types. A small vertical key switch selects source/tape, and a three position rotary selects calibration of bias and rec. cal. The bias control is on a ganged rotary with a centre indent; rec. cal. is on two separate pre-sets for L and R channels. A large friction-locked rotary control is provided for record level setting, metering being accomplished by two rows of 16 LEDs, reading transients virtually perfectly which is most commendable. A single pair of phono inputs are provided on the rear, but separate fixed and variable line output phonos are fitted, which may be found useful. The appearance and ergonomics are both very good indeed throughout, and we very much liked using this machine. A Sony remote control socket is mounted on the front panel.

1/4" mono jack microphone sockets had barely adequate sensitivity, and the clipping margin was just adequate. The line inputs had just average sensitivity with no clipping problem, and input noise was quite low.

Replay azimuth was fairly accurately set and whilst our jig showed all of the tape guides were correctly set, the replay head height was marginally in error. Replay amplifier hum measured adequately, and no hum was actually noted subjectively. Replay hiss measurements were all very good, though the Dolby improvement was only just within reasonable tolerances. The replay amplifier clipping margin was excellent, and the distortion measurements good. The replay amplifier responses all seemed about 1dB down from the presence region upwards.

Sony AHF ferric gave an extremely good overall sound quality but only up to fairly loud levels, the MOL and HF saturation performance not being quite as good as it should have been, and must be considered only reasonable for a three-head deck. When we tried Maxell *XLIS* it was generally slightly better, but bias had to be lifted for a flat response, and HF compression was still noted. It seems that too much record equalisation is built in, thus requiring too high a bias to offset it, and the HF saturation performance is also compromised a little by the replay response error. Overall noise was better than average, although the

Dolby improvement was slightly less than average, with slight 'fuffing' being noted on piano. Responses seemed slightly down at HF when aligned using the internal procedure, as the pen charts confirm.

*CD Alpha* pseudo-chrome gave quite a flat overall response subjectively, but the lab charts again showed a slight fall at HF. The overall sound quality at best was well liked, the Ravel sounding very much like the master tape, but HF was criticised occasionally, and the lab measurements confirm this is the Achilles heel. Overall weighted noise measurements were quite reasonable throughout.

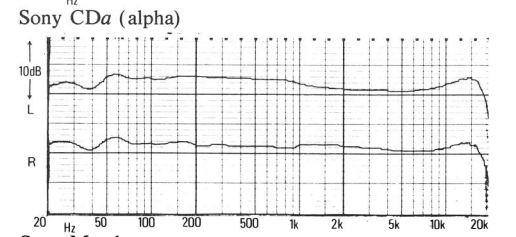
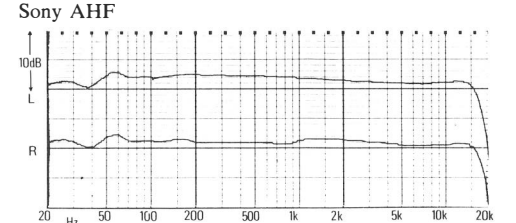
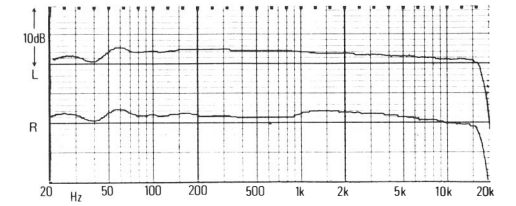
Sony *metal* gave very good measurements overall with good MOLs and HF saturation figures. But whilst the subjective quality was very good at its best, there was something in the sound quality that received occasional criticism that we could not pin down; comments of occasional 'fizziness' and traces of MF 'forwardness' were noted. Overall noise measurements were good. It would seem that the internal calibrations for user-operation were not quite correct, leading to user-maladjustment, because performance always seemed better if we adjusted it using external metering (or indeed by ear!)

Wow and flutter measured very well in the lab, and none was heard in the subjective tests. Speed was amazingly accurate and spooling time was average. All torque measurements were normal and erasure was excellent even on metal.

Although this machine is fairly expensive, it has some excellent facilities. I am a little concerned that perhaps the review sample's combination record and playback head assembly is not quite as good as it should have been, and I have a hunch that the majority of samples will actually be very good, for the quality at best was excellent. We all wanted this machine to be a best buy since it was so good ergonomically, but because of the alignment problems, it receives just a recommendation and is very definitely worth considering. It is clearly very well designed indeed, but perhaps quality control has slipped a bit at Sony in the last year, for I was so keen on its predecessor.

**GENERAL DATA**

Replay azimuth deviation from average	+24°
Mike input sensitivity/clipping	330μV/36mV
Line input sensitivity/clipping	90.5mV/10V
Replay response ferric 63Hz av L/R	-0.2dB
Worst audible replay hum component	-60dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-58.2dB
Dolby improvement	9.5dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-62.2dB
Dolby improvement	9.1dB
Replay amp clipping ref DL	17.4dB
Max replay level for DL	638mV
Wow and flutter average (peak weighted DIN)	0.091%
Speed average	-0.1%
Meters under-read	0dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-9.4/-8.4dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+6.6/+6.6dB
Overall 10kHz sat chrome position L/R ref DL	-7.8/-6.4dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.5/+6.8dB
Overall 10kHz sat metal L/R ref DL	-1.8/-0.5dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+7.2/+8.2dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-50.6/-49.8dB
Dolby improvement	9.3dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-54.2/-53.2dB
Dolby improvement	9.3dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-53.5/-52.4dB
Dolby improvement	9.3dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-77.0dB
Spooling time (C90)	1m 55s
Dynamic range ferric/chrome/metal	65.2/69.2/71.0dB
Noise reduction system	Dolby
Tapes used	Sony AHF; Sony CDα; Sony Metallic
Typical retail price	£280

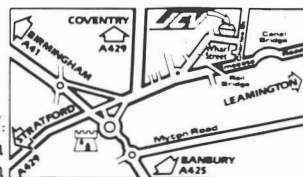


Sony Metal  
Overall frequency responses (-23dB, Dolby in)

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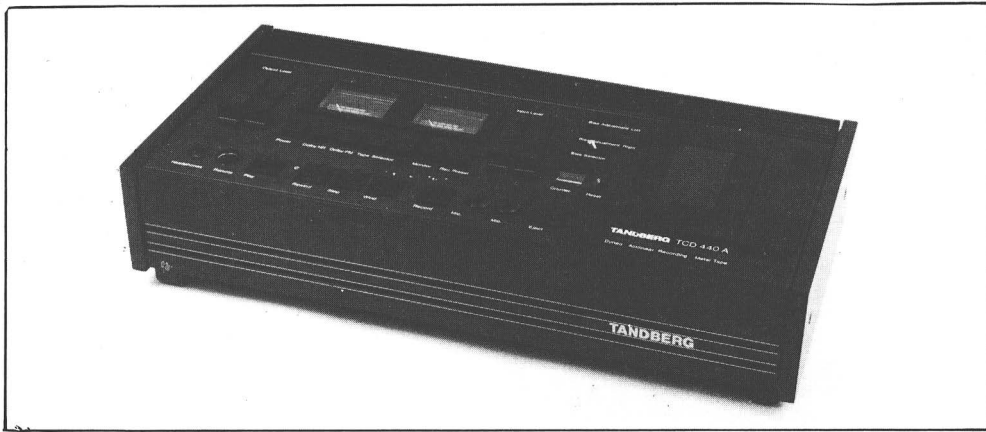
J.E. SUGDEN

MARANTZ

RECOMMENDED

# Tandberg 440A

Tandberg (UK) Ltd., 81 Kirkstall Road, Leeds LS3 1HR. Tel (0532) 774844



While the 440A looks fairly similar to the older 340A, the electronics have been redesigned throughout this three-head deck, which possesses some very fascinating features. The machine incorporates Tandberg's new *dyneq* system which prevents high frequencies from being boosted on record to a greater degree than that which can be accommodated without noticeable distortion on the relevant tape types. (See section in *Technical Introduction* explaining this further.) The deck is a top-loader, encased in wood and plastic, and has a very neat but unusual appearance. The cassette compartment is behind a trap door, the cassette being inserted sideways; another trap door exposes record azimuth controls. Phono line in/out-sockets and a five-pole DIN socket are mounted on the rear panel, together with a MPX filter switch. Separate faders are provided for left and right record and replay levels. The meters are slightly equalised with HF boost and read peaks reasonably accurately, although very fast transients were not so well indicated. All the deck functions are micro-switch logic controlled allowing transfer between most, but not dropping in or out of record (a safety record button preventing accidental erasure). Pushbuttons select Dolby in/out, source tape monitoring and equalisation for ferric pseudo-chrome, or metal tapes; a three-position bias switch is also provided with user presets allowing separate adjustment of left and right on the three bias positions. Dolby can be inserted into replay only for dubbing purposes. Additional presets for record and replay calibrations and many other purposes are available on the

underside, but are intentionally unidentified to discourage use.

The microphone inputs on 1/4-inch mono jack sockets offered excellent sensitivity for all purposes and with very low hiss, although the clipping margin was only just adequate. The DIN socket replay pins did not mute on record but no noise degradation was noted; the input impedance however was rather high. The line inputs were quite sensitive, and slight input noise was noted, but no clipping problem was encountered. Headphones (1/4-inch stereo jack for these) worked well and the gain was adjustable so that all types were usable with adequate volume.

Replay azimuth was extremely accurately set, and whilst replay hiss levels measured quite well, slight hum was measured which was just detected subjectively. The replay amplifier clipping margin was barely adequate for metal tapes with the replay gain flat out, but if this was reduced, the margin was good, although distortion above +9dB was rather higher than it should have been; distortion at +6dB however was commendably low. Maxell UDXLI gave very flat pen charts indeed, at least to 18kHz, but a slight bass 'woodle' was noted at 50Hz. A slight HF rise was apparent with Dolby in but this was not noticed subjectively, comments on response being extremely favourable throughout. Not only was distortion subjectively minimal, but praise was continually given for the superb sound quality, and only the strongest EHF transients were audibly reduced by the *dyneq* limiter. Sometimes parts of the programme were indistinguish-

able from the quality of the master tape. Background noise was average, and Dolby gave its normal improvement.

Maxell UDXLII also gave a virtually flat chart, without Dolby, but a slight presence bump was noticed with Dolby. The *dyneq* system had slightly more effect at EHF which was noticed on percussive transients and just slightly on sibilants. Once again the response sounded very flat, and distortion continually received very high praise, the sound throughout being remarkably clean and robust. Stability and stereo positioning were excellent, no dropouts being ever noted.

*Fuji metal* again gave excellent pen charts with and without Dolby, and the overall distortion performance was very good indeed, although we have a slight reservation about the 333Hz MOL which was nevertheless very good. The entire programme reproduced with a quality that was almost identical to that of the master tape, which is praise indeed, distortion being rated continually as 'superb'. Background noise on both UDXLII and *Fuji metal* measured at very low level and better than normal, with Dolby giving good improvement. Stability was considered better than on most other metal tapes and decks, and it was rated as only marginally below that of the best normal tapes.

The machine originally heard was a prototype, and slight wow was noted. But a second production sample gave no audible wow on programme at all, and the measurements were good. Speed was quite accurately set, and spooling is extremely fast (it slows down near the end to avoid any problems, which is commendable). Erase and crosstalk presented no problems at all.

This machine is definitely one of my favourites, the *dyneq* system works extremely well and allows astonishingly clean recordings to be made. The ergonomics were very much liked and the overall quality produced was amongst the best, and so I can give a firm recommendation, and the model may also be regarded as a best buy. I would like to see Tandberg gild the lily though by making a future improvement to the line input noise and the replay clipping performance. The machine does give a worthwhile improvement on metal tape, but did not quite extract the maximum performance possible from *Fuji metal*.

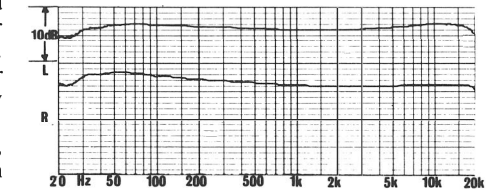
**Update** In the light of general improvements in standards, particularly in the handling of metal tapes, we have decided that recommendation rather than best buy status is now appropriate.

# Tandberg 440A

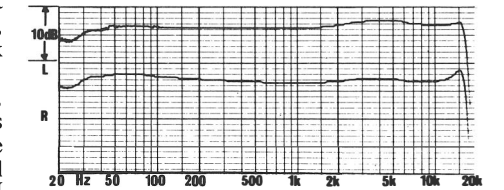
(revised and reprinted)

RECOMMENDED

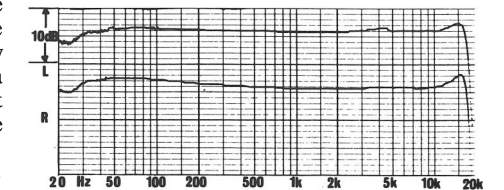
GENERAL DATA	
Replay azimuth deviation from average	-3°
Mike input sens/clipping	110uV/17.5mV
Line input sens/clipping	64mV/10V
Worst audible replay hum component	-61dB (100 Hz)
Replay noise CCIR/ARM ferric/chrome/Dolby imp	-57.5/-61.8/9.8dB
Replay amp clipping ref DL	+13dB
Max replay level from DL	1.2V
Speed average	0.11%
Wow and flutter average (peak wtg DIN)	-0.48%
Meters under-read	1.5dB on 64ms
Ferric DL dist 333Hz/5% point	0.39%/+6.5dB
Chrome DL dist 333Hz/5% point	0.87%/+6.3dB
Metal DL dist 333Hz/5% point	0.89%/+6.6dB
Overall 10kHz resp ref 333Hz Dolby out	
ferric/FeCr/chrome/metal	0/-/0/0dB
Overall noise ferric CCIR/ARM/Dolby imp	-49.8/10dB
chrome CCIR/ARM/Dolby imp	-54.3/9.5dB
metal CCIR/ARM/Dolby imp	-53.5/9.5dB
Line input noise floor ref 160mV, DL	-66.25dB
Spooling time C90	1m 10s
Dynamic range ferric/FeCr/chrome/metal	66.3/-/70/69.8dB
Tapes used	Maxell UDXLI; Maxell UDXLII; Fuji Metal
Typical retail price	£540 when reviewed, now approx £360



Maxell UDXLI



Maxell UDXLII



Fuji metal

Overall frequency responses (Dolby in, -30dB ref DL)

RECOMMENDED

# Teac C3X

Harman Audio UK Ltd., Mill Street, Slough, Berks. SL2 5DD. Tel (0753) 76911



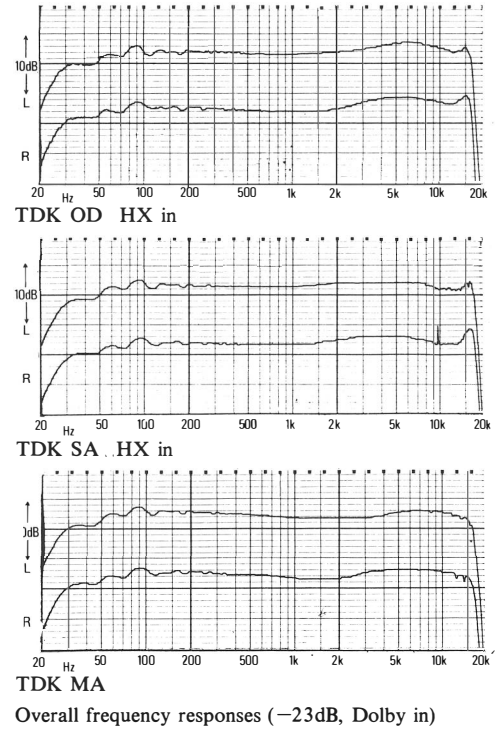
The Teac C-3X is a two-speed front-loader, designed for rack mounting; it incorporates Dolby HX as well as B processing, and also has a facility for using external noise reduction systems which can be interlinked via many phono sockets on the back (these are normally cross-linked with solid jumpers). Phono line in/out sockets are mounted on the rear panel, together with various remote control facilities and an attached two-core mains lead. This metal-encased deck has a grey crackle finish, and is literally festooned with rotary and slider switches on the front panel. A remote timer start facility is provided for play or record modes, and also a memory counter permitting stop or play from a predetermined point. Deck functions are microswitch/solenoid operating, allowing transfer from play into wind and back again and dropping into record; the pause control stops but does not restart play/record. The rotary record level controls for L/R are separated by 5cms but are cleverly friction linked (these were much liked). A stereo ganged replay gain control also adjusts headphone levels, a stereo 1/4" jack socket providing plenty of volume into low and high impedance models. Lever switches select: bias and equalisation separately for ferric, pseudo-chrome and metal tapes; high or normal speed; mike/line or test facility; noise reduction off, Dolby B, or B with HX (off position being used for all external noise

reduction); and tape/source monitoring. A push button provides preset or an adjustable bias and Dolby cal. (L and R recessed presets are provided for independent adjustment of Dolby rec./cal. and bias). Two record level meters read longer transients very accurately, but short transients under-read quite a lot. The 1/4" jack socket mike inputs had fairly poor sensitivity but a good clipping margin, whilst the line inputs had good sensitivity, no clipping problem, and input noise measured extremely well. The replay azimuth and head-heights were very accurately set, but the erase head-guide was marginally low. Replay hiss levels were about average. The replay amplifier clipping margin and distortion measurements were excellent, but the probe head test revealed a slight LF loss. TDK OD gave very good 333Hz MOLs and HF saturation measurements, the latter being even better when Dolby HX was switched in. The available sound quality with HX was very good indeed, with a particularly clear and clean HF end showing no audible HF compression at all, and sounding much like good metal tape quality. Very slight 'fuffs' were noted on piano reproduction, and organ music at a high level seemed to introduce slight IM between LF and HF, but performance was excellent at normal levels. Stereo positioning was good but not excellent. Overall weighted noise

was about average, and likewise the Dolby improvement. The sound was slightly on the bright side, but this was in no way disturbing. TDK SA again gave good MOLs, and HF saturation was average without HX and very good with HX (improving by about 3dB). The overall sound quality was again much liked, sounding very like that of the master tape, the only criticism being again of the organ track (LF/HF IM distortion). Overall weighted noise was good, and frequency responses very flat. However, stability was a little worse than average, and speech transients shifted around marginally. TDK metal gave good MOLs and an excellent HF saturation performance. Used with Dolby B only, the pen charts were reasonably flat, sound quality was at best excellent, but low frequencies seemed somehow a little 'dirty'; perhaps this was due to too much bass lift being required to compensate for the replay bass loss. Overall weighted noise was better than average for metal. The wow and flutter measurement, although quite good, was bettered by many other decks, and flutter was distinctly audible throughout the organ and piano tracks, and was also noted on brass (sample fault); whilst average readings were around 0.13%, we did note short peaks up to 0.17%. Speed was reasonably accurate, and spooling time average. Play/record torque was just slightly high, winding torques were normal, and erasure was satisfactory. Whilst bias and Dolby record cal. presets are provided, it was found quite difficult to adjust these by ear, especially when using HX, and to get the best out of this machine you would need an oscillator (the 'test' position usefully sensitising the meters for alignment purposes). The ergonomics were very good throughout. This machine could provide excellent overall quality, and also incorporates a high speed option for those who think this might be useful. This worked well, with low wow and a superb sound quality. It has some very useful facilities, and is particularly fun to use for those who like fiddling, so recommendation is in order, although its price is high. If the second speed had only been 2.4cms per second, we might have been inclined to include this model amongst the best buys. As we were going to press, we discovered that Teac market the TO-8 oscillator unit, priced about £20, which will be very useful in aligning this and many other machines. The small battery powered box has a phono socket, with a twin phono plug adaptor lead. Switches select off/-30dB/-10dB (ref Dolby) plus 400/6.3k/12kHz frequencies, distortion was negligible and output levels were within 0.3dB. This is clearly a most useful accessory.

**GENERAL DATA**

Replay azimuth deviation from average	..... +1°
Mike input sensitivity/clipping	..... 284µV/47mV
Line input sensitivity/clipping	..... 68mV/>10V
Replay response ferric 63Hz av L/R	..... -1.8dB
Worst audible replay hum component	..... -67dB (50Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	..... -58.0dB
Dolby improvement	..... 10.3dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	..... -62.0dB
Dolby improvement	..... 10.2dB
Replay amp clipping ref DL	..... 16.0dB
Max replay level for DL	..... 555mV
Wow and flutter average (peak weighted DIN)	..... 0.125%
Meters under-read	..... 7dB on 8ms
Overall 10kHz sat ferric L/R ref DL	..... -5.2/-5.0dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	..... +7.0/+7.1dB
Overall 10kHz sat chrome position L/R ref DL	..... -7.2/-7.4dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	..... +6.2/+6.2dB
Overall 10kHz sat metal L/R ref DL	..... 0/-0.2dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	..... +6.8/+6.2dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	..... -49.4/-49.4dB
Dolby improvement	..... 10.2dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	..... -53.8/-53.9dB
Dolby improvement	..... 10.1dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	..... -53.0/-52.9dB
Dolby improvement	..... 10.1dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	..... -79.8dB
Spooling time (C90)	..... 1m 55s
Dynamic range ferric/chrome/metal	..... 66.7/70.1/70.5dB
Noise reduction system	..... Dolby with HX
Tapes used	..... TDK OD; TDK SA; TDK MA
Typical retail price	..... £365



**RECOMMENDED**

# Teac A660

Harman Audio UK Ltd., Mill Street, Slough, Berks. SL2 5DD. Tel (0753) 76911



The metal-encased front-loading Teac A660 is fitted with phono line in/out sockets at the rear and has an attached two-core mains lead. Deck functions are microswitch operated, allowing transfer from play into wind and back again and also dropping into record; the pause button stops but does not restart a function. The deck logic was much liked and worked well. Switches select remote timer start (play or record), counter memory off/stop/play, bias and equalisation separately (ferric, pseudo-chrome and metal), and Dolby on/off (MPX not switchable). Push buttons select mike or line inputs, and a nice friction-locked split concentric record level control allowed easy adjustment of either channel although with marginally sufficient stiffness between them. A ganged stereo replay gain control also adjusts headphone levels, the 1/4" stereo jack socket providing slightly inadequate volume into high impedance headphones, but more than enough into low impedance models and with a satisfactory clipping margin. Two meters are provided for record level monitoring, and whilst short transients were quite accurately registered, longer ones actually over-read by around 3dB, which is most unusual; the scaling of the meters was not particularly accurate and they were actually dissimilar.

The 1/4" mono jack mike inputs had barely

adequate sensitivity but a reasonable clipping margin. The line inputs had reasonable sensitivity, no clipping problem, and input hiss measured extremely well. However with the record level controls up, a very low level hum was introduced, but this should not be audible under normal operating conditions. Replay azimuth was just a little mis-set, and whilst the head height was about right, the guide heights were a little too low, and the record/replay head was if anything too far forward.

Slight replay hum was noted, particularly at 150Hz on the right channel but this was not felt serious. Replay weighted noise measurements were average and the Dolby improvement was within specification, but on the high side on the right channel. The replay amplifier clipping margin was excellent throughout, and distortion measurements were quite satisfactory.

It was quite obvious that the importers had specified the wrong tape type in TDK OD, for there is a marked positive Dolby error of about 2dB which leads to the presence region being subjectively boosted a little. The overall pen charts show an HF lift, overall MOL measurements were very average and not good for this tape type, but HF saturation was extremely good; the tape was, therefore, under-biased. Slight distortion was noted subjectively because of this, but the sound quality

at best was good, and in fact an inferior tape type would probably have been more compatible, (TDK D might perhaps be a better choice). Overall weighted noise measurements were reasonable, but the right track showed slightly more noise reduction than it should have done considering the compatibility. Tape stability seemed very good.

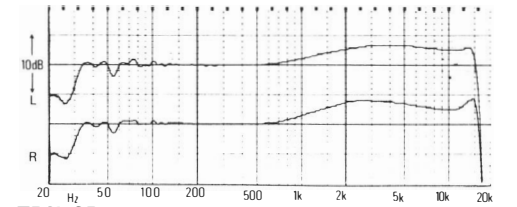
TDK SA pseudo-chrome also showed a Dolby error but only of +1.2dB. The response charts are very smooth to 10kHz, but the sharper than normal EHF rolloff was detected subjectively; it was not considered too serious, for at least the reproduced sound was smooth. Distortion was about average for a two-head deck, but HF compression received slight criticism from the panel, and was also a little below par in the lab. If the recording level was kept down a bit the sound quality was very good indeed, the organ sounding better than usual. The overall weighted noise was clearly better than usual, and the Dolby improvement was also very good, so one certainly can afford to reduce recording levels.

TDK metal tape performed very well for a two-head deck, the 333Hz MOL and HF saturation measurements being very good. The panel liked the overall sound quality very much indeed, suggesting that it was very much like that of the master tape. Distortion was considered to be at a low level and the responses very flat indeed. Note however that there is a slight EHF peak in the pen chart responses, which was not audible to the panel; possibly it somehow helped the sound seem that much clearer. Overall noise measurements were average for metal, stability was excellent throughout, and the sound quality was highly praised.

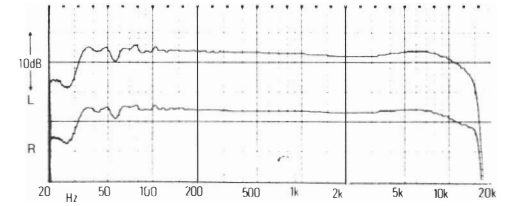
Wow and flutter measured well, and was only marginally suspected in the test programme, so it should not bother anybody. Speed averaged about 1.5% fast, which could be mildly annoying. Spooling time was average, erasure very satisfactory, play/record torque very slightly high, but the remainder of the torque measurements were very satisfactory.

There was much to admire in the overall performance of this deck, and TDK D did actually give flatter responses than the recommended tape. The machine clearly gets a recommendation, since it is good value for money, is capable of giving some very fine overall sound quality, and had attractive deck ergonomics. We all think it is a much better machine than the three-head Teac deck at about the same price, the only puzzling fact being that all the tapes showed a slight positive Dolby error, but this is clearly a sample problem. No really bad snags however, so quite a clear recommendation, although not quite a best buy.

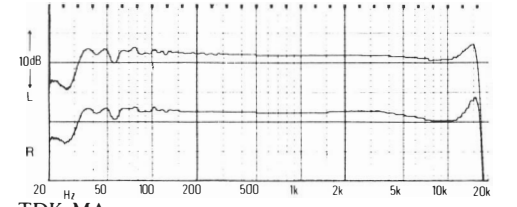
GENERAL DATA	
Replay azimuth deviation from average	-41°
Mike input sensitivity/clipping	309µV/42.5mV
Line input sensitivity/clipping	80.8mV/>10V
Replay response ferric 63Hz av L/R	-0.9dB
Worst audible replay hum component	-61dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-57.5dB
Dolby improvement	10.2dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-61.4dB
Dolby improvement	9.7dB
Replay amp clipping ref DL	+15.6dB
Max replay level for DL	525mV
Wow and flutter average (peak weighted DIN)	0.112%
Speed average	+1.6%
Meters under-read	3dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-5.1/-4.8dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+5.9/+5.2dB
Overall 10kHz sat chrome position L/R ref DL	-8.7/-8.3dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.4/+5.1dB
Overall 10kHz sat metal L/R ref DL	-0.6/-0.6dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+7.1/+6.5dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-49.9/-50.5dB
Dolby improvement	10.2dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-53.8/-54.5dB
Dolby improvement	10.2dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-51.6/-52.1dB
Dolby improvement	10.1dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-77.7dB
Spooling time (C90)	2m 10s
Dynamic range ferric/chrome/metal	65.5/69.6/69.8dB
Noise reduction system	Dolby
Tapes used	TDK OD, TDK SA, TDK MA
Typical retail price	£165



TDK OD



TDK SA



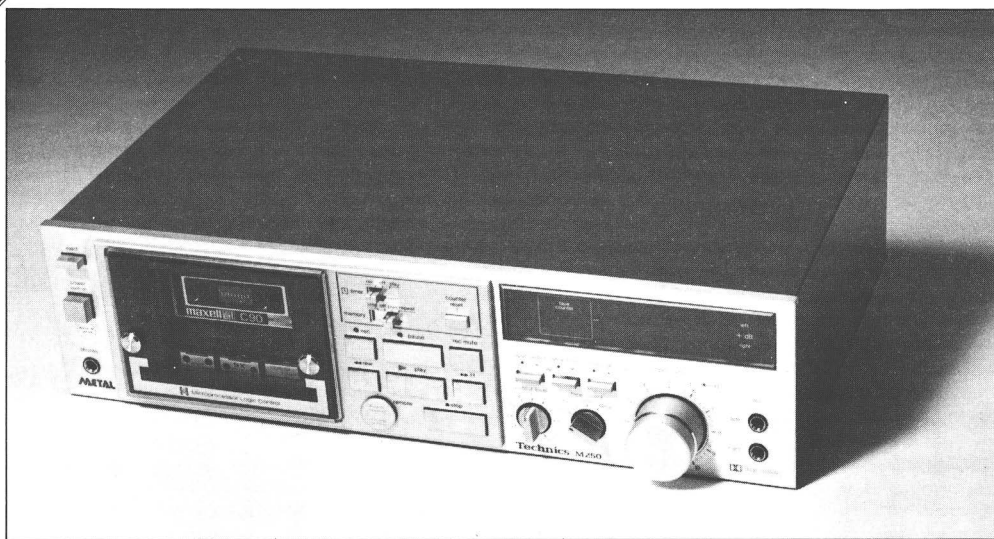
TDK MA

Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

# Technics RSM 250

National Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



The Technics *RS M250* front-loader is metal-encased with some plastics content. Deck functions are microswitch controlled, and work extremely well, allowing transfer from play into wind and *vice-versa*, but not dropping in to record from play; the pause control stops, but does not restart. Phono sockets and a 5-pole DIN are recessed in the back, and the captive mains lead is two-core. Front panel switches include a remote timer (play or record, remote control socket fitted) and a memory counter, switchable to stop, off, play, and repeat. The tape counter is an extremely neat electronic one, in which revolutions of the take up hub are counted by a magnetic/IC coupling device, the tape position being indicated by three digits plus a bar-graph 1-4 LED display. Push buttons select mike/DIN or line input, MPX on/off, and Dolby on/off, and a rotary knob switches bias and equalisation together for ferric, ferrichrome, pseudo-chrome and metal tapes. There is a record mute facility and the friction-locked rotary record level control is quite large and easy to adjust. A small stereo ganged replay gain control is fitted which unfortunately does not affect headphone output. A 1/4" stereo jack provides slightly insufficient volume for high impedance phones while low impedance models are much too loud and the clipping margins not really at all adequate. Two rows of 18 groups of three LEDs provide record level monitoring,

their auto-peak-holding facility retaining each peak reading for around two seconds before resetting, allowing quite fast transients to be read reasonably accurately, which was liked.

The mike inputs on 1/4" mono jacks were rather insensitive, and the clipping margin barely adequate. The DIN input did have replay pin muting on record but had slightly noticeable input noise degradation, and the same sensitivity and clipping as the mike input. The line inputs had average sensitivity, but as delivered had an extremely serious clipping problem due to poor circuit design. However, this has been completely rectified, and clipping on later samples (and the review sample, which was modified) is at around 9V input. Line input noise was at an extremely low level, which is excellent. The replay azimuth was found to be quite a long way out on delivery, but the record/replay head was at the right height and tape guides were also very accurately set. Replay amp noise measurements showed that hum was quite low, and hiss levels reasonable throughout with a good Dolby improvement, but I would have liked to have seen slightly better results here, and distortion was only adequate for 2nd harmonic (3rd harmonic being very good).

Maxell *UDXLI* was used in the ferric position, and the response pen charts showed a lift, particularly on the left track in the presence region, and

a slight valley around 10kHz. The panel found the response reasonably flat and generally smooth, but with apparent EHF loss caused by the presence hump. The 333Hz MOLs measured extremely well, but HF saturation was only just adequate, so it seems that ferric was slightly over-biased and therefore over-equalised, which is unusual for Technics. The panel did hear HF compression throughout the programme, but it was not serious, and MF distortion in fact sounded much better than usual, the general reproduced quality being very robust, and the organ particularly good. Overall noise was about average, with a reasonable Dolby improvement, and stereo positioning was very good.

Maxell *UDXLII* pseudo-chrome penned a very smooth response chart, showing a slight EHF rolloff. The panel thought the response was a little muffled throughout and complained continually about LF and MF distortion, which actually measured rather poorly for *UDXLII*, clearly indicating under-biasing. HF compression seemed adequate, receiving only mild criticism, and overall weighted noise measurements were about average, but we were frankly disappointed with the performance on pseudo-chrome.

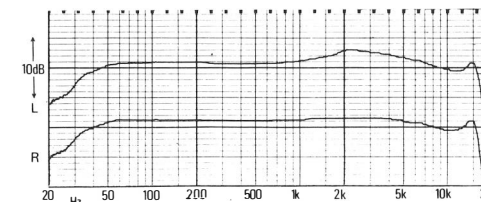
TDK *metal* produced a reasonably smooth response chart, but with a slight loss at around 10kHz, the panel commenting mildly on a loss of 'openness' but confirming the response smoothness. Distortion measured moderately well, and the overall performance on metal was thought slightly better than average, though not up to the best. The reproduction was regarded as good, but weighted noise was slightly worse than usual.

Wow and flutter measured very well indeed, and none was heard on our test programme, which is a strong plus point. Speed was a little slow, averaging -1.1%, and spooling time was about average. Torque measurements were very satisfactory, and erase was excellent on the left track, but just good on the right.

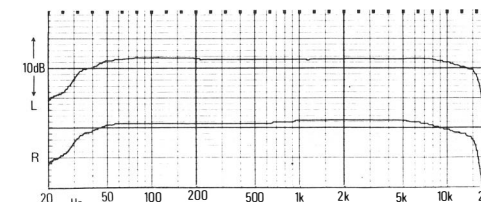
We all rather liked this machine ergonomically, but surprisingly it did better on *UDXLI* than *UDXLII*. Provided you ensure that line input does not clip, the machine can be safely recommended, since at best its sound quality was well liked, and the tape transport was obviously excellent. All models supplied after December 1980 should have had the input circuitry modified to cope with the early sample clipping problem.

**GENERAL DATA**

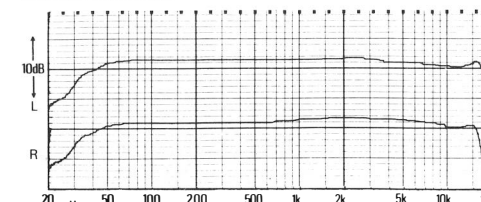
Replay azimuth deviation from average	..... +49°
Mike input sensitivity/clipping	..... 340µV/20.0mV
Line input sensitivity/clipping	..... 88.3mV/9V
Replay response ferric 63Hz av L/R	..... -0.4dB
Worst audible replay hum component	..... -63dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	..... -57.6dB
Dolby improvement	..... -9.9dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	..... -61.1dB
Dolby improvement	..... -9.6dB
Replay amp clipping ref DL	..... +11.5dB
Max replay level for DL	..... 870mV
Wow and flutter average (peak weighted DIN)	..... 0.093%
Speed average	..... -1.2%
Meters under-read	..... 6dB on 8ms
Overall 10kHz sat ferric L/R ref DL	..... -8.2/-7.6dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	..... +8.4/+7.8dB
Overall 10kHz sat chrome position L/R ref DL	..... -5.3/-5.3dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	..... +3.6/+3.5dB
Overall 10kHz sat metal L/R ref DL	..... +0.4/+0.6dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	..... +6.0/+5.5dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	..... -49.2/-50.4dB
Dolby improvement	..... -9.8dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	..... -52.6/-53.6dB
Dolby improvement	..... -9.8dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	..... -50.6/-51.3dB
Dolby improvement	..... -9.9dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	..... -81.8dB
Spooling time (C90)	..... 2m 04s
Dynamic range ferric/chrome/metal	..... 67.7/66.4/67.6dB
Noise reduction system	..... Dolby
Tapes used	..... Maxell UDXLI; Maxell UDXLII; TDK MA
Typical retail price	..... £160



Maxell UDXLI



Maxell UDXLII



TDK MA

Overall frequency responses (-23dB, Dolby in)

BEST BUY

# Technics RSM260

National Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



This model is fairly similar to the *RS M250*, being a front-loader using a metal case with plastics content. Three heads allow off-tape monitoring during recording with a button selecting source/tape; other buttons select mike/DIN or line input and Dolby in/out (MPX being permanently in). Deck functions do not permit direct transfer from record to wind etc., but going straight from play to wind allows cueing whilst wind remains depressed, the machine reverting to play when the wind button is released; a pause control stops and starts play/record functions. A record-mute button is provided together with a normal tape counter. A rotary switch selects ferric, ferrichrome, pseudo-chrome and metal tape types, and the friction-locked split concentric record level control was found easy to adjust. The replay gain control also varies head-phone levels, the 1/4" stereo jack socket providing only just adequate volume into higher impedance models, but plenty into lower impedance phones with adequate clipping margins. Eighteen groups of triple LEDs on each channel give record level monitoring, and peaks were read very accurately; the circuits were better than those on the *RS M250*, but with the same useful type of peak holding capability.

The mike inputs on 1/4" mono jack sockets were fairly insensitive, although the clipping margin was reasonably adequate. Slight noise degradation was

noted *via* the 5-pole DIN socket, and the replay pins did not mute on record. The line inputs were quite sensitive, no clipping problem was noted, and input noise measured at an extremely low level which is excellent. The record and playback heads are in one housing, known as a combination type head. Replay azimuth was a little in error as delivered, the combination head had a very slight tilt on it, and the erase head guide was found marginally low. No replay hum problem was heard, but replay hiss levels were slightly worse than average, despite showing a good Dolby improvement. The replay amplifier distortion measurement at +6dB was fairly good, but the clipping margin was only adequate for a three-head deck (although only metal tapes recorded at a very high level in other decks might have been on the verge of clipping).

Maxell *UDXLI* ferric gave extremely good MOLs at 333Hz, and 10kHz saturation measurements were satisfactory, so results were clearly even better than those on the *RS M250*. The pen charts were reasonably flat overall and actually sounded very flat to the panel, the sound quality being considered very good throughout and decidedly better than average, though the marginal EHF rolloff was just noted. Overall weighted noise measurements were rather average, though certainly acceptable and with a good Dolby improvement. Stability and stereo positioning were good

but not perfect.

In contrast *UDXLII* gave only just adequate 333Hz MOLs but good HF saturation measurements (the 333Hz MOLs should ideally have been about 2.5dB better). The panel criticised distortion as being poor, although the HF end was clean. Overall responses were reasonable on other tapes, and we felt it was such a pity that the machine could not have been a little better on distortion. Overall noise measured quite well, again with a good Dolby improvement, but if this sample is typical we cannot recommend pseudo-chrome on this deck.

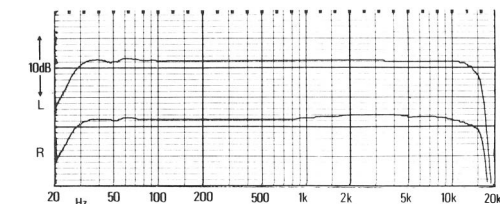
The original review sample gave very poor MOLs on *UDXLII* and on *TDK MA*, but a second sample was provided from normal stock which was rather better with both these tapes (results shown for second sample). *MA* gave a good overall sound quality with a flat overall response but could not quite take the high levels it should have done; MOLs fell short by perhaps 2dB although HF saturation was excellent. Overall noise was average for metal.

Wow and flutter measurements were very good, and only very marginal wow was detected on programme which is a very satisfactory result. Speed was extremely accurately set, and spooling time was average. Play/record torque was just slightly high, although spooling torque was very satisfactory and erasure, even on metal, was very good.

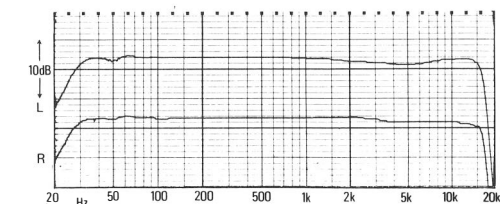
The fact that this deck is a three-head model with excellent metering, plus the achievement of excellent quality on *UDXLI* (also acceptable on *UDXLII* and *TDK MA*) allows it to be rated as a best buy, as it did not really have any serious problems. We did like its ergonomics and one soon gets used to the slightly limited deck functions (the pause control being a plus point). This deck is only £20 more than the *RS M250*, and most certainly is very good value for money. Happily Technics were very efficient in supplying a second sample, which was clearly better and presumably more typical than the original one assessed (which we discovered had actually been a prototype production model, rushed to the U.K. for photographic purposes).

## GENERAL DATA

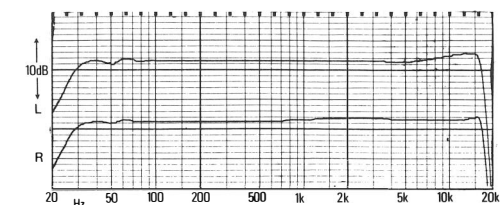
Replay azimuth deviation from average	.....	+26°
Mike input sensitivity/clipping	.....	295µV/32mV
Line input sensitivity/clipping	.....	70mV/>10V
Replay response ferric 63Hz av L/R	.....	+0.4dB
Worst audible replay hum component	.....	-63dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	.....	-56.5dB
Dolby improvement	.....	10.1dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	.....	-60.3dB
Dolby improvement	.....	9.9dB
Replay amp clipping ref DL	.....	+1.7dB
Max replay level for DL	.....	885mV
Wow and flutter average (peak weighted DIN)	.....	0.107%
Speed average	.....	-0.1%
Meters under-read	.....	3dB on 8ms
Overall 10kHz sat ferric L/R ref DL	.....	-6.7/-7.6dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	.....	+7.5/+7.5dB
Overall 10kHz sat chrome position L/R ref DL	.....	-5.4/-5.6dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	.....	+4.0/+4.2dB
Overall 10kHz sat metal L/R ref DL	.....	0/-0.2dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	.....	+6.3/+6.5dB
Overall noise ferric L/R Dolby out(CCIR/ARM) ref DL	.....	-49.8/-50.3dB
Dolby improvement	.....	9.9dB
Overall noise chrome L/R Dolby out(CCIR/ARM) ref DL	.....	-53.3/-53.8dB
Dolby improvement	.....	9.8dB
Overall noise metal L/R Dolby out(CCIR/ARM) ref DL	.....	-51.5/-52.2dB
Dolby improvement	.....	10.0dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	.....	-81.0dB
Spooling time (C90)	.....	2m 12s
Dynamic range ferric/chrome/metal	.....	67.5/67.5/69.2dB
Noise reduction system	.....	Dolby
Tapes used	.....	Maxell UDXLI; Maxell UDXLII; TDK MA
Typical retail price	.....	£180



Maxell UDXLI



Maxell UDXLII



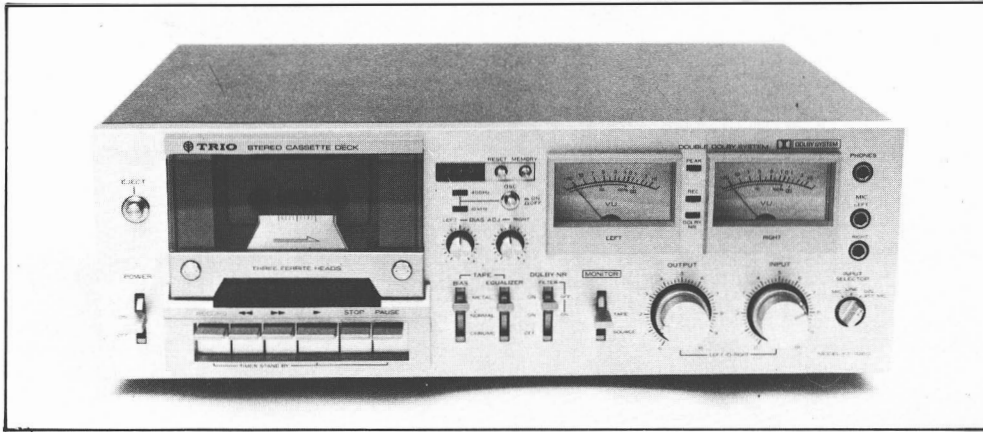
TDK MA

Overall frequency responses (-23dB, Dolby in)

RECOMMENDED

# Trio KX1060

Harman Audio (UK) Ltd., Mill Street, Slough, Berkshire SL2 5DD  
Tel (0753) 76911



This deck is a three-head metal-encased front-loader. The cassette loading behind a hinged front door did not quite allow enough room for my thick finger to pull a cassette out easily. The mechanical deck functions all worked quite well, allowing transfer between them, though some of the controls were rather stiff. Friction locked concentric record and replay gain controls are fitted, and mike (1/4-inch mono jacks), DIN and phono line inputs are selected by a three-position switch. The phono and DIN sockets are mounted on the rear, whilst all the jacks, including the 1/4-inch stereo headphone one, are on the front (variable replay gain giving a good range of adjustment for all headphone impedances). The two large VU meters under-read rather appreciably as usual, but a single peak reading light allowed reasonably accurate peak indications at +8VU. Lever switches select three positions of bias and equalisation separately for ferric, chrome and metal tapes, other switches selecting Dolby in/out with optional MPX, and source/tape monitoring. A rather natty system for user adjustment of bias is interesting, independent rotaries with centre indents being provided for left and right biasing, with a pushbutton engaging an oscillator which switches continuously from a low frequency to around 10kHz for checking response flatness. A counter with a memory facility is provided. Unfortunately, Trio omit record calibration pre-sets, and frankly this is a pity.

The mike inputs had average sensitivity, and a fairly good clipping margin. The DIN input gave no noise degradation, which is commendable, and

worked very well, although the replay pins did not mute on record. The line inputs had average sensitivity, and no input noise or clipping problems were encountered. Replay azimuth was set very precisely. Replay amplifier hiss levels were average and replay hum was not noticeable subjectively, although some was noted in the laboratory. The replay amplifier clipping margin was only just adequate, with replay gain flat out, but very good if this was brought back slightly (replay gain alters VUs and headphone levels). Replay amplifier distortion measured reasonably well, provided the control was kept just below maximum.

*UDXLI*, after bias had been manually adjusted, gave a slight down tilt at EHF on the pen chart (internal response tones were not quite flat). The 'Dolby in' charts were similar, but subjectively EHF was slightly muffled; for this test bias had been left at its nominal position. *TDK AD* seemed better on the indented position. Response was audibly reasonably flat overall, with the sound generally slightly bright on *AD*, but *UDXLI* was also very good if bias was marginally reduced. The overall quality was considered very clean throughout, with no speech 'spitchiness' at all, and therefore was very much liked. A positive record calibration error of +1.4dB was noted, and this explained the slight brightness heard (not disliked). Overall noise was slightly more marked than usual, but not poor, Dolby giving its normal improvement. Stability was considered good, but not perfect, and stereo positioning received no adverse comments.

# Trio KX1060

(revised and reprinted)

RECOMMENDED

*TDK SA* pseudo-chrome also gave an overall Dolby error of +1.4dB, and overall noise was again marginally below average. Pen charts showed the response to be reasonably flat throughout, but 'Dolby in' produced a hump in the presence region as expected, and this resulted in slight brightness on the programme which was not disliked. Mild HF compression was noted throughout, this being due to some over-biasing. However, 333Hz MOLs were extremely good for the tape type, and the reproduction was firm and stable throughout. Slightly too much equalisation was provided, which thus meant that the bias level had to be set higher by the user to achieve a metered flat response (Trio should be improving this, and the *Dolby* cal., in production).

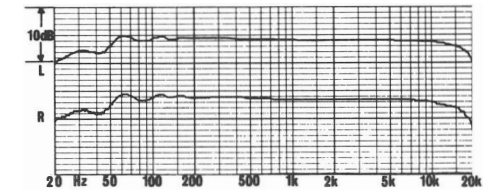
*TDK metal MAR* gave a Dolby error as much as -2.7dB, and whilst the pen chart without Dolby was reasonably flat throughout, the 'Dolby in' response was surprisingly good. Sound quality was regarded as superb, some items sounding very like the master tape. The 333Hz MOLs throughout showed that this deck had a very good record head; virtually no head saturation was noted, and low distortion received praise in the subjective tests. Overall noise, though, was again slightly below average.

The wow and flutter performance measured very well, but slight flutter was noticed just once on the piano track, which could have been the tape itself. Speed was set fairly accurately, and spooling speed was average. Erase and crosstalk presented no problems.

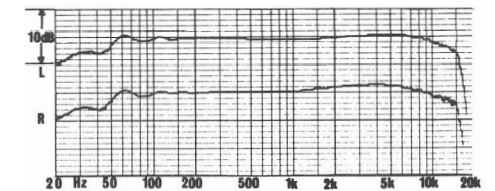
This model did give quite an impressive performance, but my main criticism must be the lack of record level pre-sets, which are really necessary to operate the different tape types. Subjective and objective responses tied in better if alignment was carried out with Dolby switched in, but this user facility is extremely useful, and a clever idea. The deck is reasonably good value for money, and can be recommended, but the lack of a really good metering facility and the slight reservation concerning Dolby levels does not allow it to become a best buy.

GENERAL DATA

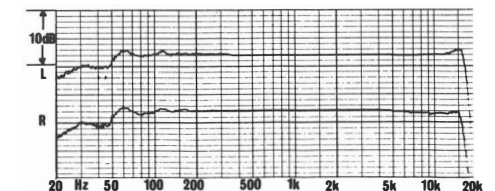
Replay azimuth deviation from average	+1°
Mike input sens/clipping	240uV/32.5mV
Line input sens/clipping	109mV/>10V
Worst audible replay hum component	-65dB (150Hz)
Replay noise CCIR/ARM/ferric/chrome/Dolby imp	-56.5/-60/10dB
Replay amp clipping ref DL	+15dB
Max replay level from DL	1.06V
Wow and flutter average (peak wtg DIN)	0.096%
Speed average	+0.2%
Meters under-read	-8dB on 64ms
Ferric DL dist 333Hz/5% point	0.17%/+8.3dB
Chrome DL dist 333Hz/5% point	0.75%/+7.8dB
Metal DL dist 333Hz/5% point	1%/+8.2dB
Overall 10kHz resp ref 333Hz Dolby out	
ferric/FeCr/chrome/metal	-0.8/-/-0.3/+0.8dB
Overall noise ferric CCIR/ARM/Dolby imp	-48/9/8dB
chrome CCIR/ARM/Dolby imp	-50.5/9/8dB
metal CCIR/ARM/Dolby imp	-49.8/9/8dB
Line input noise floor ref 160mV, DL	-76.5dB
Spooling time C90	2m 7s
Dynamic range ferric/FeCr/chrome/metal	65/-/66.8/67.5dB
Tapes used	Maxell UDXLI; TDK SA; TDK MA-R
Typical retail price	£255



Maxell UDXLI Dolby Out.



TDK SA



TDK metal

Overall frequency responses (Dolby in, -30dB ref DL)



RECOMMENDED

# Trio KX2060

Harman Audio UK Ltd., Mill Street, Slough, Berks. SL2 5DD. Tel (0753) 76911



The most advanced cassette deck that Trio have ever released, the *KX 2060* is a metal-encased front-loader with three heads, and thus offers source/tape monitoring. Phono line in/out and a 5-pole DIN socket are on the back for interconnections, and the machine has a detachable two-core mains lead which uses a special plug and socket arrangement. The front panel of this very large machine is festooned with various facilities, including switching selecting bias and equalisation separately for ferric, pseudo-chrome and metal tape types (normal chrome will also work if Dolby record calibration is changed), Dolby off/on (with or without MPX filter) and tape source monitoring. Separate concentric miniature rotaries are fitted for record Dolby calibration and bias setting; push buttons select 400Hz or 10kHz tone to allow overall calibration to be achieved, and LEDs light up when the calibration is correct. A memory counter is provided, and mike/DIN, Line inputs and replay outputs all use split concentric rotaries which allow independent control of left and right channels (unusual on replay). The mike/DIN gain control is extremely small, which might prove tiresome. The replay gain control also governs headphone levels to a 1/4" stereo jack socket, which does not give quite enough into high impedance models, but is adequate into low impedance 'phones. All deck functions are press button, solenoid operating types, the logic allowing trans-

fer from play into record and also into wind and back. The pause control stops and starts in play/record, the solenoid having an unusual thumping action which actually shook the table! Although 20 LEDs are provided for each channel for record level monitoring, there are effectively only 12 levels displayed, since below 0dB they operate in pairs. Transients were read surprisingly accurately.

The microphone inputs on 1/4" mono jacks were a little more sensitive than usual, which may be useful; the clipping margin was also adequate. Whilst the DIN input gave virtually no noise degradation at all (which is commendable), the replay pins did not mute on record. The line inputs, have good sensitivity, no clipping problem was noted, and input noise measured well. We very much liked the flexibility of setting up different tape types, although the internal indications did not quite correspond with a correct alignment as determined by external metering in the lab.

Replay azimuth was rather noticeably mis-set, although head heights and tape guides were set quite accurately. Replay hum measurements were generally very good indeed, and replay hiss was consistently substantially better than average. The replay amplifier clipping margin was excellent and distortion measured well.

*TDK OD* ferric gave some good 333Hz MOL and HF saturation measurements. The panel very

much liked the overall sound quality, stating frequently that it was very much like that of the master tape, and there were virtually no criticisms at all. The frequency response pen charts showed a marginal HF loss after user calibration, and we found that using this facility allowed the tape to be approximately correct, but that comparing source/tape could perhaps give that extra bit of flatness, which would improve the sound further. Overall weighted noise measurements were very good and the Dolby improvement was normal.

Despite *TDK SA* giving only average MOL and HF saturation measurements, the panel thought the overall sound quality was very good indeed and again frequently like that of the master tape, which is commendable indeed; background noise was better than average, and responses very flat.

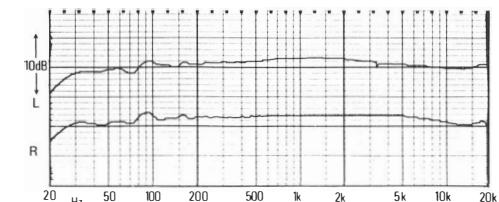
*TDK metal* gave very good 333Hz MOL measurements, but HF saturation was only average for metal. Overall responses with bias in the centre indent position showed a very marginal HF loss on the left channel, but the panel were not really concerned about this, and the overall sound quality was very good indeed throughout. This deck was quite obviously much better than average even on metal, although the Nakamichi three head decks were clearly better still. Overall noise was again better than average for metal.

A slight tendency to a wheeze was noted on a continuous tone on all tape types, and we suspect that the modulation noise was perhaps a little inferior to what it should have been. Stereo positioning was very good throughout, and the wow and flutter measurements were excellent, though just a suspicion of wobble was detected once or twice on piano (we were listening rather hard for it). Speed was a little fast, measuring +1.3% at the beginning of a cassette and +0.8% at the end, and this should really have been a little better. Spooling was slightly faster than normal, and whilst most torque measurements were normal, wind off torque was marginally high. Erasure was satisfactory.

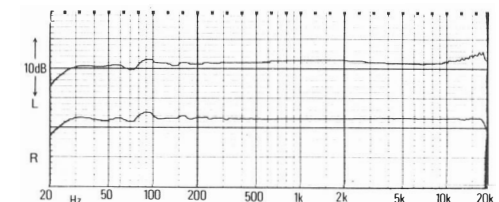
We must judge this machine by a standard commensurate with its very high price, but even so it could give such superb overall sound quality and was much liked by all of us that it really must be recommended highly. It is interesting perhaps that Dolby Labs modified this deck to incorporate the early prototype Dolby C system, and it proved an excellent test bed for the new system. Trio have obviously worked hard at improving quality control, and their efforts have clearly been very well worthwhile on this model. There were no snags noted in any department, which is most commendable.

## GENERAL DATA

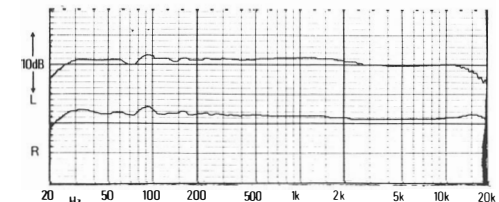
Replay azimuth deviation from average	+45°
Mike input sensitivity/clipping	199µV/28.6mV
Line input sensitivity/clipping	88.3mV/>10V
Replay response ferric 63Hz av L/R	-0.3dB
Worst audible replay hum component	-58dB (50Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	-59.9dB
Dolby improvement	-10.3dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	-63.0dB
Dolby improvement	-10.6dB
Replay amp clipping ref DL	+15.6dB
Max replay level for DL	910mV
Wow and flutter average (peak weighted DIN)	0.087%
Speed average	+1.1%
Meters under-read	1.5dB on 8ms
Overall 10kHz sat ferric L/R ref DL	-4.8/-5.2dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+6.9/+6.9dB
Overall 10kHz sat chrome position L/R ref DL	-7.0/-7.0dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.4/+5.2dB
Overall 10kHz sat metal L/R ref DL	-2.2/-2.4dB
Overall distortion metal L/R for 5% dist @ 333Hz ref DL	+7.8/+7.8dB
Overall noise ferric L/R Dolby out (CCIR/ARM) ref DL	-50.7/-51.0dB
Dolby improvement	-9.8dB
Overall noise chrome L/R Dolby out (CCIR/ARM) ref DL	-54.5/-54.9dB
Dolby improvement	-9.6dB
Overall noise metal L/R Dolby out (CCIR/ARM) ref DL	-52.7/-53.1dB
Dolby improvement	-9.7dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	-76.6dB
Spooling time (C90)	1m 45s
Dynamic range ferric/chrome/metal	67.6/69.6/71.4dB
Noise reduction system	Dolby
Tapes used	TDK OD; TDK SA; TDK MA
Typical retail price	£350



TDK OD



TDK SA



TDK MA

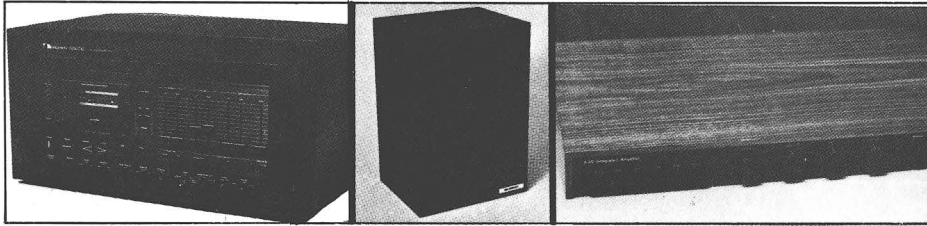
Overall frequency responses (-23dB, Dolby in)

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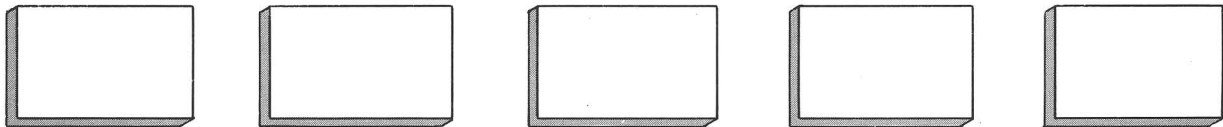
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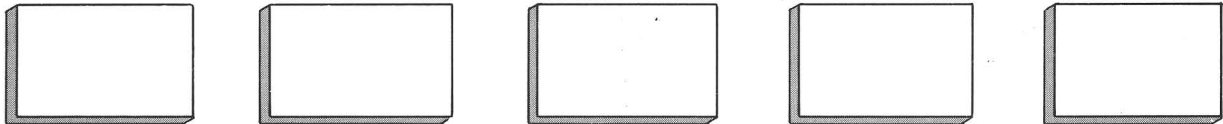
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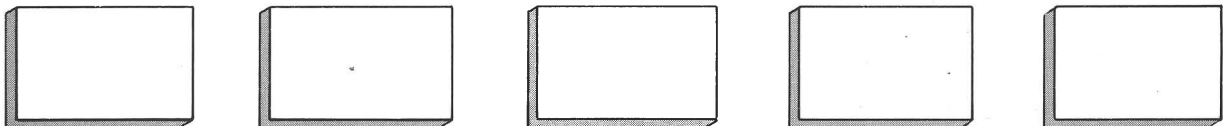
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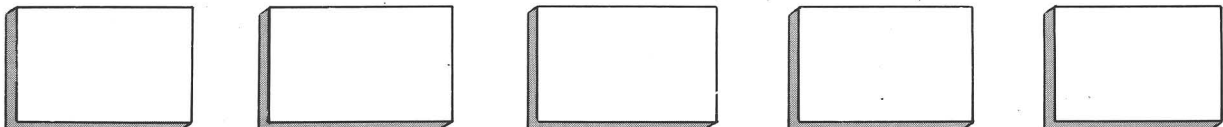
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RECOMMENDED

# Uher CR240

Uher Ltd., 24 Market Place, London NW11. Tel 01-458 0943



This very compact portable can be operated off batteries, or a mains unit which produced bad hum if used internally. Other than a stereo headphone jack socket, all inputs and outputs are DIN types. These include sockets for normal DIN in/out accessory, a stereo loudspeaker output (also for headphones), auxiliary and car DIN for 12V DC input and stereo output. Cassette loading is achieved by placing the cassette in a slot and depressing a lever. An 8 pin mic/DIN socket on the front panel allows connection of stereo or mono microphones, other pins bringing in various time constants when shorted in the plug for use with the limiter. All the controls are very miniaturised and include separate L and R levels which can be ganged with a slide switch. Another gain control (also on/off switch) operates headphone or loudspeaker monitoring levels. Push buttons select internal loudspeaker (mono), internal microphone (mono), limiter, Dolby and record. Miniature press-studs operate counter re-set, battery indication and meter illumination with the battery. A slide switch selects three different tape types. A side-ways acting lever selects wind in either direction, while another lever engages the tape into play or record modes depending upon its position and the appropriate push button being depressed. The record level meters are peak reading indicating transients very well but also unfortunately incorporating equalisation. A small cover facilitates access to the tape mechanism for cleaning etc when withdrawn.

The microphone input sensitivity was quite good for all normal purposes and the clipping margin was

amazingly good. The main DIN input had good sensitivity and a wide clipping margin, showing also virtually no noise degradation, which is most commendable but hardly surprising for a German machine. Both distortion and frequency response on this input measured reasonably well. The auxiliary input is connected through to the DIN input via ridiculous 470k ohm resistors, thus producing bad noise degradation unless the input level is very high. The limiter acted reasonably but insufficient gain was present before it.

Replay azimuth was quite badly mis-set. Replay hiss levels measured well but Dolby only gave 9.25dB improvement, and when the mains unit was used externally replay hum at 50Hz was just noticeable, but otherwise satisfactory. The replay clipping margin will be found adequate for normal tapes and the replay amplifier distortion reached 0.3% at +6dB. The replay responses on ferric were excellent to 10kHz but chromium had not enough cut. The Dolby did not show quite the correct tracking performance at 10kHz. Headphones of all types worked excellently with a good clipping margin and external loudspeakers could be driven up to 1W into 4 ohm before the onset of clipping.

Maxell UD<sub>XLI</sub> was used as agreed with Uher, and produced an HF shelf averaging 2.5dB from the presence region upwards. The bass response was excellent, overall noise levels were average, and Dolby gave the usual improvement. 333Hz distortion averaged 0.65% at Dolby level, rising to an average of 4% at +4dB, the two channels being rather unequal. The sound quality, subjectively, was good but clearly up from 5kHz to 12kHz.

BASF FeCr was not altogether suitable, producing some HF compression and slightly muffled sound with Dolby (obviously over-biased since 333Hz distortion at +4dB measured only 1.8%). TDK SA used on the chrome position penned a chart showing a similar HF boost to ferric, but again, with a good bass end. Distortion averaged 2% at +4dB and the overall quality was reasonable if the level was held down, but high levels produced HF compression and speech spitchiness. Overall noise was satisfactory. The chromium position showed a +2dB Dolby error.

Wow and flutter was only fair, being noted particularly on piano. Speed was just over 1% fast but HF stability was quite good. Spooling was slow at 2.75 minutes. Erasure was only fair on ferric and rather poor on chrome. Crosstalk was generally excellent, except at high frequencies (DIN sockets!) but slight right on right crosstalk was noted, though not troublesome.

The internal microphone and loudspeaker were quite reasonable for their purposes and the motor flywheels were contra-rotating, allowing the machine to be swung around a bit whilst in use. All the input sockets were permanently live together, which may be a nuisance, and the absence of phono sockets is annoying. The record level pots, if turned at the commencement of a recording, seemed to produce DC 'thumps' clearly on the tape and visible on the meters.

Despite the criticisms, the relatively light weight and small size of this portable made it very convenient for its intended main purpose. The various controls allowed great flexibility in use and recordings could be made out of doors at surprisingly high quality, although the overall performance was clearly originally geared to poorer DIN-compatible tapes. The machine cannot be really recommended as a mains operated home recorder, but it can most certainly be recommended as a 'best buy' for use as a portable, particularly suitable for caravans, etc. As a complete system with very sensitive 4 ohm speakers, it can produce quite a reasonable quality in a small space but volume was severely limited of course. A machine which Uher can be sure will be accepted as their old reel-to-reel ones have been for many years.

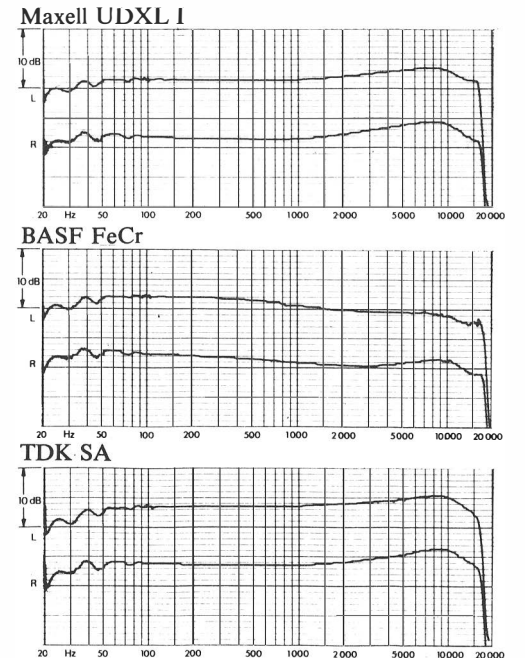
# Uher CR240

(revised and reprinted)

RECOMMENDED

GENERAL DATA	
Replay Azimuth Deviation From Average:	+57°
Microphone Input Sensitivity/Clipping:	178µV/399mV
DIN I/p Sens/Clipping/Av. Imp:	-17dB/ +26dB/12.9Kohm
Line Input Sensitivity/Clipping:	66mV/ 10V
MPX Filter 15kHz Attenuation:	-1dB
Replay Response Ferric Av. L+R 63Hz/10kHz:	-0.75dB/-0.25dB
Replay Response Chrome Av. L+R 10kHz:	+0.45dB
Worst Audible Replay Hum Component:	-54.5(Mns Sup)-65(Batt Sup)
Replay noise ferric CCIR/ARM Dolby out/imp	-58.8dB/9.1dB
Replay noise chrome CCIR/ARM Dolby out	-61.8dB
Replay Amp Clipping ref DL:	+8.5dB
Max. Replay Level for DL:	775mV
Wow & Flutter Av./Speed Av. (peak DIN Wtg):	0.17%/+1.26%
Meters Under-read:	-2.75dB 8ms
DIN Input Distortion 2mV/Kohm:	0.12%
Overall Distortion Ferric Av. L+R, DL/+4dB:	0.67%/4.0%
Overall Distortion Ferrichrome Av. L+R, DL/+4dB:	0.64%/1.8%
Overall Distortion Chrome Av. L+R, DL/+4dB:	0.71%/2.2%
Overall Response 10kHz Av. L+R Dolby Out	+1.5dB/-1.75dB/+1.5dB
Ferric/FeCr/Chrome:	-49.2dB/9.6dB
Overall noise CCIR/ARM Dolby out/improvement	-51.7dB/9.1dB
Ferric:	-51.5dB/9.3dB
FeCr:	-61dB
Chrome:	-68.9dB
Worst erase figure:	-60.5dB*
DIN input noise floor (ref 1mV/kohm):	2.75 min
Line input noise floor (ref 160mV, DL):	63dB/64.25dB/64.75dB
Spooling Time (C90):	Maxell UD <sub>XLI</sub> , BASF FeCr, TDK SA
Dynamic Range Ferric/FeCr/Chrome:	Typical retail price: £380

Overall Frequency Responses, Dolby out -24dB.



# CASSETTE TAPES

*Hi-Fi Choice* assessed cassette tapes as part of issue No. 22 to give the reader some idea of the differences between brands and to enable him/her to choose the tape best suited for a cassette deck. The summaries of Angus McKenzie's comprehensive tests on over 60 tapes are printed below for quick reference but some additional explanation seems in order.

The tapes are now grouped as follows with Group 1 including all tapes intended for use in the ferric or 120 *us* equalisation position, Group 2 includes all chrome or pseudo-chrome formulations, Group 3 includes the ever decreasing population of ferrichrome tapes and Group 4 covers the newer metal tapes. It may be that you know of cheaper tapes which are not included in this survey but our experience has been that these tapes are an expensive waste of time suffering from problems like shedding of the magnetic coating or jamming. These tapes should not be confused with the better 'own brand' tapes from companies like Woolworths, Dixons or Boots who buy from well-known manufacturers but have their own name on the product.

## Cassette tape types

The first tapes used ferric oxide coating and were designed to playback with 120 *us* equalisation, marked on most machines as normal, ferric or position I equalisation setting. Tapes made from chromium dioxide were introduced about ten years ago in an attempt to improve the high frequency performance; international agreement was secured for 70 *us* equalisation playback for these tapes. Chrome tapes were both difficult to produce and suffered from poor maximum level potential in the mid and low frequencies. Improved formulations have been marketed (Dupont's *Crolyn 2* and BASF's *Super Chrome* and *Chromodioxid Super 2*) but these are not that compatible with most Japanese decks. Though they often have quieter background than the pseudo-chromes their Maximum Operating Level (MOL) is usually rather poor at one point or another.

Experiments were made with ferric tapes for use in the chrome position to get the best of chrome performance with the ease of ferric tape manufacture.

These pseudo-chromes are more sensitive in the mid frequencies than chrome tape and have a high frequency response roughly equal to that achieved with the super-chromes. All modern decks are now aligned for these tapes during manufacture but many older machines cannot either supply the extra bias required or their tape heads saturate. Metal tape compatible heads with sufficient headroom mean that most modern 'metal' decks work well on position II (chrome).

The Group 3 tapes are dual layer tapes called ferrichromes, but market research suggests that they now only form a rapidly shrinking 4 per cent of the tape market. These tapes were originally intended to be used with a bias between ferric and chrome bias but deck manufacturers, rather than offer an additional bias position, began to suggest that ferric bias and chrome equalisation would work. Invariably it didn't! Many decks now have no ferrichrome or position III setting.

Pure metal or metal alloy tapes were first introduced onto the UK market during 1979 but were only available in small quantities and at high prices, not to mention short lengths (C46s were the longest tapes available for some months). There are still many modern decks which are called metal compatible but turn in better performance with pseudo-chrome tape because they are incapable of recording the very high levels necessary to benefit from metal formulation. An improved high frequency response from your machine with metal tape may be compromised by worse low frequency performance. Angus McKenzie held by the view in writing the *Hi-Fi Choice Cassette Decks and Tapes* issue that if you are contemplating buying metal tapes then buy only one unless your metal capable deck has 'received a trustworthy review which endorses its metal performance' – even over a year later I would support that view.

## What is bias?

The audio signal exists in a record tape head as a modulated current. For this current to magnetise the tape with minimum distortion it is necessary to pass a supersonic current through the head at between 75 and 150kHz; this is known as RF (radio frequency) bias,

or more simply as bias.

As bias is increased an optimum setting is reached for low distortion, first at high frequencies then, as bias is further increased, at lower frequencies. If the tape is optimised for quite low frequencies (333Hz standard frequency) then the high frequencies (typically measured at 10kHz) become degraded. Immediately you can see that setting bias is a compromise between acceptable low and mid frequency performance and low distortions and a good response at high frequencies.

## Where does equalisation come in?

Equalisation refers to the cutting or boosting of certain frequencies by the amplifier circuits in the cassette deck both during record and replay. This is done to obtain a flat frequency response from the tape in use. For reasons of technical convenience the equalisation curve is referred to by a time constant (ferric EQ – 70 *us*).

Variable bias and EQ can be used further to optimise the tape's response though most decks are fitted with switchable fixed value bias and EQ.

## Notes on using the comparison table

Groups 1A and 1B are based on the same criteria; the order of words used to describe degrees of quality being: superb, excellent, extremely/very good, good, fairly/quite good, average, fair, fairly poor, poor, very poor and bad. Modern cassette decks are usually biased between average and fairly high so tapes having a low bias requirement will sound muffled on modern decks though they may work well on older or European models.

In Group 2 the bias requirement for Maxell *UDXLII* is taken as average. Group 3 tapes are not included as for various reasons they cannot be recommended. Group 4 tapes were judged against a high quality metal tape but dynamic range and noise can be compared with Groups 1 and 2.

All the mechanical properties can be directly compared. Dropouts are momentary drops in level off the tape which may be due to uneven coating, bad head/tape contact or bad cassette mechanics.

# CASSETTE TAPES COMPARISON CHART

GROUP 1A TAPES	Bias Requirement	MF Sens	HF Sens Opt Bias	HF Sens Reference Bias	DL Distortion	333Hz MOL	10kHz MOL	Drop Out Performance	Wow and Flutter	Background Noise	Dynamic Range	Print Through	Housing	Leaders	Head Cleaners	rreremission, Mech. Quality
Agfa Ferrocolour	average	low	average	average	poor	poor	fair	fair	average	average	poor	extr. good	screw	yes	no	average
Ampex + 371	lowish	average	f. good	fair	good	good	fair	average	average	average	f. good	average	screw	yes	no	f. good
Ampex 20/20 +	lowish	high	average	fair	good	good	average	average	average	average	f. good	fair	screw	yes	no	average
BASF LH	lowish	fair	poor	poor	f. poor	fair	fair	fair	poor	average	f. poor	extr. good	screw	yes	no	f. good
BASF Ferro-Super LH	lowish	average	average	poor	average	f. good	fair	average	average	average	average	average	screw	yes	no	good
Denon DX1	average-	f. high	average	average	f. good	good	f. good	good	good	fair	f. good	average	screw	yes	no	fair
Denon DX3	average-	high	good	fair	f. good	good	average	good	good	average	average	fair	screw	yes	no	fair
Dixons Prinzsound	low	average	fair	poor	fair	fair	fair	fair	average	good	fair	average	screw	yes	yes	poor
EMI Standard	lowish	f. high	fair	fair	f. good	f. good	fair	poor	fair	f. good	f. good	good	screw	yes	no	poor
EMI Super	lowish	average	fair	fair	average	fair	fair	average	average	average	fair	excellent	screw	yes	no	poor
Fuji FL (new)	average+	average	average	average	average	average	average	good	good	average	average	excellent	screw	yes	no	good
Maxell UL	average	fair	average	average	f. poor	fair	average-	good	good	fair	fair	v. good	screw	yes	yes	good
Maxell UD	f. high	f. high	good	high	good	good	good	v. good	good	average	good	good	screw	yes	yes	good
Memorex Normal Bias	lowish	average+	average	high	good	good	f. good	average	average	average	good	-	screw	yes	no	fair
Osawa LH	average	high	good	average	f. good	good	average	good	good	average	average+	fair	screw	yes	no	good
Philips Ferro	lowish	average	average	f. poor	average	average	fair	good	good	average	average-	v. good	screw	yes	no	average
Philips Super Ferro	lowish	average	average	f. poor	f. good	f. good	average	average	good	average	f. good	average	screw	yes	no	good
Tandy Concertape	v. low	f. high	poor	bad	bad	bad*	v. poor	bad	average	poor	bad	-	welded	yes	no	bad
Tandy Realistic	low	f. high	average	bad	poor	fair*	poor	bad	average	v. poor	v. poor	-	welded	yes	no	fair
Tandy Supertape Gold	average+	f. high	f. good	good	good	v. good	good	bad	fair	fair	v. good	-	screw	yes	no	v. poor
TDK D	average	average	average	average	average	average	average	v. good	good	average-	average	v. good	screw	yes	no	v. good
<b>GROUP 1B TAPES</b>																
Agfa Superferro	lowish	f. high	f. good	fair	v. good	v. good	good	fair	average	average	v. good	average	screw	yes	no	poor
Ampex Grand Master I	average	high	average	average	v. good	v. good	average	average	good	fair	f. good	fair	screw	yes	no	good
BASF Ferro Super LHI	f. high	f. high	good	v. good	good	good	excellent	good	average	fair	good+	poor	screw	yes	no	good
Dixons Prinz Professional	f. high	average	good	good	average	average	good	average	average	good	f. good	extr. good	screw	yes	no	good
EMI Hi-Fi	average	f. high	average	average	good	good	average	average	good	good	good	excellent	screw	yes	no	average
EMI XT	f. high	f. high	good+	v. good	v. good	good+	v. good	good	good	average+	v. good	v. good	screw	yes	no	good
Fuji FX1 (new)	f. high	average	good	good	v. good	good	good	good	good	good	v. good	v. good	screw	yes	no	good
Maxell UD XLI	f. high	good+	v. good	v. good	v. good	v. good	v. good	v. good	v. good	average	v. good	good	screw	yes	yes	v. good
Maxell XLI-S	high	f. high	good	v. good	extr. good	excellent	excellent	v. good	v. good	average	v. good	excellent	screw	yes	no	v. good
Memorex MRX 3	average+	f. high	good	f. good	v. good	v. good	good	good	good	average+	v. good	fair	welded	yes	yes	good
Philips Super Ferro I	average	f. high	average	Philips	average	good	good	good	average	average	good	average	screw	yes	no	average
Scotch Master I	f. high	high	good	good	v. good	v. good	good	average	good	fair	v. good	fair	screw	yes	no	average
Sony AHF	f. high	f. high	good+	good	good+	v. good	v. good	good	good	average+	v. good	good	screw	yes	no	good
TDK OD	f. high	f. high	good	v. good	v. good	v. good	v. good+	v. good	good	average+	v. good	good	screw	yes	no	v. good
TDK AD	v. high	f. high	good	v. good	good	v. good	v. good	good	average	v. good	v. good	f. poor	screw	yes	no	v. good
<b>GROUP 2 TAPES</b>																
Agfa Superchrom	average-	average+	fair	f. poor	v. good	v. good	fair	fair	average	superb	good*	v. poor	screw	yes	no	good
Ampex Grand Master II	average+	average	f. high	high	good	good	good	average	good	v. good	v. good	v. good	screw	yes	no	good
BASF Chromdioxid Super	high	fair	high	high	good	good	excellent	good	fair	superb	good+	v. poor	screw	yes	no	good
Denon DX 7	average	average	average	average	f. poor	fair	fair	good	good	v. good	average	-	screw	yes	no	fair
EMI Superchrome II	average-	average	average	average	average-	good	excellent	fair	average	v. good	v. good+	f. poor	screw	yes	no	average
Fuji FX2 (new)	average	average	average+	average+	good+	v. good-	good	good+	good+	good+	v. good	good	screw	yes	no	good
Maxell UD XLI	average	average	average+	average+	v. good	extr. good	good	v. good	v. good	good+	extr. good	good	screw	yes	yes	v. good
Maxell XLIIIS	high	average	high	v. high	good+	v. good	excellent	v. good	v. good	good+	extr. good	good	screw	yes	yes	v. good
Memorex High Bias	high	fair+	average	v. high	average	f. good	v. good	average	good	v. good	good+	bad*	welded	yes	no	good
Osawa CR	average	average	average	average	f. poor	fair	fair	good	good	v. good	average	-	screw	yes	no	fair
Philips Chrome	average-	fair	average-	average+	average	v. good-	f. good	good	good	extr. good	v. good	average	screw	yes	no	good
Scotch Master II	average	average	average+	average+	good	good	good	fair	average	superb	v. good-	fair	screw	yes	no	f. good
Sony CD Alpha	average	average	average	average	v. good-	v. good	good	average+	good	good+	v. good	v. good	screw	yes	no	v. good
TDK SA	average	average	average+	average+	v. good	extr. good	good	v. good	v. good	good	extr. good	fair	screw	yes	no	v. good
TDK SA-X	high	average	high	v. high	v. good	extr. good	excellent	v. good	v. good	good	extr. good	fair	screw	yes	no	v. good
BASF Chromdioxid II C-90	average	fair	high	high	good+	v. good-	good	good+	good	good+	excellent	fair	screw	yes	no	v. good
BASF Chromdioxid Super 2	f. high+	average-	high	v. high	v. good	excellent	good+*	good+	v. good	superb+	extr. good	f. poor	screw	yes	no	v. good
<b>GROUP 4 (METAL) TAPES</b>																
BASF Metal C60	lowish	average	average	fair	v. good	average	average	fair	average	good+	excellent	v. good	screw	yes	no	average
Denon DX-M C60	average	average	average	average	v. good	good	good	average	average	good	excellent+	v. good	screw	yes	no	v. good
Fuji Metal C90	average+	average	average	average+	v. good	f. good	good+	average	average	good	excellent+	v. good	screw	yes	no	good+
Maxell MX C90	average	average	average	average	excellent	v. good	good	average	average	f. good	superb	v. good	screw	yes	yes	v. good
Osawa MX C60	average	average-	average	average	v. good	average	average	average	average	good	excellent	v. good	screw	yes	no	good
Philips Metal C60	average	slightly low	average	average+	v. good	fair	fair	average	average	good+	v. good	v. good	screw	yes	no	average
Scotch Metafine C60	lowish	average	average	fair	v. good	f. good	fair	poor	average	v. good	excellent+	v. good	screw	yes	no	average
Sony Metal	average	average-	average	average+	v. good	f. good	average	average	average	good	excellent+	v. good	screw	yes	no	good
TDK Metal MA C90	average+	average	average	f. high	v. good	good+	good+	average	average	f. good	superb	v. good	screw	yes	no	v. good
TDK Metal MA-R C90	average	average	average+	average	v. good	good+	good	average	average	good	superb	v. good	screw, metal frame	yes	no	v. good
Agfa Metal C60	average	average	average	average	v. good	f. good	good	fair	fair	f. good	excellent+	v. good	screw	yes	no	good

\*see review

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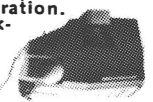
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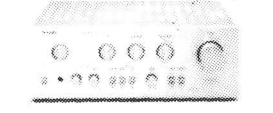
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AMU11(20)	£59.95	ATK 11L	£59.95	R5L(25)	£89.95	D95M	£84.95	KD3100	£92.95	T225 Mayfair	£249.95	X 330(No.L/S)	£319.95	SUC04/STC04L/	£399.95	
AMU22(25)	£79.95	ATK33L	£109.95	R7(45)	£129.95	D350M	£179.95	SLB2/SLB202	£68.95	Cheviot II	£399.95	X 550(No.L/S)	£399.95	RSM07	£399.95	
AMU33(43)	£109.95	AT555L	£159.95	R99Z(30)	£139.95	D500M	£214.95	SL83	£84.95	Berkeley II	£499.95	X 770(No.L/S)	£519.95			
AMU55(55)	£139.95	AT508	£169.95	3900Z(40)	£189.95	D100M	£99.95	SLD1	£84.95	Arden II	£579.95	X 990(No.L/S)	£609.95			
AMU06(72)	£149.95	<b>AUREX</b>		4900Z(55)	£229.95	<b>SHARP</b>		SLD2/SLD202	£84.95	Windsor	£1299.95	XR110	£279.95			
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SB A50(30)	£144.95	ST T50	£109.95	SA4000(52)	£139.95	RT 3151	£99.95	SLQ2/SLQ202	£119.95	<b>TANGENT</b>		XR310	£379.95			
SB 66 (Clean Drive)	£169.95	ST 10L	£114.95	SA5000(70)	£169.95	<b>SONY</b>		SL3033	£134.95	SPL1	£89.95	<b>ROTEL</b>				
<b>HITACHI</b>		ST 55	£169.95	SA101L(20)	£79.95	TCFX2	£79.95	SL1800	£174.95	TM3	£79.95	A1000	£399.95	QLM 32	£9.95	
HA 2700	£64.95	<b>HITACHI</b>		SA202L(30)	£79.95	TCFX3	£99.95	SL1700	£199.95	XLR2	£174.95	5000(No.L/S)	£324.95	QLM 34	£10.45	
HA 3700	£79.95	FT 4400	£109.95	SA 101L(20)	£79.95	TCFX5C	£159.95	SL10	£299.95	Laser 40	£64.95	4000(No.L/S)	£349.95	QLM 36	£16.95	
HA 4700	£99.95	FT 3400	£69.95	SA 202L(30)	£79.95	TCFX6C	£194.95	SL7	£179.95	Laser 60	£79.95	6000(No.L/S)	£379.95	VLM	£24.45	
<b>J.V.C.</b>		<b>J.V.C.</b>		SA 302L(40)	£129.95	TCFX7	£249.95	SLD1	£159.95	Laser 80	£99.95	9000(No.L/S)	£519.95	XLM	£22.95	
AS3(22)	£59.95	TX 1L	£79.95	SA 313L	£239.95	<b>TEAC</b>		SLQ1	£199.95	Laser 100	£129.95	9000A(No.L/S)	£5739.95	ZLM	£55.95	
AX1(30)	£74.95	TX 2L	£133.95	SA 515L	£279.95	CX 310	£79.95	SLQ2	£179.95	Laser 200	£149.95	<b>SANYO</b>				
AX2(40SEA)	£106.95	TX 3	£98.95	<b>SONY</b>		CX 410	£149.95	SL120 II	£149.95	Laser 400	£199.95	V20	£299.95	AT 10	£8.95	
AX3(55)	£129.95	TX 6L	£159.95	STR VX2L	£119.95	LA 108 SYNC	£129.95	SL200	£179.95	Laser 200	£209.95	H20	£189.95	AT 12 XE	£17.95	
AX4(60SEA)	£159.95	TX 10L	£67.95	STR VX3L	£149.95	CS 350	£99.95	SL210	£199.95	E20	£139.95	V20	£189.95	AT 30 XE M/C	£27.95	
AX5(70)	£209.95	TX 10L	£67.95	STR VX4L	£229.95	<b>TECHNICS</b>		SL210 II	£199.95	E30	£174.95	V30	£449.95	AT 32 M/C	£34.95	
AX9(105)	£499.95	TX 10L	£67.95	STR V5L	£259.95	RSM 51	£159.95	AR18S	£89.95	E50	£269.95	V35	£769.95	AUXE	£84.95	
A10X(125)	£59.95	TX 10L	£67.95	TOSHIBA	£119.95	RSM 215	£89.95	AR28S	£129.95	E70	£314.95	V55	£949.95	C400/21000	£189.95	
AX7(90)	£299.95	TX 10L	£67.95	TRIO	£109.95	RSM 205	£74.95	AR8S	£69.95	'90	£449.95	<b>SHARP</b>		GOLDRING		
<b>MARANTZ</b>		TX 1616	£49.95	KR710L	£109.95	RSM 225	£109.95	AR85S	£229.95	<b>REEL REEL</b>		SG1E/SY1HX	£209.95	G900 IGC/ADC		
PM310	£64.95	TX 1616	£49.95	KR720	£169.95	RSM 230	£139.95	AR92S	£289.95	GX G25	£359.95	FULL RANGE P.O.A.		H/SHELL	£48.95	
PM350	£89.95	TX 1616	£49.95	KR80L	£194.95	RSM 250K	£159.95	AKAI		GX 4000 DBL	£199.95	ZR1(SSE34)	£389.95	FTE+1/ADC	£12.95	
PM410	£79.95	TX 1616	£49.95	RSM 260	£179.95	RSM 260	£179.95	SWT 30	£99.95	Z1/SSE34	£429.95	Z/SSE44	£519.95	FCE+1/ADC	£14.95	
PM450	£99.95	TX 1616	£49.95	RSM 65	£149.95	RSM 270K	£219.95	SWT 50	£159.95	S80/SSE50II	£839.95	F2/ADC	£31.95	F3E/ADC	£20.95	
PM550(65)	£139.95	TX 1616	£49.95	RSM 280K	£339.95	RSM 280K	£339.95	SWT 70	£189.95	<b>PIONEER</b>		F1+ADC	£44.95	G/C		
PM750(80)	£189.95	TX 1616	£49.95	<b>CASSETTE DECKS</b>		PC 230	£59.95	CASTLE		RT 707	£399.95	<b>TECHNICS</b>		FF150E	£11.95	
<b>PIONEER</b>		TX 608L	£69.95	AKAI	£69.95	PCX 10	£59.95	Clyde	£89.95	TC 399	£219.95	Z22 System	£499.95	F15E	£16.95	
SA 708	£99.95	F7	£189.95	CSM3	£89.95	PCX 12	£69.95	Richmond II	£119.95	X7	£339.95	80's System	£799.95	VMS20II	£24.95	
A7	£269.95	F9	£239.95	CSM02	£89.95	KX 400	£79.95	Kendal II	£174.95	X3	£289.95	ZII System	£389.95	M.C.A 76	£49.95	
A8	£329.95	TX520L	£189.95	GXM10	£119.95	KX 500	£109.95	CEI ESTION		3440	£699.95	335 III	£499.95	VMS 10II/ADC	£18.95	
A8	£449.95	TX720L	£139.95	GXM30	£129.95	KX 600	£139.95	Ditton 120	£57.95	EA G40	£99.95	V300	£249.95	H/S	£18.95	
SA420(20)	£59.95	ROTEL	£54.95	GXM50	£149.95	KX 800	£169.95	Ditton 121	£69.95	EA G80	£199.95	V400	£364.95	VMS5/H/Shell	£19.95	
SA520(30)	£94.95	RT 300	£87.95	GXF 80	£179.95	<b>TURNTABLES</b>		Ditton 130	£109.95	EA 800	£339.95	V60XE	£369.95	M75 ED	£13.45	
SA620(45)	£119.95	RT 1000	£87.95	GXF 35	£159.95	BSR Quanta 500	£39.95	Ditton 150	£139.95	SS1	£49.95	V80	£519.95	M95 ED	£18.95	
SA720(65)	£139.95	SANSUI	£169.95	GXF 35	£159.95	AKAI		Ditton 160	£184.95	SS110	£79.95	V1000 R	£934.95	M44G	£7.95	
A5(35)	£139.95	T5	£74.95	AUREX	£149.95	APD 33C	£74.95	Ditton 200	£224.95	SS211	£119.95	<b>MUSIC CENTRES</b>		M91 GD	£7.95	
A6(60)	£199.95	T7	£99.95	PCX6AD	£109.95	AP 21C	£49.95	Ditton 210	£224.95	SS3	£169.95	HITACHI		M92E	£9.95	
<b>ROTEL</b>		T9	£119.95	PCX25AD	£109.95	AP 307	£119.95	Ditton 232	£269.95	SS3	£169.95	FULL RANGE P.O.A.		M97 HE	£32.95	
RA 300(25)	£54.95	TUS 5	£119.95	PCX45AD/44AD	£139.95	APQ55C	£94.95	Ditton 100	£89.95	S.E.A 20GL	£89.95	MF 33L	£209.95	M97 HEAH	£34.95	
RA 350(40)	£78.95	TUS 7	£149.95	PCX88AD	£199.95	AUREX		Ditton 110	£89.95	S.E.A 50	£144.95	MF 55LS	£349.95	<b>VIDEO RECORDERS</b>		
RA 500(37)	£68.95	ST225	£79.95	ADM2000	£89.95	SR0 550	£99.95	Ditton 110	£89.95	S.E.A 70	£164.95	VS 5E6	£639.95	VS 5E6G	£639.95	
RA 550(50)	£87.95	ST230	£79.95	ADM800	£229.95	SR0 770	£99.95	Ditton 110	£89.95	S.E.A 70	£164.95	VS 10E6/EG	£719.95	VS 10E6/EG	£719.95	
RA 1000(45)	£119.95	SONY		AD3100	£99.95	HITACHI		Ditton 150	£139.95	EO10	£87.95	7000VHS	£629.95	2000VHS	£499.95	
RA 1010(70)	£137.95	STJX2L	£72.95	AD3200	£129.95	LF 66	£89.95	Ditton 150	£139.95	SG 9800	£249.95	NV3000B/	£699.95	NV3000B/	£699.95	
RB 1000(PRE)	£97.95	STJX4L	£119.95	AD3500	£169.95	QLA5R	£93.95	Ditton 200	£224.95	RE 700	£67.95	NVV300B	£549.95	NV300B	£549.95	
RB 1010(100)	£166.95	STJX5L	£139.95	AD3600	£189.95	QLF4F	£119.95	Ditton 332	£269.95	RE 1010	£87.95	VV 3200E	£429.95	VV 3000E	£429.95	
RC 1000(PRE)	£117.95	STJ60	£109.95	ADR500	£189.95	QLF6F/X1	£224.95	Ditton 332	£269.95	RE 1010	£87.95	VV 6000E	£369.95	VV 6000E	£369.95	
<b>OPTONICA</b>		ST21L	£49.95	<b>HITACHI</b>		QLF7F	£163.95	Ditton 332	£269.95	SG 220 E	£154.95	SG 220 E	£154.95	JVC		
SM 4100(35)	£99.95	ST51L	£69.95	D22SII	£69.95	QLF7Y5F	£199.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	HR7700VHS	£729.95	
SM 5100(45)	£114.95	ST57K	£179.95	DE25	£79.95	LA 21	£59.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	HR2200/TU227	£719.95	
SM 1700(65)	£169.95	ST8044	£99.95	DE35	£84.95	LA 31	£70.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	GX33	£349.95	
SO 9100(PRE)	£169.95	ST82L	£89.95	DE55	£179.95	LA 41	£94.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	GX88	£499.95	
SX 9100(PRE)	£339.95	ST84L	£129.95	J.V.C.		LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	HR7200EK	£524.95	
A5(25)	£74.95	ST84T	£149.95	KDA 11	£79.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	9300 BETA	£399.95	
A7(45)	£99.95	ST84T	£149.95	KDA 33	£119.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	SLC5	£449.95	
A9(65)	£129.95	ST84T	£149.95	KDA 66	£219.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	SLC7	£629.95	
AUD5(65)	£174.95	ST84T	£149.95	KDA 66	£219.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	C7E	P.O.A.	
AUD7(80)	£209.95	ST84T	£149.95	KDA 66	£219.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	SL3000UB/		
<b>SONY</b>		KT 400L	£49.95	DD5	£149.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	TT3000UB	£749.95	
TAAX2(25)	£89.95	KT 60L	£87.95	DD7	£289.95	LA 51	£104.95	Ditton 551	£249.95	SG 3220	£249.95	SG 3220	£249.95	H.V.C.2000P	£514.95	
TAAX3(35)	£114.95	KT 413	£129.95	DD9	£394.95											

# TUNERS

It has been quite a time since *Hi-Fi Choice* looked at tuners and so rather than reprint out-of-date material it has been decided to pull together a list of recommended separate tuners with brief comments on measurements and listening tests from the tuners tested as part of *Hi-Fi Choice Receivers (Tuners & Amplifiers)* Issue No 19. With the turnover of Japanese electronics now coming with a grim 9 month regularity you will not find many Oriental products among this list of 'stayers'. Though to help the prospective customer to draw up a shortlist containing enough products from this guide it has been decided to mention briefly those tuners that did well but are now known to have been replaced. The benefit here is hopefully that the manufacturers will not have seriously downgraded their products and that last year's model may have undergone only simple cosmetic changes to become this year's, and also that any buyer wishing to pick up a bargain may yet find last year's model at a tempting discount. Where we have been unable to make firm recommendations I would state that auditioning is essential, preferably on the aerial installed in your home rather than on any shop rig. If auditioning cannot be arranged then do not buy, or realise that purchase will be a gamble.

## Radio broadcasts

To transmit music through the air an audio signal is made to ride piggy-back on a radio wave. There are two ways in which the signal can be encoded on a radio wave, one is where the frequency of the radio wave (Very High Frequencies (VHF) in itself) is changed or modulated according to the frequency of the audio signal - this is known as *frequency modulation* or *FM*. The other system is *amplitude modulation* or *AM* where the radio wave varies its strength in time to the audio frequencies.

Take the FM transmission first. The FM transmitter operates about a nominal carrier frequency upon which the audio signal rides. The frequency or pitch of the audio signal is modulated in one way onto the carrier while it also carries amplitude information as a frequency variation. The benefit here is that the audio signal is not affected by changes in the radio signal strength and comes free of background noise limitations and interference inherent in AM broadcasting where the amplitude, intensity or strength of the radio signal is used to encode the audio signal. FM broadcasting is thus capable of handling high quality audio signals of wide frequency range and wide dynamic range.

FM broadcasting also offers the potential to transmit stereo information by broadcasting the sum of the left and

right channel signals but then to broadcast the difference signal of the left and right channels encoded on a 38kHz subcarrier. This gives good mono compatibility but enables a stereo decoder to do a bit of adding and subtracting to come up with separate left and right channel signals for stereo.

(For those who need to know a bit more the stereo information is broadcast as an amplitude modulation of the FM radio wave with the 38kHz subcarrier suppressed to give more room for the sum signal. Instead a pilot tone of 19kHz is transmitted which enables the tuner to reconstruct the subcarrier (19 x 2) to get at the difference signal.)

FM broadcasting has its problems though, as those readers who live in Wales or Scotland will know; its waves don't travel too far (about 60 miles) and don't go round hills too well requiring a chain of main transmitters and repeater stations to give UK-wide coverage of FM stereo.

AM broadcasting is split between two wavebands, the Medium waveband and the Long waveband. Medium wave travels well but is prone to atmospheric and local electrical interference, the quality of signal that can be encoded is very limited too. Long wave travels better and is a less populated waveband. Longwave transmission is used mainly in the UK and Europe and after recent internationally-agreed wavelength changes (to minimise after-hours interference) it has become essential to have a Longwave receiver if one is to listen to Radio 4 UK from the BBC.

## Aerials

Clearly each waveband has its own shape and style of antenna or aerial. Medium and Longwave reception can be achieved by using a ferrite rod with tuning coils attached to it, this is the bar aerial fitted to the back of tuners. This should be free to swivel about to help get the best signal and minimise interference.

FM aerials have in my experience been the cause of more problems with folks' hi-fi than almost all the other hi-fi worries put together. You can't buy a 'best' aerial because too much signal is often worse than too little. You need an aerial that is suited to the specific reception conditions local to the tuner. However well meaning advice from a shop in Glastonbury is, it is of little help to the guy installing an aerial in Bradford. Local help and local knowledge of the compass bearing of transmitters and of multipath conditions is essential. (*Multipath* is where the FM signal reaches your aerial after being bounced off different large objects both near and far - hills, blocks of flats, even aircraft can reflect the signal.)

The balanced 300ohm sockets on the tuner are for the connection of a

wire dipole aerial. These aerials are frequently unsuitable for hiss-free stereo reception. The 75ohm unbalanced sockets or terminals on the tuner are for the connection of coaxial aerial lead (like TV aerial wire) and a real aerial. You can buy 'baluns' transformers to connect 75ohm unbalance feeds to 300ohm balanced inputs and vice versa if necessary. The aerial should be mounted high and should be aligned onto the compass bearing of the strongest transmitter; signal strength should be checked as should any multipath signals coming down the lead.

Many people have never heard FM stereo as it should be. Remember that a stereo transmission needs ten times more signal to have the same background hiss as a mono signal. A good aerial properly installed is the only way to provide this; TV aerials, coat hangers, 'rabbit ears' and dipoles wires are not really suitable.

## Features

A tuning knob with flywheel and a long illuminated tuning scale with pointer are the most common features. Some tuners however have an LED or similar digital display. This can be one of two things, a digital readout of the tuned frequency, or the reading from a true digitally synthesised tuner front-end. Don't pay for the latter if you are getting the former. Though these digital scales are impressive many are more convenient for the manufacturer than they are for the user (and family) unless they remember radio stations as they would telephone numbers rather than 'up the left of the scale'. Preset tuning is convenient once the initial tuning is secured though some manufacturers spoil the simplicity of preset with over sophisticated wave band switching or auto scanning.

Some aids are normally provided for accurate tuning, almost always a centre-tune meter or LED display showing when the station is tuned bang on. A signal strength meter is less often found but this gives an idea of how strong a station is and whether it will be able to be received in noise-free stereo. Many of these meters are just so many wasted LEDs as manufacturers choose inappropriate sensitivities.

There are other features which help with tuning. Most tuners and receivers are nowadays fitted with an AFC (Automatic Frequency Control) which holds a station once selected. If you are trying to receive a weak station very close to a strong one you may have to disable the AFC as it will normally lock onto the strongest signal in the vicinity of your tuning. The FM mute feature cuts out interstation noise by suppressing the tuner's front end output if it is not receiving a strong



enough signal. This should cut out noise between stations if correctly aligned but again may have to be switched out to receive weak stations on or near its threshold strength.

Some tuners, often the more expensive models, offer variable selectivity with wide and normal positions which can help keep away interference problems from adjacent channels but is thus of more interest to the DX-ing enthusiast (DX is the jargon term for long distance radio reception).

One common facility is called the FM hi-blend which enables the irritation value of noisy stereo to be reduced without losing stereo separation by progressively blending the stereo high frequencies, where all the hiss is, together into a quiet mono signal.

An output level control is a useful feature if you want to be able to switch from radio to disc to tape or cassette without having to change the volume control setting.

### Performance

**Sensitivity** shows how well the tuner will pick up weak stations above a certain background noise. It is a measure of the aerial strength required to suppress the background noise a certain way below the signal. Figures are quoted for both mono at 30dB signal to noise and for mono and stereo at 50dB signal to noise. The lower the figure the better the tuner.

**Limiting.** When different stations are received at different signal strengths, to avoid the user having to adjust his volume control to cope, the tuner carries this out with a limiting circuit which keeps the tuner's output constant for signals which are stronger than the limiting threshold. The lower the threshold the easier it is to listen to weak stations.

**RFIM or Radio Frequency Inter-modulation** is caused when two adjacent stations interact to produce harmonics which crop up around the tuning scale. The RFIM test checks how well the tuner can reject these unwanted intermod signals, the higher figure the better. Good tuners show better than 75dB.

**Capture ratio** shows how well a tuner would deal with two stations on the same frequency but at different strengths. Its figure is one for the smallest difference between the two stations that will result in the weaker being rejected 30dB below the stronger. The lower the figure the better the tuner will be in areas where two transmitters operate on the same wavelength, for instance in the fringe area overlaps between two transmitters.

**Selectivity** tells how well the tuner can cope with two stations close in frequency and is specifically quoted for the adjacent channel (200kHz away) and the alternate channel (400kHz away). The signal strength in these channels required to breakthrough onto the desired station is measured. The bigger the figure the better, with 10dB being good on the adjacent channel and 60dB good on the alternate channel.

**AM rejection** measures the tuner's immunity to interference from electrical or other radio-borne noise. The bigger the number the better the rejection.

**Image rejection** and **IF rejection** are both measures of the tuner's front end

performance; the bigger the figures the better.

All these measures relate to the radio frequency part of the tuner; the audio section is of equal importance and can be assessed with three simple measurements.

**Crosstalk.** This is the breakthrough of one channel of stereo information onto the other and should be familiar from amp and cartridge measurements. The lower the figure for crosstalk the better the stereo separation and the better the imagery of the received broadcast.

**Pilot-tone suppression.** The stereo decoder will produce at its output a signal which contains all the wanted audio signal, some high frequency rubbish and the 19kHz pilot-tone used to activate the decoder. A steep filter is introduced above 15kHz to chop off this rubbish and pilot-tone which could otherwise upset preamps or tape recorders. Pilot-tone suppression measures how good the tuner is at removing this frequency and gives a figure for how far down the pilot-tone has been reduced, the more minus dBs the better.

**Frequency response.** The filter mentioned above must act very steeply to get rid of the 19kHz pilot-tone and yet leave the top end of the audio spectrum intact. Tuners don't give us the 20 to 20kHz bandwidth expected of amplifiers and cartridges but should produce a clean response up to 15kHz without wrinkles.

### Getting the best from your Tuner

Aerials have already been covered to some extent but it is important to bring home the point that an aerial must be suitable for local reception conditions. There are two things that increase with increasing complexity of aerial design, the first is *gain* (more signal) the other is increased *directionality*. If you want good stereo from the BBC FM stations and from your local BBC and independent radio stations then you will in all probability need only a simple roof or loft mounted dipole (an aerial with a couple of elements).

If you want to go in for longer distance reception of local radio stations in the next big city or even of foreign FM stations then more gain will be required and a more complex aerial installed (more elements). But more elements means more directivity which may mean compromising the reception of one station to be able to beam in on another. The solution here for the real enthusiast is to install an aerial rotator which offers perfect aerial alignment from the armchair with a motor-driven aerial controlled by a compass setting on a remote control.

Once you've got a good aerial installed don't spoil the job by using cheap lossy cable for down lead. The best it will do is weaken your signal which cost you money to get in the first place but it may just as well act as a rain trap and channel water down from the chimney pots into your tuner. Aerial amplifiers may be used to boost the signal over very long runs but professional advice and installation is recommended in these circumstances to avoid disappointment after expense.

Finally if you are plagued by interference check first that it is not just a badly aligned or connected aerial and

then bring in the BBC/IBA, better still the Post Office Interference people.

### Models worth considering

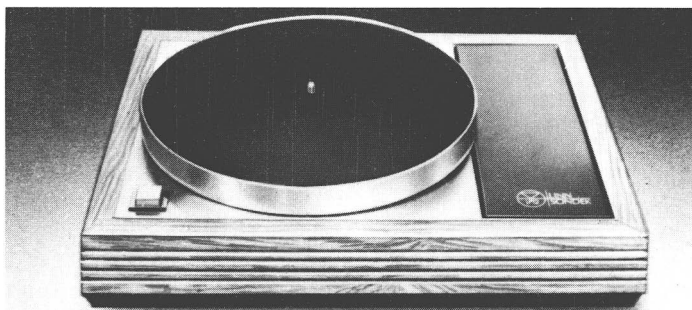
The **A&R T21** showed good technical measurements and offers preset tuning with basic features at £173. The tuning scale which uses LEDs was not well liked but for the buyer who is looking for domestic convenience is a hassle-free package coupled with good performance this tuner can be recommended. A full report appears in the chapter on *Receivers*.

The **Aurex ST-T10L** (£115) three band receiver is part of the Aurex micro-components series. A simple manual tuner the *ST-T10L* has good sensitivity but proved difficult to hold on tune with weak signals. Other measurements were above average or better, apart from AM and image rejection, and there was some inter-modulation with the pilot tone. Auditioning proved FM to be significantly better than average. The signal strength meter was criticised. A *ST-T12L* model is available for £12 more fitted with ceramic filters in the front end which should improve some measurement figures. The *T10L* is now also available in black.

The **Meridian 104** (£225 when reviewed, now £259), the now medium wave capable **NAD 4020** (£86 when reviewed, now £89.50), the **Rogers T75 Series 2** (£155) and **Sugden A48/II** (£150 when reviewed, now £161) are all recommended models and receive full reviews in the chapter on *Receivers*.

The **Sugden R51** (£172), though of somewhat spartan appearance, can be recommended as it measured well throughout with only a slightly bright frequency response. Sugden have shown a digital frequency synthesised version of the *T48* circuitry for about £250. Rogers likewise have produced a digital tuner to match their *A100* amp. The slim line *T100* tuner is expected to cost around £200.

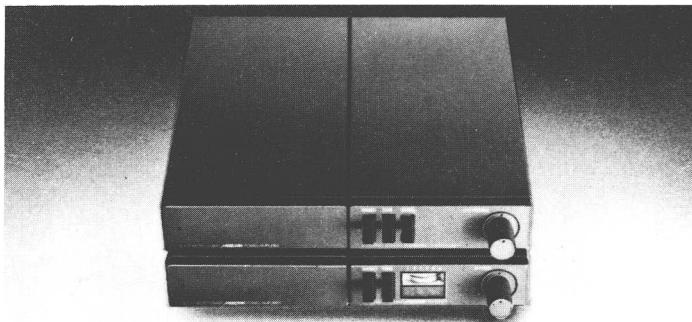
Sony's **ST-J55L** did well on RFIM, crosstalk and pilot tone suppression measures though was in other areas below average. However, in use the tuner was liked with reasonable sensitivity and good rejection of spurious. This tuner has just been discontinued but may yet be found in the shops at around £140 or less. Other tuners which did well but are now discontinued included the mammoth **Aiwa AT9700** (£250) and **JVC's TV3L**, though AM performance was below average. The **Marantz ST600** proved disappointingly aligned but should have been capable of good performance. The **Optonica ST5100** was similarly problematic but proved a competent subjective performer. Sansui's excellent *AU/TU* range has now been discontinued including the recommended *TU217*; Technics too have changed ranges though the cheapest Technics tuner (the **ST-S1 L**) proved reasonable sounding if noisy. The **Yamaha T550** tuner was well liked on audition and showed useful performance on AM reception too. These obsolete machines are listed only for the bargain hunter and as an indication of which current models could be shortlisted for audition.



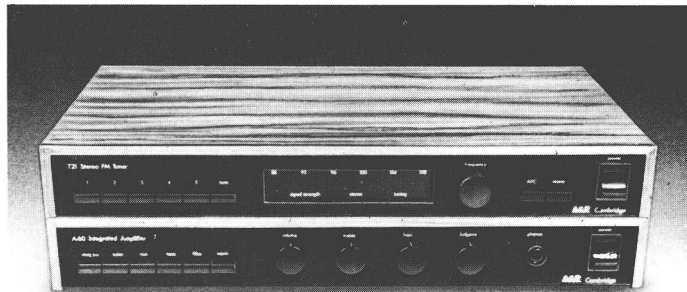
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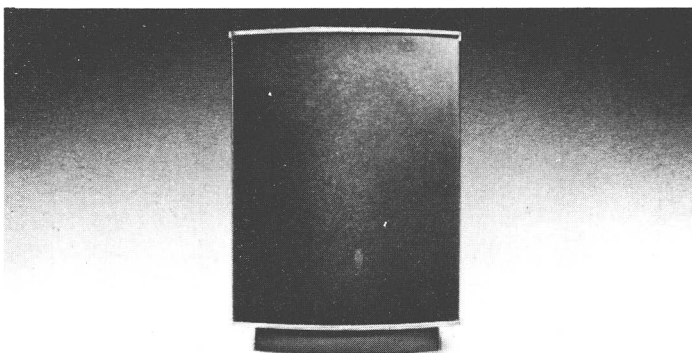
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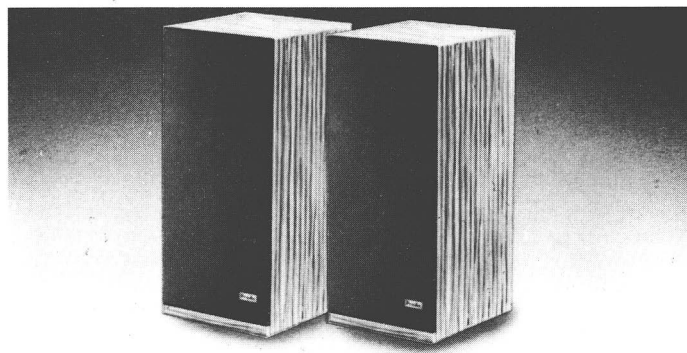
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# HEADPHONES

Technically it is very difficult to lay down guidelines for what a headphone should do as so little understood is the complex area of psychoacoustics that relates to headphone listening. Our reviews are therefore strongly biased towards a subjective assessment of the headphones though frequency response measurements were made to various standards and charted against suggested ideal curves for each measurement technique. These graphs do give an indication of the general tonal balance of the product in question.

## Types of phone

The single most important distinction in headphone design is between open and closed earpiece designs which is often, but not invariably, related to whether the phone sits on the ears (*supra-aural*) or over the ears (*circum-aural*). Open back designs do not cut down sounds from outside that much and often can be heard by people other than those using this type of headphone. The benefit to the open backed design is that they don't produce ear-claustrophobia. Closed back designs usually exclude outside noise well and often couple better to the ear at low frequencies but do give some listeners a boxed in feel.

Among the conventional moving-coil phones there is a distinction between high and low impedance designs. The amp headphone socket is commonly a stepped down loudspeaker signal (using a series resistor and offering a 300ohm load). This steps down the power for low impedance phones and helps the amp match and protect higher impedance designs which could be otherwise connected directly to the loudspeaker terminals (this is not however recommended). Some of the less sensitive/well matched phones will not match tape recorder headphone sockets well and this is mentioned in the reviews. The more exotic electrostatic or electret designs are connected via a transformer box direct to the loudspeaker outlets.

## Choosing headphones

Checking what you need from headphones, whether they are to be used by a member of the family while others watch TV in the same room or whether you need to hear the telephone while wearing phones, etc, will help cut down the sizeable market to a handful. Checking on these phones for comfort and tonal balance will provide a short list.

## OTHER MODELS WORTH CONSIDERING

In this chapter it was decided to reprint only the Best Buy reviews to economise

on space. Of course many other models can be recommended and a brief resumé of their strong points and weakness as discovered by Martin Colloms in his test programme follows.

The **AKG K80** proved to be a quite comfortable phone offering a good balance of performance; this open backed model sells for around £20. The Audio Technica electrostatic headphones were found to offer exceptional dynamic range capabilities. The asking price of £70 and £80 for the **ATH-7** and **ATH-8** models seemed to represent good value for money for high quality electrostatic phones; since testing the price has increased to £80 and £139 for the models respectively, though typical discount prices seem to have changed little.

Beyer's **ET1000** electrostatic (£140) was found to be neither particularly comfortable nor capable of high volume levels but it was still the smoothest and most accurate phone auditioned, despite its bright balance. It can therefore be recommended but compared with models like the conventional Beyer **DT440** it offers only poor value for money.

JVC's **HM200E** (£48) is more than a simple closed headphone system. Indeed as a closed back design its performance is ordinary but the phones contain microphones for binaural recording. As a low cost complete binaural recording system they are extraordinary and can be recommended.

The **Ross RE-258** (£20) were found to be both light weight and comfortable to wear, they were quite detailed and neutral with reasonable bass extension. The 258s are semi-open phones.

Two Sennheiser models received recommendations, the **HD424X** (£26 when reviewed, now around £32) is a lively, open backed model with fine stereo performance but some 'metallic' colouration, the seriousness of which will depend on how this irritates or appeals to the individual listener. The **HD222** is a closed, noise-excluding headphone and though not accurate it is pleasant to listen to and was recommended at the price (£30 when reviewed, now around £34).

Sony's basic **DRS3** (£15) is related to the volume control-fitted **DRS4** and the **DRS5** which is similarly equipped but has additional tone controls. At its price the **DRS3** was found to offer some noise-exclusion and a reasonably balanced performance.

The complete range of Stax headphones seems to have come in for recommendation! The **SR44** (£70 when reviewed, now £89) is a polarised electret model complete with a transformer unit which also contains speaker switching. These phones were comfortable and easy to drive having an airy,

clean and detailed character although their balance was considered on the thin side.

The other Stax headphones can all be used with the **SRD-6B** adaptor box which is self powered from the loudspeaker outlets and costs £49. (Other energisers are now available including a headphone pre-amplifier but these were not tested as part of the *Choice Headphones* programme. The two-phone **SRD7SB** energised makes a welcome comeback in self-energised form. The **SR5** phones are the cheapest of the Stax Electrostatics (£69 plus energiser) and were found to be quite accurate, showing the characteristic delicacy and musical detail for which electrostatics are renowned. The **Stax Lambda** (£155 plus energiser) was found to offer exceptional performance missing the strongest recommendation only because of its necessary high price. These phones have an extraordinary clarity and immediacy with minimal midrange colouration though the bass is a little humped and the balance bright. The *Lambda* can be used with **SRD07X** adaptor which can be either battery or mains powered; deriving its audio signal from a standard jack plug this unit is particularly suited to high quality monitoring of portable tape recorders. The sound quality of the phones was preferred though with the cheaper **SRD6SB** adaptor.

The **Stax Sigma** (£212 plus energiser) has its electrostatic diaphragm placed forward of the ear and is loaded by an acoustic box into which the ears are introduced, for once living up to Stax's description of their phones as 'Ear Speakers'. Though the price is difficult to justify they were rated highly on their spacious, coherent and ambient stereo, and of course comfort though other listeners were aware of bass lift and a fizziness in the upper treble together with some midrange suckout. Overall they were regarded as a significant advance in headphone design and recommended, though audition is essential before purchase.

Wharfedale's **102** (£28) phone contains transducers of the isodynamic or orthodynamic type. Though their sound quality was judged competitive at the price they do need a fair amount of driving and were not noted for comfort.

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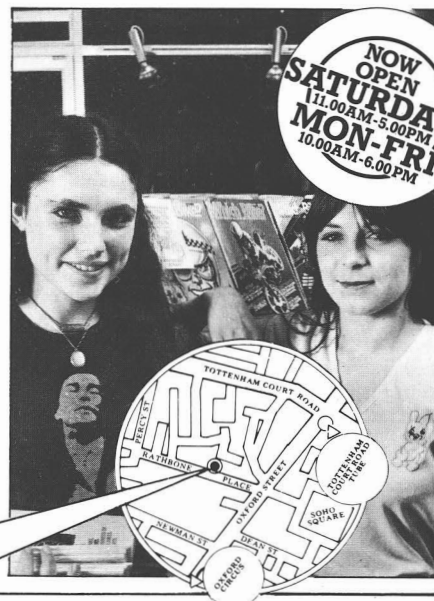
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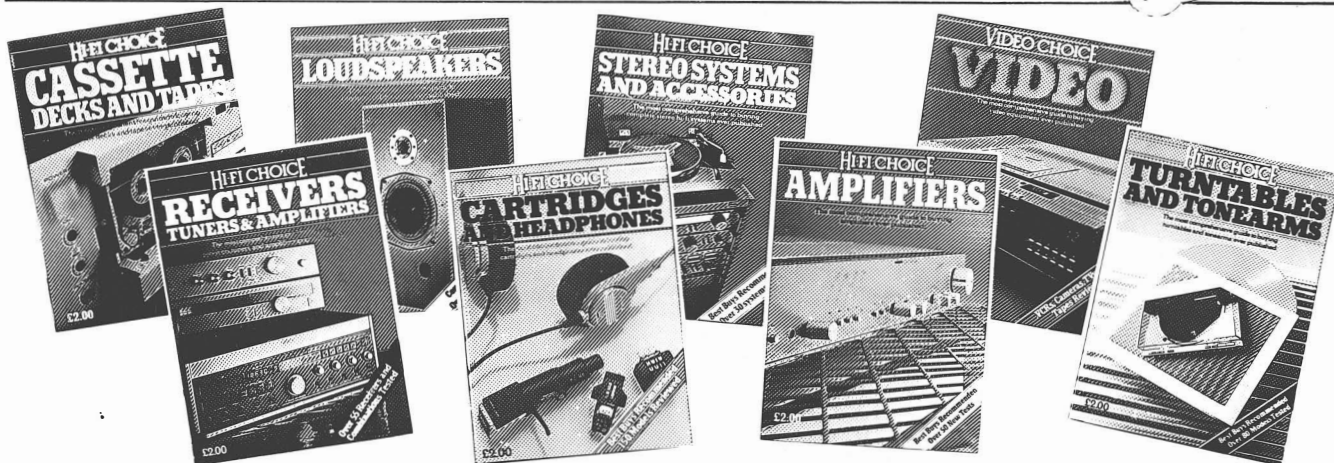
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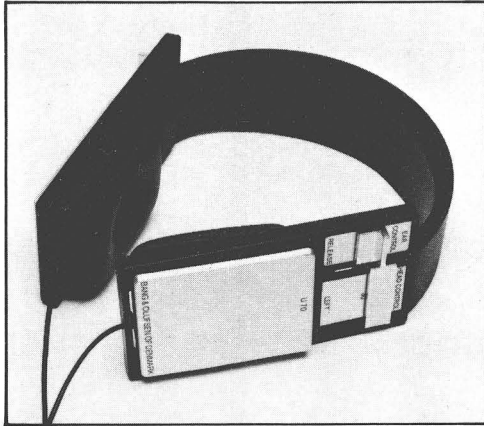
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## Bang & Olufsen U70

**BEST BUY**

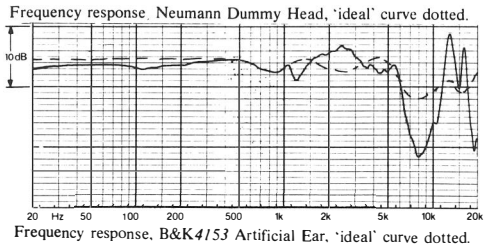
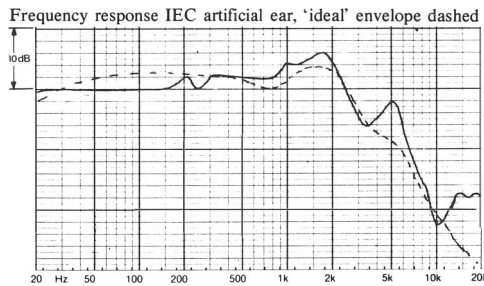
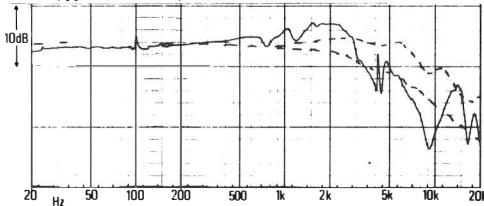


extension at low and high frequencies. However, the stereo effect was not quite as airy and ambient as for some of the 'open' phones, and some slight veiling of detail was occasionally noted.

Worthy of best buy status, these are fine headphones which excel on normal domestic program, and offer some useful acoustic isolation. For long term monitoring though they are probably a bit tight, and they also need a fair amount of driving.

### GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz  
(deviation from mean curve) ..... +3.5dB, -2dB  
Frequency response overall within  $\pm 5$ dB,  
(deviation from mean curve) ..... <20Hz to 7kHz  
Impedance ..... 140 ohms  
Sensitivity for 2.83V (via 330 ohms for Jack) at  
500Hz; (equivalent to 1 watt/8 ohms) ..... 94dBlin/89dBA  
Connection and lead length ..... jack\*, 3m  
Weight and comfort ..... 300g, above average  
Type ..... orthodynamic, supra-aural, semi-open  
Sound insulation ..... moderate  
Loudness ..... good, needs fair driving  
Subjective quality ..... v. good,  
Price (typical, inc VAT) ..... £39



These unusual looking headphones employ the orthodynamic principle of operation, a plastic film with lightweight surface coil and magnetic drive. The successful soft inner headband technique is used, together with rather stiff controls to permit locked adjustment of pad angles and axis. While they were pretty comfortable, the side pressure was judged too high and could not be reduced by pre-stressing (a useful dodge with steel sprung headbands.)

The lower than average impedance (a very uniform 140 ohms) meant that the sensitivity was lower than the voltage specification might indicate, and to produce a decent sound level using nominal 330ohm impedance amplifier sockets the volume setting needed to be well up. Consequently these 'phones are not suited to tape deck outputs. The low frequency range was excellent, exhibiting good power and a cutoff below 20Hz, with no audible distortion; the quality of ear seal did not affect this unduly.

Lab measurement showed an interaction with the artificial ear at around 8kHz, which varied with position, but which would also seem present on the dummy head graph, relative to the 5 and 15kHz regions. This anomaly aside, an interestingly close correspondance to our 'ideal' was shown by the curves for this model, and the response was clearly very extended and generally well balanced and even.

This character was confirmed by audition, the U70 proving to be quite clean and neutral with good

## Beyer DT440/441

(extensively re-assessed)

Beyer Dynamic GB Ltd., 1 Clair Road, Haywards Heath, Sussex RH16 3DP  
Tel (0444) 51003

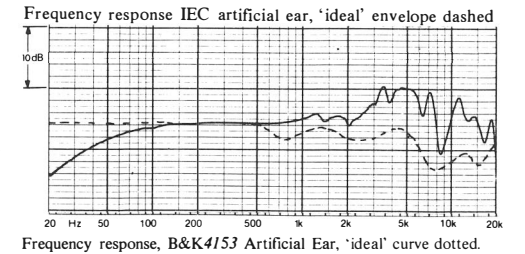
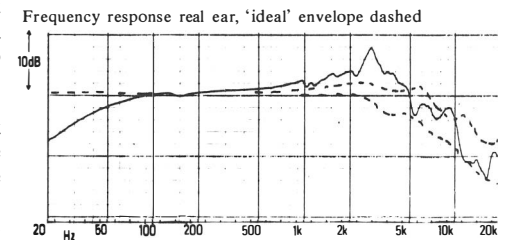
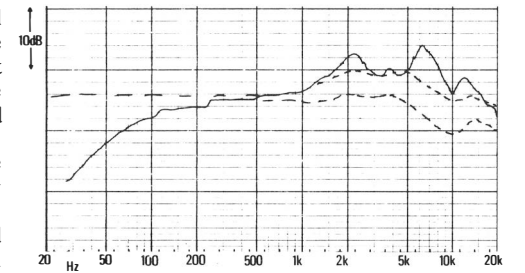


A recommended buy, the DT440 sounded best with a few notches of treble cut, the overall sound quality as well as level of comfort being highly favoured. A restyled model the DT441 was also checked and auditioned in the latest tests, and results were substantially identical.

### GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz  
(deviation from mean curve) ..... +6dB, -1dB  
Frequency response overall within  $\pm 5$ dB,  
(deviation from mean curve) ..... 32Hz to 3kHz  
Impedance ..... (710 to 560) 560 ohms  
Sensitivity for 2.83V (via 330 ohms for Jack) at  
500Hz; (equivalent to 1 watt/8 ohms) ..... 104dBlin/103dBA  
Connection and lead length ..... jack\*, 3m  
Weight and comfort ..... 260g, good  
Type ..... moving-coil, supra-aural, open  
Sound insulation ..... little  
Loudness ..... good  
Subjective quality ..... good  
Price (typical inc VAT) ..... £32 when reviewed,  
now £35 (440) £41 (441)

\*on LS or DIN



This well styled 'phone was lighter than its size might at first suggest, and proved comfortable for all those who tried it. Of the 'open' type little noise exclusion was provided, the ear pads being of a soft grey foam material. The pressure appeared to be just right, and because a tight seal was not required they were not over-critical of positioning.

Nominally 600 ohms, the impedance varied little over the frequency range, and the good sensitivity allows their use with virtually any normal source. The low frequency range was reasonably extended to 35Hz with moderate but not serious distortion audible on sine wave drive below 100Hz. Our first sample was faulty but as the second developed a similar buzz after only a few hours use, we are left to wonder about power handling/reliability aspects. Decent sound levels were however easily attained.

Artificial ear measurement gave an excellent correspondance with the theoretical 'ideal' curve except for a shelf boost of an average 5dB over the entire treble band. Otherwise the response was clearly smooth, and the dummy head also provided comparatively close correlation with this result, with the inflexibility of its plastic 'ears' producing a little more bass loss than would actually occur with normal use.

On audition this model rated as 'good' which was fine for the price. It was favoured for its open, airy sound at low and mid frequencies, fine stereo, and low levels of coloration, but some mention was made of the excessive, albeit even, treble; if this were solved, its rating could well have been even higher.

**BEST BUY**

**Sennheiser HD400** (revised and reprinted)  
 Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont-St-Peter SL9 9EW  
 Tel (02813) 88447



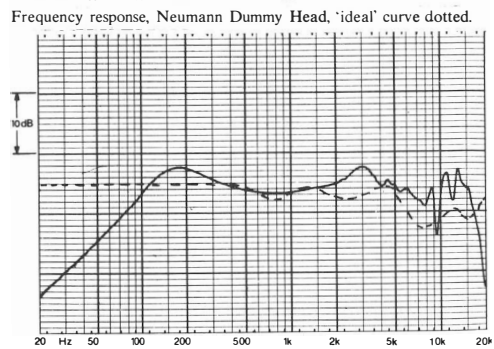
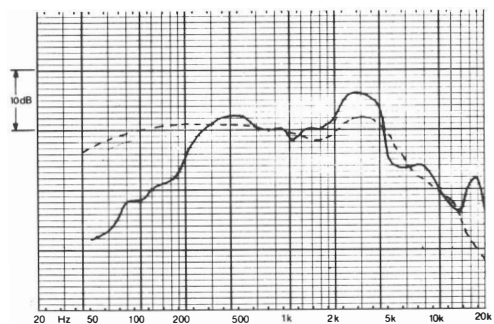
**GENERAL DATA**  
 Frequency response 100Hz-5kHz, rel. 500Hz  
 (deviation from mean curve) ..... +4dB, -1dB  
 Frequency response overall within  $\pm 5$ dB,  
 (deviation from mean curve) ..... 75Hz to 18kHz  
 Impedance ..... (540-660) 540 ohms  
 Sensitivity for 2.83V (via 330 ohms for Jack) at  
 500Hz; (equivalent to 1 watt/8 ohms) ..... 99dBlin/97dBA  
 Connection and lead length ..... jack\*, 3m  
 Weight and comfort ..... 80g, good  
 Type ..... moving-coil, supra-aural, open  
 Sound insulation ..... little  
 Loudness ..... good  
 Subjective quality ..... above average  
 Price (typical inc VAT) ..... £15 when reviewed, now £19  
 \*DIN and DIN speaker versions available

Apart from a moderate pressure from the soft foam ear pads, one was hardly aware of the presence of the HD400s; in fact, representing Sennheiser's least expensive 'open' type of headphone, they felt almost too insubstantial to work properly! With a nominal impedance of 600 ohms the sensitivity was sufficient for most applications and little variation was observed over the frequency range. Subjectively, the bass extended to 40Hz, with no audible distortion.

The lab results were surprisingly good in view of the price. While the low frequencies clearly rolled off below 100Hz with an associated mild hump at 200Hz, quite promising correspondence with the ideal curve was obtained thereafter, although the 3kHz region was forward and the treble also elevated a few dB. On the Neumann fixture increased output was shown in the 1-2kHz range, but the excess high frequency output above 7kHz was also indicated, as was the low frequency rolloff.

On audition the HD400 was found to produce convincingly ambient stereo with a well integrated if restricted frequency response bandwidth. The sound was not without some coloration, notably mid nasality and hardness, plus some mild treble fizz; however, these defects did not spoil the general clear and open quality of these phones.

Warranting a 'best buy' recommendation, the HD400 proved to be comfortable and provided a more than satisfactory sound quality at a rock bottom price. As with all Sennheisers, the whole device unplugs and disassembles for easy service, and was almost indestructible.



Frequency response, B&K 4153 Artificial Ear, 'ideal' curve dotted.

(extensively re-assessed) **Sennheiser HD420**  
 Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont-St-Peter SL9 9EW  
 Tel (02813) 88447

**BEST BUY**



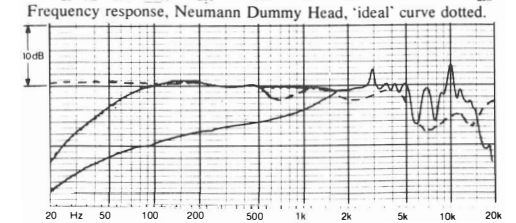
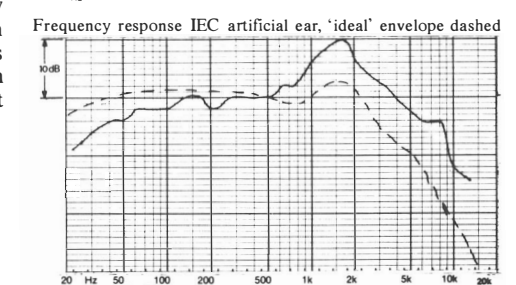
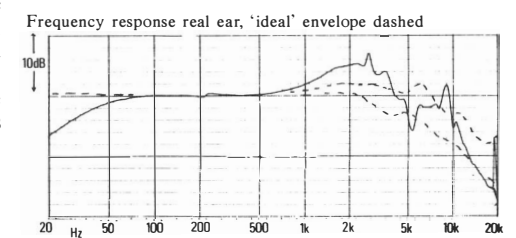
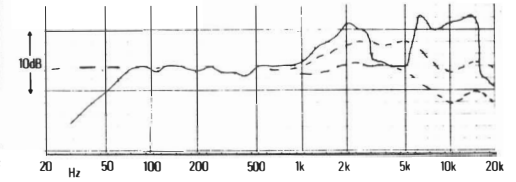
**GENERAL DATA**  
 Frequency response 100Hz-5kHz, rel. 500Hz  
 (deviation from mean curve) ..... +2.5dB, -2dB  
 Frequency response overall within  $\pm 5$ dB,  
 (deviation from mean curve) ..... 50Hz to 8kHz  
 Impedance ..... (530-625) 530 ohms  
 Sensitivity for 2.83V (via 330 ohms for Jack) at  
 500Hz; (equivalent to 1 watt/8 ohms) ..... 100dBlin/101dBA  
 Connection and lead length ..... jack, 3 m  
 Weight and comfort ..... 140g, good  
 Type ..... moving-coil, supra-aural, open  
 Sound insulation ..... little  
 Loudness ..... good  
 Subjective quality ..... good  
 Price (typical inc VAT) ..... £27 when reviewed, now £37

This brand new design has abandoned the traditional Sennheiser foam pads in favour of the flat velour type of cushioned fabric, the tension headband being of comfortable foam with a separate flexible head support. Of 600 ohms nominal impedance the variation over the frequency range was small and sensitivity was about average at 100dB, sufficient for most applications. No audible distortion was evident at lower frequencies, with the limit appearing about 35Hz.

Measurements on the IEC jig gave generally good results apart from some treble exaggeration around 10kHz. Measured on the real ear the bass register was quite well maintained but a much brighter treble range was recorded which did not correlate well with the listening test data.

On audition the '420 scored well for its price, the sound being basically quite well balanced with a wide response. A stable ambient stereo presentation with good clarity was provided. These 'phones were not however without faults, and some criticism was made of a mild metallic coloration and a slightly peaky treble range, with some attendant fizz and harshness.

Overall, the benefits of comfort and general sound quality, particularly the stereo presentation, outweighed the coloration aspects, and the model is therefore recommended at the price.



Frequency response, B&K 4153 Artificial Ear, 'ideal' curve dotted.

**BEST BUY**

# Sony MDR3

Sony (UK) Ltd., 134 Regent Street, London W1  
Tel 01-439 3874



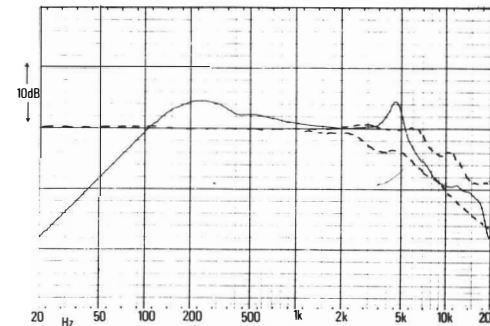
**GENERAL DATA**

Frequency response 100Hz-5kHz, rel 500Hz (deviation from mean curve)	+3dB, -3dB
Frequency response overall within ±5dB (deviation from mean curve)	80Hz to 20kHz
Impedance	essentially 32 ohms
Sensitivity for 2.83V (via 330 ohms for Jack) at 500Hz (equivalent to 1 watt/8 ohms)	103.5dBlin/101.3dBA
Connection and lead length	jack, 3m
Weight and comfort	40g, very good
Type	moving coil, supra-aural, open
Sound insulation	none
Loudness	very good
Subjective quality	good
Price (typical, inc VAT)	£17

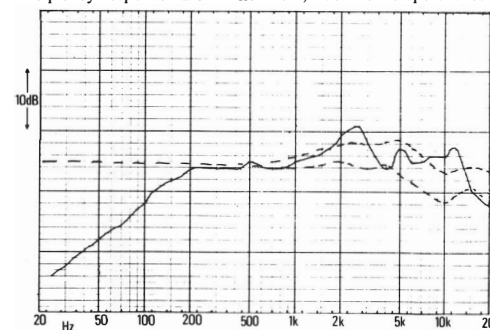
These genuinely lightweight 'phones (40g) have rapidly established themselves, the consensus of opinion being that they sound good and are inexpensive, while also providing high user comfort - all comments confirmed in our findings. (These same 'phones are supplied with the Sony *Stowaway* portable stereo cassette player where they are fitted with a micro jack plug.) The finish and construction were both excellent, with easily adjustable headbands, and they certainly proved comfortable. In fact, these 'phones were so light that it was more or less possible to forget you were wearing them, while their open construction meant that they sounded transparent in the 'ambient' sense. Sensitivity was sufficient for most applications, and they could be driven to high sound levels without distress.

The response curves showed a characteristic which corresponded well to our target envelope above 150Hz. However, despite the good response extension at high frequencies, the unit clearly suffers from a premature bass rolloff; in fact, the response was down at 100Hz, and low bass frequencies were well attenuated.

This bass loss was apparent on audition, but the high level of clarity available, the openness and spaciousness of the perceived stereo sound field, as well as the even and extended treble, won over most listeners. A rating of 'good' was awarded, and taking into account comfort and finish, 'best buy' status at the price is clearly merited.



Frequency response IEC artificial ear, 'ideal' envelope dashed



Frequency response real ear, 'ideal' envelope dashed



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## Yamaha HP3

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex  
Tel 01-863 8624



This inexpensive headphone was heavier than it looked, and in comparison with the *HPI/2*, its headband resulted in greater ear pressure. Since the *HP2* appears to employ the same innards, we feel that their improved wearer comfort could be worthwhile despite the slightly higher cost. The *HP* series of headphones are all well made and finished, and use flat film diaphragms with spiral coils of very low mass – a sort of magnetic film transducer. Of supra-aural design, the capsules are semi-open and provide only a little sound insulation. Their sensitivity was below average, and as a result some cassette decks may not drive these 'phones to high volume levels. At high levels the sound exhibits negligible low frequency distortion, with a smooth and comparatively well-extended bass register.

The frequency response of the *HP3* showed some family resemblance to that of the previously reviewed *HPI*, notably in its flat bass and mid frequency range, with a suggestion of excess around 1kHz and then a smooth resonance-free but depressed treble. The result was equivalent to a '-3' or so of treble cut setting on an amplifier tone control, and may therefore be corrected if so desired.

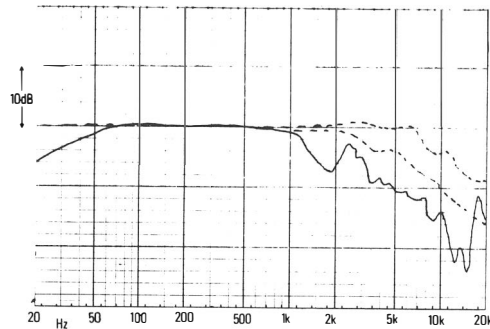
The subjective performance resulted in an 'above average' rating, which is fine at the price. The stereo presentation was good with the overall character relatively uncoloured, but with some dulling and with an impression of mid prominence; the effect was smooth and slightly 'shut-in'. Compared with the *HPI*, the bass showed a little

less extension while the treble was not quite so airy.

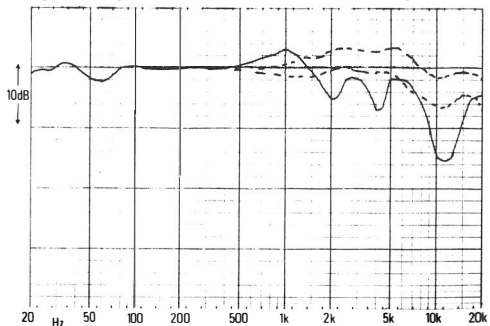
The *HP3*s may be recommended, but we suspect that most purchasers would opt for the similar but more comfortable *HP2* at ten pounds more.

### GENERAL DATA

Frequency response 100Hz-5kHz, rel 500Hz (deviation from mean curve)	+2dB, -4dB
Frequency response overall within ±5dB (deviation from mean curve)	20Hz to 10kHz
Impedance	150 ohms
Sensitivity for 2.83V (via 330 ohms for Jack) at 500Hz; (equivalent to 1 watt/8 ohms)	101 dBlin/97dBA
Connection and lead length	jack, 2.4m
Weight and comfort	170g, average
Type	magnetic film, supra-aural, semi-open
Sound insulation	fair
Loudness	good
Subjective quality	above average
Price (typical, inc VAT)	£17



Frequency response IEC artificial ear, 'ideal' envelope dashed



Frequency response real ear, 'ideal' envelope dashed

BEST BUY BEST BUY

## Yamaha HPI (extensively re-assessed)

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middlesex  
Tel 01-863 8624



A subtly styled and relatively compact headphone, the *HPI* utilised the soft sub-headband system which gave good comfort. Two other smaller and less expensive phones of similar design (*HP2* & '3') are also available, which offer progressively less sensitivity and bass extension. The impedance of the *HPI* was entirely uniform at 140 ohms, and the sensitivity was about average; higher than for most orthodynamics. Some noise exclusion was provided, and judged subjectively, the bass extended down to a low 23Hz, with inaudible distortion.

Lab measurement confirmed the extended low frequencies which were not greatly affected by the poorer seal on the real ear. Using the B&K, the response was quite close to the ideal, apart from a slight forwardness at 800Hz, a mild depression at 1.8kHz, and broadly deficient upper treble, 3 to 5dB down. This overall 'shape' was confirmed on the 'real ear' although rather more energy from 2-8kHz was recorded here.

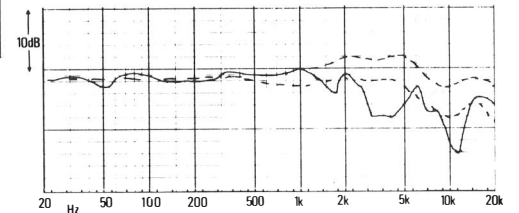
Subjective testing gave results which corresponded closely with the B&K response. Extended, smooth and mildly 'rich' in character, a degree of mid hardness was noted (possibly the 800Hz lift), together with a slightly 'enclosed' feeling to the frequency balance; one listener commented that he felt it was a little oppressive. Stereo was well reproduced, with good clarity and detail, and a natural vocal balance.

Easy on the ears, the *HPI* warrants strong recommendation. In some ways it represented the opposing solution to the Beyer *DT440*: both were

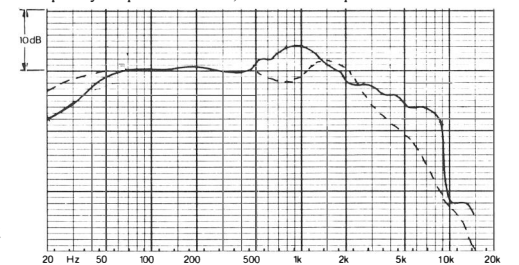
judged good, but each in their own way deviated from the ideal response.

### GENERAL DATA

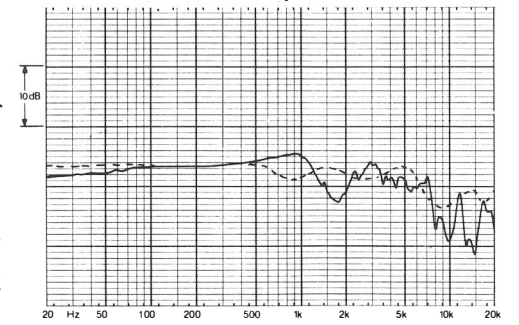
Frequency response 100Hz-5kHz, rel. 500Hz (deviation from mean curve)	+4dB, -4dB
Frequency response overall within ±5dB, (deviation from mean curve)	< 20Hz to 12kHz
Impedance	140 ohms
Sensitivity for 2.83V (via 330 ohms for Jack) at 500Hz; (equivalent to 1 watt/8 ohms)	104dBlin/98.5dBA
Connection and lead length	jack, 2.4m
Weight and comfort	250g, above average
Type	orthodynamic, supra-aural, semi-open
Sound insulation	moderate
Loudness	good
Subjective quality	very good
Price, (typical, inc. VAT)	£35



Frequency response real ear, 'ideal' envelope dashed



Frequency response, Neumann Dummy Head, 'ideal' curve dotted.



Frequency response, B&K4153 Artificial Ear, 'ideal' curve dotted.

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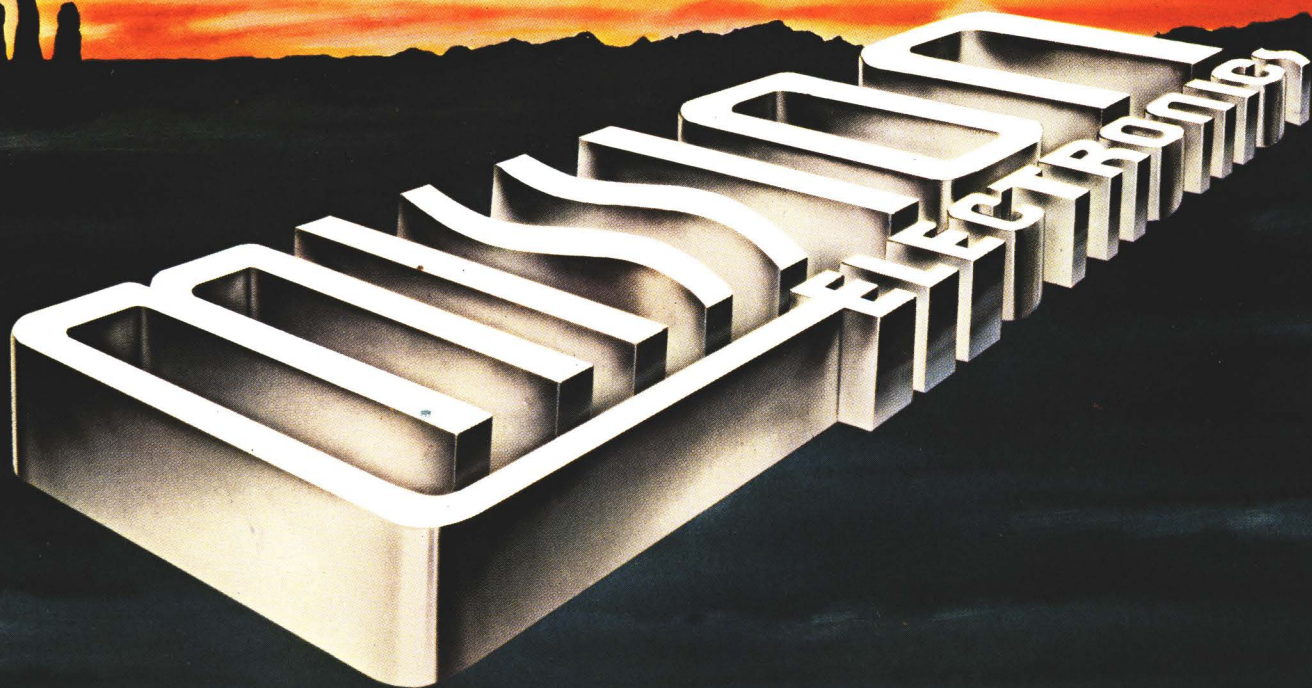
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