

**HI-FI CHOICE**

# LOUDSPEAKERS

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## Origin of Speakers.

### An Introduction

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

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

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

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

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



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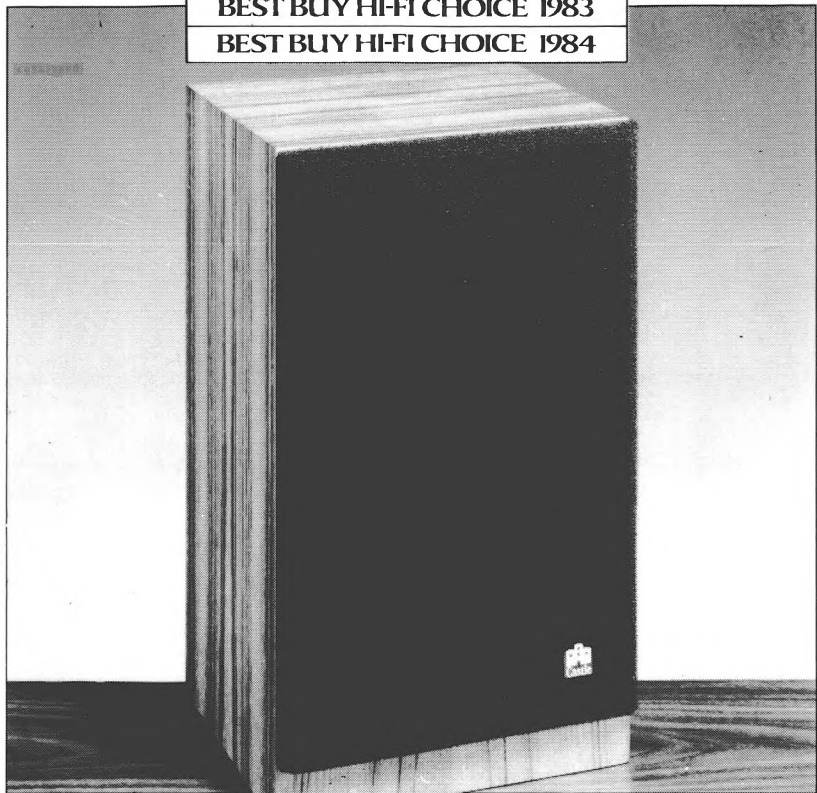


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# HOW TO USE THIS BOOK

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Each edition in the *Hi-Fi Choice* series aims to test and compare as many models as possible in a given hi-fi product category. The introductory and concluding chapters are intended to help you make the best use of the reviews themselves, as well as filling in the hi-fi background.

Although each *Hi-Fi Choice* test programme generates an immense amount of data, some of it extremely technical, each book is intended to provide a straightforward, accessible guide for the general hi-fi buyer — as well as for the more technically-inclined enthusiast or professional.

First, a brief **Editorial Introduction** sets out the *Choice* approach to hi-fi product assessment, discusses the problems of inclusion and omission of models tested, and makes some important points on the interpretation of review judgements.

One of the main advantages of the **Hi-Fi Choice** format is that it allows consistent review procedures to be applied to all the products tested — and with results obtained under consistent conditions, truly valid comparisons can be drawn between competing models. Gathering together a large number of reviews in a single publication gives the opportunity for a fair appraisal of strengths and weaknesses which might go unrecorded under less exacting test methods.

With a comprehensive review project like this, there is no need for a generalised and probably repetitious preamble at the start of each review. So while the reviews may at a glance seem rather terse, they can be seen in the context of the general overview given by the introductory sections. And while each review of course summarises our test findings on the model concerned, the later concluding chapters draw these results together and put them in context.

Written in strictly non-technical language, the **Consumer Introduction** starts with loudspeaker basics — how they work, and general design considerations. Test methods used are explained in terms of their relevance to actual use and to the sound quality you can expect to hear at home, and some pointers are offered to help you select the best speakers for your room requirements, existing equipment and musical taste.

The **Technical Introduction** includes a more detailed explanation of laboratory test techniques and their relevance in engineering terms, with more information on the general standards to be expected in measured performance, as well as the methods and equipment used for the panel listening tests.

**Reviews** of course occupy the biggest single

section of the book, nearly 150 pages. Each contains a general description — covering construction, finish and engineering quality — followed by a report on the findings of the listening panel in 'blind' tests, and a lab report covering the technical performance. The summary draws together these judgements and in each case attempts to offer a constructive conclusion or recommendation on the model's overall merit and value for money.

Following the reviews proper is a section of **Summary Reviews**, briefer assessments of a number of models for which space did not permit the inclusion of the full review. The bulk of these are models which, while theoretically discontinued or reaching the end of their currency in manufacturers' ranges, are still available quite widely.

**Conclusions** is the section in which the author looks over the results as a whole, and is able to point out some general findings and trends which have emerged. It is worth noting that the author of a *Choice* book is in a unique position to do this, having assessed a larger number of current products than almost anyone, and also working with consistent test conditions.

**Best Buys and Recommendations** offers an attempt to summarise the strengths and weaknesses of the best-performing models. While such concrete findings are of course important, they should always be treated with caution — and we cannot stress too strongly that our judgements here should be interpreted carefully in the light of the reviews themselves. To do less is in many cases to be unfair to the products, as our recommendations inevitably reflect *our* assessment of the relative importance of the performance aspects reported on, which may not be the same as yours!

Covering all the models included in the full reviews, the **Overall Comparison Chart** gives an instant guide to the major test findings, and may be of help in trying to shortlist models for a particular requirement.

Finally, the **Glossary** offers definitions of the technical terms and jargon which inevitably surround the subject of hi-fi!

Steve Harris

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**From the increasingly competitive 'budget' models to true studio monitors, this edition covers the best of recent speaker designs, along with established models in all price categories.**

Progress in loudspeaker design tends to be less than obvious from the outside, as technical advances are often hidden within conventionally self-effacing boxes. Perhaps this is one reason why nearly all manufacturers now make grilles removable, and ensure that the speakers look at least presentable without them!

Even with grilles off and drive units exposed, you cannot tell much about how a speaker will sound just by looking at it. But a look at this year's crop of new models will reveal some definite design trends.

Most obvious, perhaps, is the predominance of two-way systems, evidence that manufacturers are giving up the unrewarding business of including a midrange unit in low- to mid-price models. While European buyers apparently still demand the 'perceived value' of three drivers, the UK market has long accepted that a good two-way design will nearly always beat a three-way at a similar price. Confusing the issue slightly, some makers are now using pairs of smallish bass units rather than a single large one — this leads to a speaker with three units which is nonetheless a two-way design.

Polypropylene and other advanced plastics are now widely used for bass/midrange cones, with demonstrable benefits in many cases. Most radical, though are Sony's aggressive-looking square metallic drive units, which may really upset the traditionalists.

Despite these incursions of 'high tech', it is still true that success in speaker design is more dependent on how well the designer makes use of the resources available to him than on the inclusion of some 'magic' technical ingredient. At least a couple of the outstanding speakers in this issue have been created by experienced and skilful designers working with decidedly conventional and even old-fashioned drive units. Some smaller British firms have achieved good results mainly through painstaking listening and experimentation, thus taking a basically simple design to a high level of refinement; the success of the product in this case may be helped by a craft approach to construction which would be impracticable for the larger-scale manufacturers.

Setting out to cover the loudspeaker field as thoroughly as possible, we have I think

succeeded fairly well in representing all of the major brand names and most of the smaller speaker makers. However, we have to admit to a number of omissions due to imminent model changes, and among the specialist British firms whose products are in many cases produced and distributed on a fairly limited scale. We would suggest that readers who discover these models at their dealer will be able to compare them with established 'yardstick' models. We must in any case firmly stress that omission of any model from the test programme does not mean to imply that we consider it inferior!

At this point, the author would like to make it known that he had privately evaluated samples of certain models at the manufacturers' request well prior to the commencement of the *Choice* test programme. These were the B&W *DM110* and *220*, Sony *APM22ES* and Celestion *SL600*.

Our test techniques remain essentially unchanged since the last edition, though we have continued to refine the tests with the benefit of another year's experience. The great strength of the *Choice* approach is of course its consistency, in that we are able to test each product under constant conditions. We feel that this in itself gives a unique validity to our conclusions. With detailed, carefully-interpreted lab tests, plus 'blind' listening tests by a panel of listeners, we are able to give both objective and subjective findings on product performance. We believe that the *Choice* format allows us to give balanced conclusions free from the all-too-common confusion of fact with opinion.

While our tests allow a fair prediction of room interactions, it is true that ultimately only a home trial can tell you how a pair of speakers will sound in your own listening room. And it is also still true that which speakers are your best buy must to an extent be a matter of personal taste.

So while this book will offer invaluable guidance, I must end here by saying that the most vital step to a satisfying hi-fi purchase is to find a good, helpful and enthusiastic dealer, who will let you use your own ears to make up your mind.

Steve Harris

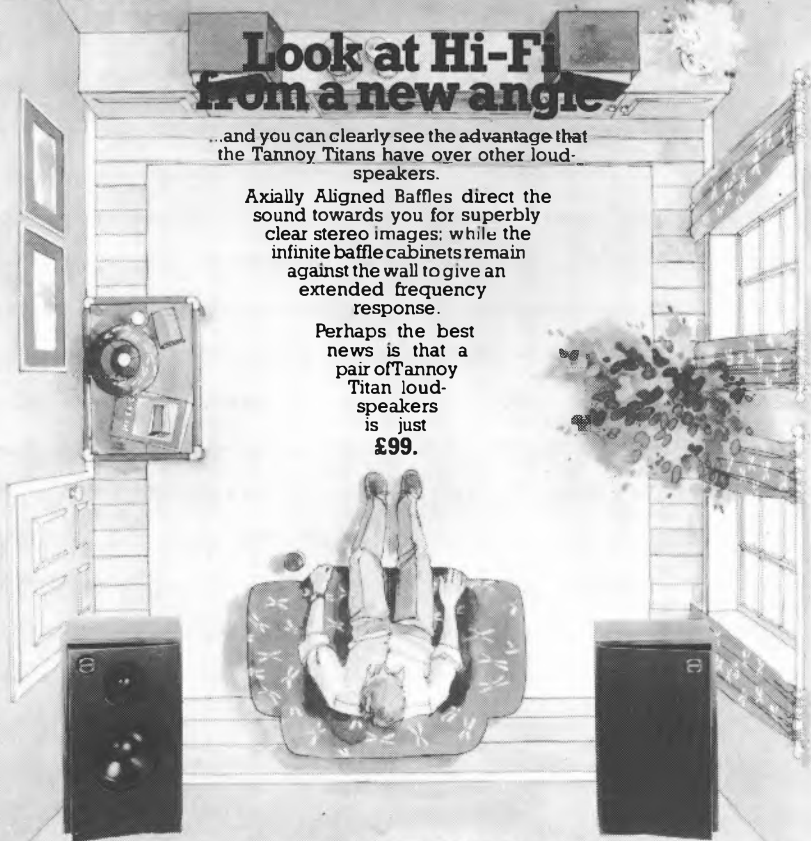
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# CONSUMER INTRODUCTION

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**This introduction covers basic speaker principles and reviewing considerations and lastly offers some notes on choosing and using speakers.**

As the final link in the hi-fi chain, the loudspeaker's influence on sound quality is self-evident — after all, the loudspeaker is 'where the sound comes out', and changing from one pair of speakers to another almost always produces the most obvious difference in the sound of a system. But despite this, speakers are sometimes just taken for granted. Either they are chosen for their unobtrusive appearance and expected to work properly when shoved out of the way in the corners of the room, or they are picked for their impressive size and expected to produce audibly impressive results in keeping with their dominant role in the decor! The chances are that a little more understanding of how speakers work, how they interact with the rest of the equipment, how they behave within the acoustic environment of the room, and in many cases whether they suit the kind of music you like to listen to, will help you choose speakers that give years of pleasurable listening — rather than leaving you with a hi-fi system that only gets turned on when there is nothing worth watching on television.

## HOW A LOUSPEAKER WORKS

In non hi-fi applications, the word loudspeaker usually indicates just the device that produces the sound — a single device recognisable by its cone. In hi-fi terms, this is a *drive unit*, and because hi-fi loudspeaker cabinets almost always contain two or more drive units of differing size and type, they are more correctly (or pedantically!) known as *loudspeaker systems*. But nearly all drive units, of hi-fi pretensions or not, work on the same fundamental *moving-coil* principle.

In order to set the air vibrating to produce sound, the cone itself has to be free to move back and forth, so it is mounted on a flexible surround. Attached to the back of the cone is a small cylindrical former on which is wound the *voice coil*. The two ends of the coil are connected by flexible wires to the unit's input connections. Surrounding the coil are the circular pole pieces of a strong permanent magnet, arranged so that when the cone/voice coil assembly is at rest, the coil turns lie within a concentrated magnetic field.

If an electrical current is passed through the coil, it will move either forward or back within the gap between the pole pieces. An audio

signal, consisting of current which alternates or changes direction at frequencies corresponding to those of musical notes, thus sets the cone moving to produce sound waves. A loudspeaker drive unit is really a simple but specialised form of electric motor.

A single small and inexpensive drive unit can be made to produce surprisingly loud sounds and will be quite good enough for reproducing speech intelligibly, for background music on TV, or while you are cleaning the car. But when it comes to reproducing music with some degree of accuracy, something much more sophisticated is needed. This is mainly because a single small unit cannot hope to respond to the lowest and the highest frequencies found in musical notes.

Conventionally, the range of audible frequencies is regarded as 20Hz (20 cycles or alternations per second) to 20kHz (20,000 cycles per second), and this 20Hz to 20kHz range is therefore regarded as the spectrum of frequencies which a hi-fi system ought to be able to reproduce. Theoretically, a given input level at 20Hz ought to produce the same sound output as the same input level produced at 20kHz — this would mean that the system had a perfectly *flat frequency response* in the range 20Hz to 20kHz.

But to put this in perspective, the lowest fundamental note produced by a bass guitar is just below 50Hz, while at the other extreme, the fundamental frequency of the highest note on the piano is only about 4kHz. Above this frequency are the harmonics which give different instruments their tonal character and such things as the final 'edge' which makes a cymbal sound realistic. In practice, then, the important part of the frequency range is between about 40Hz and 15kHz because most records actually contain nothing except spurious output outside these limits. The same goes for FM radio broadcasts where the programme content has an upper limit of around 15kHz because of the broadcasting system used, while cassette decks seldom in practice produce a flat response much higher than this. Digital recordings can, at the discretion of the engineer, be made to accurately capture sounds right up to 20kHz and right down to 20Hz, but at such low frequencies the output of the speaker is likely to be affected by other

"They'll never match the fidelity of open reel!"

"They'll never crack the problem of wow and flutter."

Wrong, wrong, wrong

Can anyone ever resolve your doubts about cassette decks?

Gentlemen, our RS-B100 is about to answer them all.

Let's start with those fundamental doubts about recording fidelity.

True, all cassette decks have to suffer the sheer limitations of equalization circuitry for analog recordings.

But we've now developed our own phase compensation circuitry system that circumvents the problem entirely.

Thus offering you, for the first time, real waveform fidelity comparable with open reel

performance.

Now for that old chestnut about wow and flutter.

Again, it's an inherent problem of cassette decks generally caused by unstable tape transport.

We've now cracked it by introducing a closed loop system with dual capstans.

The result being a reduction in wow and flutter you have to hear to believe.

(For the record, it's a mere 0.022% WRMS).

And now for that vexed question about the limitations of automatic tape bias adjustment.

On the RS-B100 they simply don't exist.

Instead, we give you the option of manual

"They only ever allow for average tape bias."

"They'll never get the head gaps right."

g and wrong again.

bias adjustment to let you fine tune for particular tapes.

Finally, we've managed to overcome the compromise of a single record/playback head.

By giving you not one but three heads engineered to quite inhuman precision.

Such is their accuracy, we can guarantee

record/playback gaps of 2.5 and 0.8 microns respectively.

All resulting in a frequency response rated at 15Hz-25,000Hz on metal.

Naturally our RS-B100 meets all the expectations you'd have of a top-class deck.

What it doesn't raise are the usual doubts.



**Technics**  
RS-B100

dbx, Quartz DD, 3-Head Cassette Deck.

300-318 Bath Road, Slough, Berks SL1 4JB. Tel: Slough 34522.

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factors such as the dimensions of the room — more of which later!

## DRIVE UNIT TYPES

If a loudspeaker cone is to reproduce high frequencies, it must be light enough to be set vibrating very rapidly — this conflicts with the requirement at low frequencies, where it must be big enough to move a large volume of air to produce any appreciable level of sound. In addition, the cone must be stiff, because if it flexes as it moves back and forward the result will be distortion. So it is now generally accepted that it is not worth trying to make a single *full range* drive unit to cover the entire frequency spectrum.

The answer, of course, is to split the incoming frequency range, feeding the low frequencies into a suitably large and robust *bass unit* while the higher frequencies are handled by a *treble unit* with a very much smaller and lighter cone or diaphragm. This is a *two-way* speaker system, and the electrical filter network which makes sure each drive unit only receives the appropriate frequencies is called the crossover.

## Bass units

'The bigger the better' used to be a foolproof maxim for judging bass units, but is no longer a very useful yardstick for domestic loudspeaker systems! While it is true that a large diameter cone will be able to move the necessary volume of air to give extended deep bass, the same result can be achieved by a somewhat smaller cone if it has a correspondingly longer *throw*, or permissible movement. Over the last ten years there have been great strides in the production of relatively small bass drivers which can still give extension to quite low cut-off frequencies when mounted in a suitable cabinet. As far as two-way domestic systems are concerned, units of 200mm nominal diameter seem to have become almost standard.

In a two way-system, the main unit is really a *bass/mid* unit, because it covers midrange frequencies up to perhaps 3kHz. The cone itself may be made of impregnated paper or pulp material, or it may be made from one of a range of suitable plastic materials including Bextrene, Cobex and various kinds of polypropylene. Apart from considerations of cost, the choice of cone material is mainly determined by the desirability of getting maximum stiffness for minimum weight. Ideally, the cone

should move back and forth with perfect piston movement, but in reality it will flex and 'break up' at certain frequencies, and any behaviour of this kind will cause distortion or coloration in the sound. The actual profile or flare of the cone can be quite important in minimising flexural problems, and many cones are 'doped' to damp resonances.

As with the cone itself, the flexible surround and suspension have been the subject of continual experiment particularly as new types of plastic materials have appeared. The *motor system*, that is the magnet system and coil, should be substantial, and a rigid chassis is also desirable.

## Treble units

In some speaker systems the treble unit or *tweeter* looks pretty much like a smaller version of the bass/mid unit, having a paper cone of around 30 to 50mm diameter. There are still a number of designs which extract good performance from cone-type tweeters — but at the same time, there are plenty of low-cost speakers in which the tweeter is little more than a transistor radio speaker, often glorified or disguised by some judicious metallising!

Most hi-fi designers now in fact opt for *dome* type tweeters, in which the radiating element is usually 25mm or less in diameter and forming an outward-facing hemisphere or curve as the name suggests. Here the voice coil is usually the same diameter as the dome, and the whole moving assembly can be made very light. Dome tweeters can be broadly categorised as 'hard dome' and 'soft dome' types, the latter including diaphragms made from impregnated cloth and soft plastic materials. A hard, non-flexible diaphragm is potentially more accurate, but the practical problems of making a hard-dome tweeter which does not have unpleasant resonances have led to a predominance of soft-dome types in recent years. However, the very sophisticated tweeter developed by Celestion for their *SL6* speaker marks a reversal of this trend.

## Midrange units

It certainly seems logical enough to take the two-way system's division of labour a step further by adding a specialised *midrange* unit.

Some three-way systems include a dome midrange driver which looks like an *overgrown* tweeter. In fact the corresponding slang term for midrange unit is 'squawker', which in some cases has unfortunately been quite an apt

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description of the sound produced. There is no doubt that it is quite difficult to design a successful midrange unit of this type, and it will also need a very complex crossover network to integrate it with the other two drivers.

Other examples of three-way systems are in essence a small two-way system with a large extra bass unit added to extend the low-frequency response below the range of the 'middle' unit, which is still really best described as a bass/mid.

## Supertweeters

Yet another kind of three-way system is the configuration exemplified by the *Spendor BC1* — here a highly-developed two-way system is topped by a *supertweeter*, which is even smaller than the main treble unit and augments extremely high frequencies, say above 15kHz.

## Crossovers

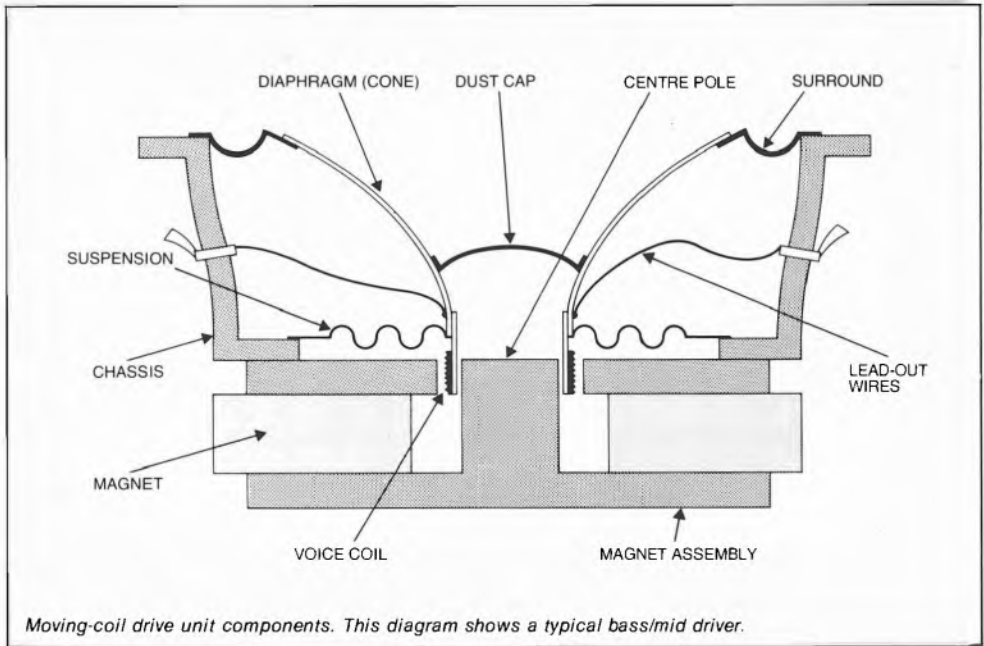
The very simplest form of crossover consists of a single capacitor, which acts as a high-pass filter to prevent low frequency signals from reaching the tweeter and burning it out. This

approach can be used successfully with drive units whose characteristics have been carefully designed to avoid the need for any further electrical 'tailoring' of response, sensitivity and impedance characteristics. But in most high-quality speakers, a complex network is used.

While the basic behaviour of a crossover network appears fairly straightforward, in practice the subtler aspects — which make the difference between a competent speaker and an excellent one — still remain something of a black art. Quite apart from the actual circuit design, the quality of the components used can be crucial to the results, and even the way they are laid out may be important!

## Active loudspeakers

Though the design of passive crossover networks has reached a high state of refinement, there are strong theoretical arguments for getting rid of them altogether, as it can never be ideal to have passive filtering arrangements in the signal path between the power amplifier and loudspeaker drive units. The alternative is the *active* type of loudspeaker, in which each



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drive unit has its own power amplifier. The speakers are thus 'bi-amped', or 'tri-amped' if a three-way system, with the power amplifiers themselves fed from the pre-amp via an active crossover unit which can be adjusted to tailor the overall responses very precisely.

Active systems originated in the professional field, but there are now quite a few complete active systems designed for domestic use, and there are some manufacturers who will supply the necessary electronics to 'upgrade' their passive speakers to active configuration.

## Electrostatic loudspeakers

Representing the main proven alternative to the moving-coil type of drive unit, the electrostatic principle is of course primarily associated with the name Quad. In an electrostatic speaker, the moving element is a light and flexible membrane suspended between two grids. A very high polarising voltage is applied across the two grids or plates, and the audio signal alternations can be made to set the membrane moving in sympathy by electrostatic attraction to the plates. Unlike moving-coil cabinet speakers, the electrostatic normally radiates sound equally from front and rear surfaces.

## CABINET TYPES

Cabinet design and quality are important to the sound a speaker produces. Apart from merely housing the drive units and crossover, the enclosure has the important function of giving the correct acoustic loading to the bass unit, and it is the type of loading which gives rise to the names of the various cabinet types.

### Infinite baffle

This confusing term dates back to the early days of sound reproduction, when speakers were customarily mounted on a flat board or *baffle* rather than in a cabinet. The purpose of the baffle was to prevent the sound radiation from the rear of the speaker cone from cancelling the wanted movements at the front, by making the path around the speaker from back to front much longer. The ideal would be an infinitely large baffle, but much the same effect could be obtained more conveniently by the simple expedient of enclosing the speaker behind! So, to this day, the term *infinite baffle* is used to describe speakers which have a *sealed box*. Another term relating to sealed box enclosures is *acoustic suspension*, this

indicating that the compliance of the mass of air in the cabinet has a contributory effect on the suspension of the bass unit.

### Bass reflex

In a sealed box enclosure, the radiation from the rear of the bass unit is effectively absorbed, but in a ported or *reflex* cabinet some of this rear output is put to use. The cabinet and port dimensions are designed to produce a resonating enclosure volume, tuned to the resonant frequency of the drive unit. When this is done correctly, the sound which emerges from the port will be in phase with the frontal output and so reinforce the bass. As a generalisation, bass reflex cabinets allow a designer to get more bass and higher sensitivity from a given drive unit or cabinet size.

One or two speaker designers have utilised port or duct loading but have placed the port at the rear of the cabinet, as the aim here is not to augment the front output, only to provide the correct loading for the bass unit to function at its best.

### Transmission lines, labyrinths and horns

Involving more complicated cabinet structures, *transmission line*, *labyrinth* and *folded horn* bass loading arrangements are now less popular. In the transmission line enclosure, the radiation from the back of the driver cone flows down what is in effect a pipe, filled with low-density sound-absorbing material.

Horn loading means that a flared tunnel is placed either in front of or behind the drive unit, which makes for great efficiency. However, the low frequency capabilities of a horn loaded full-range driver will be dependent on the size of the horn, and a very long horn with a very large flared exit is needed, making the system relatively impractical. However, the firm of Lowther has for many years specialised in horn-loaded loudspeakers for domestic use.

Horn-loading of treble units is more common, and examples include the 'dual concentric' Tannoy unit, where the treble horn is built into the centre pole of the main magnet. Horn loaded treble units can be made extremely robust but very sensitive, and so are ideal for high-level applications such as rock monitoring or stage systems.

## OVERALL DESIGN

It is never really possible to say that certain design approaches are inherently 'right' while others are 'wrong', though it is often possible



# LOUDSPEAKER BUYER'S CHECKLIST

High frequency sounds from the tweeter may 'beam' in some designs while others have purposely tailored vertical or lateral dispersion patterns. The speaker needs settling to put the tweeter at an appropriate height for the ears of seated listeners.

Grilles on or off? Many speakers sound better with grilles removed, because of the diffractive effects of the grille frame. Can you live with naked drive units?

Efficiency. A more efficient speaker is one which is better at converting electricity into sound. A speaker of 90dB sensitivity will sound literally twice as loud as one of 80dB for the same power. To achieve the same by upgrading amplifier power would require a 500w amp be replaced with a 500w model! Higher efficiency may save you expenditure on unwanted amplifier power.

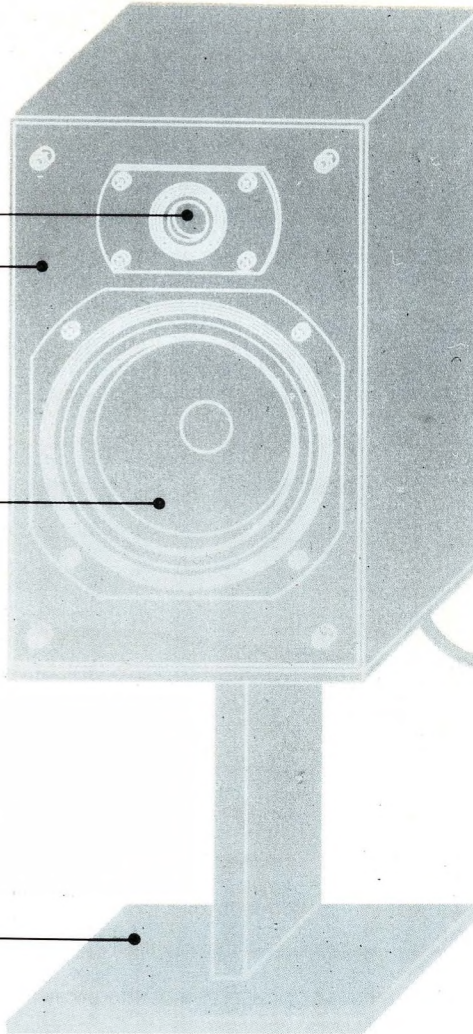
The stands should be inert, rigid and coupled to the floor to prevent the speaker rocking or moving. The speaker system will then be able to produce clean deep bass and stable stereo imagery.

Angling speakers inwards can improve stereo imagery. Room placement for good stereo is as important as that for good bass. Experimentation with angling and relative distances from the room boundaries is recommended.

Electrical matching. Speakers are far more easily damaged by an amp that is under-powered than one that is 'too big'. A small amp, when driven flat out, may 'clip' the output waveform, lopping off the tops of the waves. This generates high-level high-frequency distortion products that can destroy tweeters. Big amps can only damage a speaker by pushing the drive unit too far or by heating the voice coil over a period of time — unlikely in normal use. Loudspeaker manufacturers give a bracket for the power ratings of suitable amplifiers, so choose speakers and amp to match each other.

'Special' speaker cables may give subtle improvements in clarity and bass definition. In any case, use heavy-duty multi-strand cables rather than light gauge lighting flex or 'bell wire'.

Where will the speakers be placed? If designed for true bookshelf or near wall location, they will only give a balanced output in that location. Speakers designed for free space do best on stands and will boom if put near walls or corners.



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to try and assess how well a particular principle has been put into practice. It is very dangerous to assume that because a designer has used a particular technique, this confers some inherent superiority, or similarity in performance to designs using similar techniques. Such assumptions are irrelevant and misleading, because after all the proof of the pudding is in the eating — even if there are a few recipes which experience tempts us to pre-judge as poisonous!\*

## REVIEWING LOUDSPEAKERS

Loudspeaker reviewing is difficult and necessarily imperfect. One of the most important distinctions to be borne in mind by the reader is the difference between fact and opinion; measurements taken on a speaker represent facts, while their interpretation represents opinion. Likewise, listening tests are the synthesis of a number of opinions under specific and inevitably limited conditions — a comparatively brief time span, with one set of ancillaries in the one listening room.

It can be argued that the only way to assess speakers subjectively is to do so over a long period of time and in different rooms. Certainly this can give a good result in absolute terms for the experienced listener, but unfortunately gives no reliable relative assessment of the design in relation to its many competitors.

So while a long-term 'living with' assessment seems ideal from some points of view, it has some serious drawbacks, not least because of the ear's unusual capacity for self-deception! On the other hand, comparative multiple assessment as used in *Choice* does seem to give the sense of perspective that assists reliable judgment in a realistic context — and is particularly appropriate for speakers in the popular price brackets, which are in strenuous competition with each other.

When it comes to facts rather than opinion, the multiple review is without equal. The problem with performance measurements taken by manufacturers is that they are rarely comparable with one another because of differences in standards or techniques. By adopting the same standards throughout, there can be little doubt about the relative differences between designs. So even those who might

criticise speaker reviewing strongly can hardly argue that the objective data is not of value to the prospective purchaser. There certainly bound to be some disagreement over value judgments which may arise from the listening tests results, or even over the interpretation of measured data. Opinions, appropriately qualified, is an essential part of reviewing. But the reviewer's opinions should not be just accepted in blind faith — rather they should assist the reader in forming his own.

## LOUDSPEAKER CHARACTERISTICS

As well as carrying out listening tests and conducting a physical examination of the constructional quality and engineering of the loudspeakers, a considerable number of measurements were taken. This section tries to explain the basis of our assessment in non-technical terms, while more detailed explanation of review techniques and interpretation will be found in the technical introduction.

### Frequency response

Strictly speaking 'frequency/amplitude' responses, *frequency response* measurements show how the relative loudness of the speaker changes when a similar level is fed in at different frequencies. This gives an indication of the tonal balance of the speaker, and indeed of how it will modify the tonal balance of the system.

Speakers give a much poorer frequency response performance than other items in the audio chain, even though the tests are carried out in an anechoic chamber so that room effects cannot make the picture any gloomier.

The main frequency response test is an examination of the responses taken in several positions in front of the speaker, which gives an indication of how uniformly the response is maintained at typical extremes of sensible listening position. The smoothness and similarity of the responses on and off axis is often an indicator of the stereo performance and level of coloration as well as tonal balance. These 'major' response curves were taken using an averaged noise signal to avoid overemphasising small response wrinkles that are not considered significant. A second trace using swept tone gives a more precise indication of how the extended the bass is and the manner in which it rolls off.

One might question the usefulness of taking measurements in a special chamber which does not reflect sound, and is consequently

\**Loudspeaker design is the subject of several technical books, including the comprehensive 'High Performance Loudspeakers' by Martin Colloms (Pentech Press).*

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very different from a listening room. And the room certainly can influence the total balance of a system markedly, or indeed make or mar the stereo imaging. But the contribution from the room must always reach the listener *after* the direct sound from the speaker, so except perhaps from some low frequency (bass) effects, the anechoic frequency responses still determine what the ear hears first, and are therefore very important. Certainly the anechoic response gives a useful comparative measurement that is highly relevant for most designs and locations.

## Coloration

Coloration is the term used to describe the extra 'character' that a loudspeaker adds to a sound; a gentle change in frequency response over a broad band of frequencies will tend to give a speaker a particular *tonal balance*, but a fairly narrow peak or dip or a resonance, over perhaps half an octave, will usually result in the speaker possessing a particular character. This is (admittedly rather inadequately) described by a number of adjectives, most of which are self-explanatory, if a little vague. Terms used are likely to include the following: 'boomy', 'chesty', 'plummy', 'tubby', 'cup-like', 'nasal', 'hard', 'metallic', 'edgy', 'gritty', 'fizzy'; it is noteworthy that many come from characteristics we use to describe the human voice, because subtle differentiation of voice timbre is the thing with which our ears are most practised and familiar.

Colorations are subjective observations rather than hard data, and may have a variety of different causes which are not always easy to pin down. Although much of the responsibility rests with the loudspeaker, coloration may already be present in the programme (from microphones or pickup cartridges for example) or introduced by the listening room. One of the big advantages of the multiple comparison review is that such factors can to some extent be isolated, as they will be common to all models (this to some extent an oversimplification, as the room will react unpredictably to different aspects of loudspeaker performance, perhaps to the benefit of one model rather than another).

Coloration is caused by a number of different mechanisms in the loudspeaker system, including mechanical resonances in the drive units and cabinetwork, electrical resonances between components in the crossover and voice coils, re-radiation and delayed

resonances from drive units, baffles and cabinetwork, resonances in trapped air masses, to name but a few. Colorations are quite easily and consistently identified on listening tests, even though it would be a long and arduous task to identify all the causes in a particular design. The importance of different types of coloration to an individual listener may depend on the type of programme usually played, the required loudness levels, and to some degree the characteristics of ancillary equipment and the listening room. This is quite aptly illustrated by examples in the professional sphere. BBC research-based designs, such as the Spendor *BC1*, have become very popular in broadcasting studios and one design technique used in these is a 'thin-wall' cabinet, which effectively accepts a slight penalty in the level of cabinet coloration for the benefit of moving this coloration down into the bass frequencies and out of the highly critical midband. Recording studios on the other hand are likely to be used predominately for rock music at much higher levels, and the quality of loud bass reproduction is likely to be considered more important than low midrange coloration, consequently quite different speakers such as the professional-series Tannoys and JBLs are commonly employed. This clearly shows that while this publication can help the reader to find models which suit his requirements, the final decision on the best compromise must rest with the individual himself.

## Impedance

This refers to the electrical impedance which the loudspeaker presents to the amplifier by which it is driven. To explain this in simple terms is not easy: a starting point is that the power amp is presenting at its loudspeaker terminals a varying voltage which is an analogue of the audio signal. As the loudspeaker is a type of motor, it draws current from the amplifier to do its work, and the amount of current drawn for a fixed voltage will be directly dependent on the impedance of the speaker. (This is rather an oversimplification of AC operation, but is relevant here.) The power taken from the amplifier is the product of current (measured in amps) and voltage, and is measured in watts. The impedance determines the ratio of volts to amps that the speaker draws, which can be important when choosing speakers to match an amplifier or vice versa.

One of the decisions an amplifier designer



## If you can't tell whether it's a Bechstein

When a famous concert pianist insists on a Bechstein rather than a Steinway (or vice versa), we think you should hear why.

So it's not enough for our speakers to get a piano to sound like a piano.

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And by evolving these two techniques into something even more sophisticated, namely a scanned laser plot.





## **n or a Steinway, it isn't a Wharfedale.**

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The result of our efforts is not only better sounding speakers, but also better value than you'll find elsewhere.

The best example is our new Laser range. Four speakers that share the same handsome design shown here.

But even the least expensive of them will play back the differences between concert grands costing thousands.

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has to make is to determine the conditions under which maximum power is available, or in other words the maximum voltage that can be supplied before 'clipping' and the maximum current that can be supplied before 'limiting' — the maximum power being the product of the current and voltage maxima; which can only be obtained into one particular impedance value. If one assumed that loudspeakers were a simple constant load, just like an 8ohm resistor, things would be quite easy, but in reality loudspeakers present rather a complex load, due to the inherent characteristics of drive units and crossovers. The impedance changes with frequency and may also require the voltage and current to be slightly out of step (out of phase) with each other, this being known as a *reactive load*.

So the loudspeaker designer has to make sure that his design is capable of being driven by the majority of amps without difficulty, while the amp designer should build in sufficient flexibility to cope with most speaker designs. In practice, most amps today are quite happy driving impedances falling significantly below the 'target' 8ohm nominal figure — while the speaker designers try to ensure that their designs do not drop too far below the 8ohm level and avoid offering 'nasty' out-of-phase conditions at the point of minimum impedance.

In each review, an assessment is made of how 'easy' or 'difficult' a speaker is to drive. This is not to say that a 'difficult' load will be 'difficult' with every amplifier, but its use with some amps may not permit maximum amplifier power to be delivered. To put it another way, some amps will have no difficulty driving virtually any loudspeaker load, while others will not be able to realise their full output with a 'difficult' load. It is now quite widely accepted that amplifiers should be made as far as possible impervious to loudspeaker load changes, although there is little published evidence on the significance of the more obscure complexities of loudspeaker loading.

## Sensitivity and efficiency

These two terms are often confused or misapplied. Strictly speaking, *efficiency* would indicate an attempt to measure the actual conversion efficiency of the speaker from electrical input to acoustic output. More useful is a measurement of *sensitivity*, which is based on a fixed amplifier gain (ie output voltage) and is averaged from the midband output obtained

from a microphone a fixed distance in front of the loudspeaker. Lower impedance models will draw more current and therefore use more power than high impedance ones, and so they can be expected to show a slightly greater voltage sensitivity — however this may mean that more care has to be taken in selecting an amplifier to match.

Sensitivity is very useful in attempting to assess how loud a loudspeaker will sound under practical conditions, but it must be taken in isolation from other design considerations. For example, some models may have a high midrange sensitivity at the expense of bass extension; more over to achieve high volume levels, the speaker must have good power handling as well as high sensitivity, otherwise the effect will be merely to save amplifier power, not to achieve high sound levels without distortion.

## Power requirements

Trying to estimate the minimum power requirement and the maximum power handling of a loudspeaker is an almost impossible thing to do, for various reasons. Firstly, the size and furnishings of the room, and position from the speaker, will affect the loudness perceived by the listener. Secondly, everyone will have his own idea of what constitutes a 'normal' loudness. Most important perhaps is the type of music being played, because the peaks in musical signals can be enormous in relation to the average level. For example, a loudspeaker manufacturer found that when a direct-cut disc was registering 100watt peaks, the mean power (averaged over 3seconds) was only 8watts; in contrast a more compressed pop record showed some 17watts mean for 100watt peaks. With the advent of digital playback, the headroom available for musical peaks has greatly increased, and consequently the dynamic range between peak power and mean power requirement greatly increased. It is quite easy, with digital material, to find that an amplifier is producing 150watts peak power when driving speakers to quite modest levels. In the absence of distortion, these very short duration peaks do not *appear* loud — whereas a 150watt mean level would of course be extremely loud with any speaker.

The additional dynamic potential of Compact Disc only serves to reinforce the old advice that a too-powerful amplifier is less dangerous to speakers than an underpowered one. If you are using an amplifier which is

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capable of exceeding the working maximum rating of the speakers, you can overheat the voice coils and cause breakdown of the speaker, but only by driving the speakers to deafening sound levels. It must be said though that this can happen quite easily at parties, where the bodies of the guests absorb so much sound that you may be unaware of just how much power is being used — and party spirits have dulled the usual sensitivity to distortion!

A grossly underpowered amplifier will go into clipping as it attempts to meet the power demanded of it, and in this condition will produce severe distortion. This in effect turns the musical input into high-frequency distortion components, which can overload and burn out the tweeter. Audible treble 'nastiness' should provide a warning on impending danger.

As a general rule, then, it is not a bad thing to have an amplifier which is towards the maximum recommended size, rather than just above the minimum requirement — but having said that, to confuse things even more, not all amplifiers behave the same way when faced with sudden current demands and changing load conditions, so that two amplifiers of the same nominal power rating might well not sound equally loud!

## **Stereo performance**

The word stereo comes from a Greek root meaning 'solid', the concept being that it is possible to create/recreate a solid image of the recorded sound field by using two loudspeakers instead of one (mono). To do this it is first necessary to ensure that the original sound field has been captured in the recording, a state of affairs that is unfortunately rarely the case. To capture the sound field coherently, it is necessary to use a simple two-microphone technique that is similar to the '3D' pictures found in children's slide viewers. In the latter example, the two similar but slightly different images enable the viewer to perceive a sense of depth or 'solidity' in the picture, and this is very similar to the way in which true stereo works, enabling the sound of an orchestra playing in a hall to be caught with a fair degree of accuracy.

The steady adoption of electronic instruments and multi-channel recordings has come about for a number of sound (and sometimes not so sound) reasons, but the net result is that most so-called stereo recordings are in reality

a sort of multiple-mono — the visual analogy would be a series of close-ups that are formed into a sort of collage, which can help to highlight certain things at the producers' discretion, but at the same time distorts the perspectives.

To assess the accuracy of speakers under stereo conditions, we have deliberately included programme material which contains genuine and coherent stereo imagery — but it could be argued that the ability to recreate stereo is of limited importance. Certainly it is more useful under some conditions than others, and additionally, the stereo illusion seems to work better for some people than others. It is probably still true to say that relatively few listeners have any real idea of the capability of good stereo signal and system, but for those who have, good stereo is probably one of the most important benefits of hi-fi.

## **CHOOSING AND BUYING**

If you are planning to spend one or perhaps several hundred pounds on a pair of loudspeakers, it makes sense to take a little care over the choice — though (as my predecessor, Paul Messenger used to remark at this point) the reader of this is presumably prepared to take some trouble, by virtue of the fact that he has reached this rather obscure page of a very specialised publication, devoted to trying to make things easier!

However, our efforts in *Choice* should really help you to reach a decision — not make it for you. For one thing, we do not sell speakers; we do not live in your room, playing your type of music at your preferred levels through your ancillary equipment. You need to find the products which best satisfy your particular requirements, and the first step to doing this is to clearly specify those requirements.

Having set a budget, it may be a little more difficult to assess some of the other variables — such as finding the best trade-offs between size, bass extension and sensitivity. However, most of these questions can be resolved with the data in our reviews, and it should be possible to start shortlisting suitable models.

At this stage, considerations of room matching and taste become important, and it really becomes essential to seek out a helpful and competent dealer. A good demonstrator should be able to help a customer get some idea of where his tastes in sound lie, in terms of the relative importance of levels and

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locations of coloration, precision of stereo imagery, transmission of dynamics and so on (conversely, be wary of the overzealous demonstrator who will merely succeed in inculcating his own preconceptions and prejudices!). The overall quality of demonstration remains the best guide to the standard of a retailer. If you are visiting several shops, it's a good idea to take along a couple of your own records — one that you like and one that you dislike — as a means of assessing the dealer as well as the loudspeaker. Any demonstration which can make a known but disliked record more enjoyable than hitherto must have something going for it!

## Home demonstration

A final step in choosing a speaker can be home trail if your dealer offers this facility, which admittedly is an awkward and expensive service to offer. A good alternative offered by a growing number of dealers is a 'period of grace' which allows you to exchange unsuitable products if they are returned undamaged within say seven days. Providing that customers do not become too demanding — remember the retailer has to make some profit! — this can work to everybody's benefit.

## Getting the best results

There are a few points which can really pay dividends in getting the best results from speakers. The most important of course is placing them correctly — the maker's instruction leaflet will give some indications here. If you want to put speakers on bookshelves or with their backs against a wall, it is worth choosing models that are designed for this. It is an almost universal natural law that optimum speaker positioning conflicts with normal domestic requirements of aesthetic and comfortable room-arranging, so some compromise is bound to be necessary. Most models will be at their best away from walls on stands, and it is well worth apportioning part of the budget to a pair of stands of suitable height. Aware that the mechanical properties of the stand can affect sound quality (notably clarity in the bass) many manufacturers supply suitable stands of their own — otherwise good types are available from specialist firms such as QED, who have recently launched their 'Sound Definition' range of stands.

It is always worth experimenting with speaker positioning, distance apart, distance from the wall, height and angle, since the

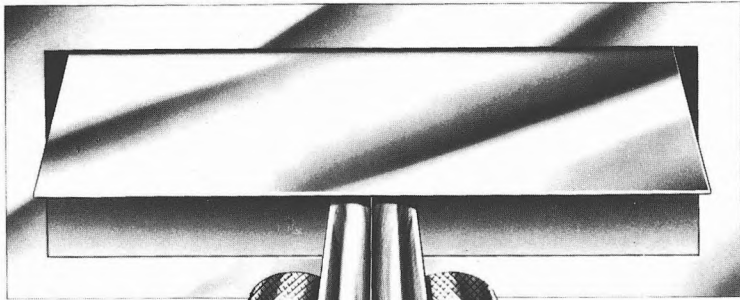
position which 'looks' right may not be the best. It is often worth making a little effort to 'tailor' the acoustics of the room — if, for example, you have two hard and therefore acoustically reflective walls facing each other, for example, it will probably improve matters to 'deadened' one of them with a wall hanging of soft material. Likewise, the reflective properties of a hard floor between the listener and the speaker can be softened with a rug. For a satisfactory stereo balance, the speakers should be positioned in a way that is reasonably symmetrical with respect to the room boundaries, remembering that objects near or between the speakers have subtly adverse affects (the dedicated, of course, will throw the TV away!).

With the underlying idea of rigid mounting, some commentators have recently started to recommend that once you have found the right position for the stands you should not simply place them on the carpet, but should rest them on the heads of large woodscrews driven through the carpet and into the floorboards. This can be quite worthwhile in 'tightening up' the bass quality, but as with most 'tuning tips' in hi-fi, the effect will be varied by a number of factors, and may or may not be significant. The variables here are the type of cabinet design, the mechanical strengths of the stand and the rigidity of the floor.

The final detail in connecting up speakers is the choice of cable — within reasonable limits, the heavier the cable and the more strands it has the better. The 50-strand 20 amp cable available from Radiospares, or QED's specially-packaged 79-strand and C38 cables are worthwhile. The vogue for specially-wound Litz type speaker cables now seems to have passed, and in fact these ultra-special cables did seem to have some unwelcome side-effects.

Connections at both speaker and amplifier should be as firm as possible, and for this reason the use of binding-posts are preferable to plug-and-socket or spring-clip connectors. Good connections really can make a subtle difference to clarity and 'life' in the sound, and anyone who is not convinced of this has only to try it for themselves.

'Fine tuning' apart, the intention of this book is to at least offer some guidance in choosing the right speaker for your requirements — even if, as always in hi-fi, there are very few concrete and definite answers, we hope that our efforts will help.



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# TECHNICAL INTRODUCTION

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While some aspects of the review method have already been discussed in the *Consumer Introduction*, this *Technical Introduction* gives a complete and detailed description of the latest series of tests, covering both objective and subjective evaluation techniques.

In this, my fifth edition of *Hi-Fi Choice: Loudspeakers*, a number of changes have been made. This time, in the light of experience certain aspects of evaluation have been accorded less importance, and others given more detailed attention.

As usual the greatest problem occurred when attempting to write up the final results of the project since it is then that the recommendations and value judgements must be made. The reviewer always hopes that this task will be made relatively easy by the wealth of subjective and technical data collected, but it nonetheless remains a very difficult task, particularly so in view of the necessity to integrate the findings on a new batch of 50 of so speakers with results on previously-reviewed and still current designs.

If changes are made in the review format or indeed if some new influential factor emerges such as the introduction this time round of CD digital material — earlier reviews require very careful reassessment. To this end, we included a continuing re-evaluation of our 'reference' models; those previously reviewed and appearing again in the new programme of listening tests included the Quad *ELS63* (current version), the Spondor *BC1*, BBC *LS3/5a*, KEF *Coda II* and *R105:4*, the Yamaha *NS1000*, Keesonic *Kub* and Mordaunt Short *Pageant III*. These all helped to establish a key to the mean performance of the reviews carried over from last time relative to the new models tested here for the first time.

So many worthy models were available for the new edition that it proved very hard to make a final decision as to which to include and which to leave out.

Our aim is always to provide as many reviews as possible within the time and space available for the project. Accordingly, this year we felt we needed to reassess the true worth of the 'live-versus-recorded' section of the listening tests. While philosophically attractive, in the past the live test section has in fact proved disproportionately expensive in relation to its real contribution to the project. For the last issue, the elements on which each review judgement was based, broke down roughly as follows: sound quality on recorded stereo programme 40%, 'live-versus-recorded' 20%, technical performance 35% and engineering content 5%. For this edition therefore we decided to put in more new reviews at the expense of abandoning

the live-versus-recorded sessions.

However, with the re-evaluation of so many previous designs plus other improvements in technique, we believe that the accuracy of the issue has not suffered; indeed much greater effort has gone into other areas, notably the far higher programme standards used for the stereo listening session. A considerable proportion of the recorded material was of studio master quality; either from error-corrected digital copy masters reproduced using the Sony *PCMF1*, or from Compact Disc, again via a Sony machine.

Fortunately by the time the listening sessions came round, there was a decent selection of CD software to choose from, and a prime virtue of this type of programme soon became apparent, namely its utter consistency. Previous tests have unavoidably included disc and analogue tape replay, and even with multiple 'safety' copies, the deterioration during the tests was obvious to the listeners. The participation of Tony Faulkner, a recording engineer who had produced two of the musical sections we used proved to be most helpful, as he was well placed to judge the truthfulness or otherwise of the reproduced sound.

On the technical side the swept harmonic results have been analysed to a 10dB greater sensitivity, providing more discrimination for the lower-distortion models; while other improvements in technique have resulted in computed room averaged responses of far greater consistency.

## LISTENING TESTS:

### Replay environment

My personal listening room has been analysed for reverb. character and found to be particularly favourable. Above 100Hz the  $R_t$  curve aligned closely to 0.3 of a second, indicating an even, balanced and uncoloured characteristic. Inevitable irregularities below 100Hz were recorded but were considered to be well damped; for example the  $R_t$  did not exceed 0.51 at 50Hz.  $R_t$  data was recorded by two methods using 5 microphone position dispersed throughout the room. Real time high speed pen traces were taken, plus recordings of warble tone bands, which were also analysed. On the basis of the results, and as the room was large enough to accommodate comfortably the 6 panelists with

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# TECHNICAL INTRODUCTION

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a realistic distance between them and the test speaker (2.5-3m), it was decided once again to use the room for all our listening sessions.

## Panel listening sessions.

These sessions proved quite arduous for the panel, as the members were required to provide a considerable amount of information for each loudspeaker. In addition to particular comments on frequency balance and coloration (these mainly drawn from a recommended table of characterisations), in all the panelists needed to give a numerical judgement on a total of five factors: overall accuracy and/or realism; frequency balance or subjective response flatness; clarity and detail; coloration; precision and depth of stereo image.

Concealed behind an acoustically-transparent curtain, each pair of speakers was presented to the panel, care having been taken to observe the optimum mounting conditions (correct height, angle, and also position relative to local reflecting surfaces). A programme lasting approximately twenty five minutes was reproduced at a realistic 93-95dBA maximum sound pressure (measured at 2m), with the average level in the 80-90dBA range.

## Choice of source material

A reasonable balance of taste was catered for in the programme excerpts which included solo grand piano, flute, singing voice both male and female, small choir, and popular material possessing excellent bass and transient quality, as supplied by Dire Straits and Abba. Small and fully-orchestral pieces were included plus the Sheffield drum record, with both 'purist' simple mic techniques and multimiked recordings represented.

## Control repeats

During the stereo listening sessions, a number of repeats were incorporated, both to test and check the validity and consistency of the methods employed, as well as to investigate panel marking variations and possible extraneous influences on results such as session timing, morning or afternoons, etc.

As already mentioned, models from the previous tests were also inserted so that the correlation between the two sets of tests could be determined.

## Data analysis

The test sheets were analysed in two ways, firstly for scoring on each programme excerpt, 26

and secondly for each performance parameter, independent of program. Possible interactions between particular speaker and programme characteristics were also investigated and duly taken into consideration.

The usual statistical analysis was applied to the numerical data obtained from the panel score sheets, including mean and standard deviation, which allowed the basic ranking order to be established, the error factors to be assessed, and consequently the groupings on the basis of sound quality to be established. A Normal distribution curve was assigned to the data in order to roughly subdivide the group on the grounds of their subjective performance, such groupings being undertaken *prior* to the author being appraised of the name of the model concerned. Furthermore, the general comment on subjective quality is drawn directly from the panel assessments as written on the individual test sheets.

## Live-versus-recorded tests

While no new live-versus-recorded tests were carried out for this issue, 'revised and reprinted' reviews contain comments based on the 'live' material used for the last edition. This type of test was undeniably difficult to set up, and it involved several compromises as well as relying to some degree on the skill of the recording engineer in accurately capturing on tape a satisfactory proportion of the natural character of a live sound. To this end, we used the finest microphones available, chosen on the basis of their minimal coloration, with a sensible spacing between live source and mike, namely 1-2 metres. The recorder was carefully aligned to suit the type of tape we used, and a professional Dolby A noise reduction system was employed in order to preserve the maximum dynamic range. Experience has shown that the benefits accruing in terms of dynamic range extension (80dB wtd. record/replay) are preferable to any minor transient errors which might be introduced.

Even reverse copying was considered, in order to eliminate the usual phase shift accompanying most recordings. The actual recording environment itself is also important; it should be very 'dry', ie possess a very short reverberation time, the latter ideally measuring zero, which corresponds to true anechoic conditions. Accordingly we used an anechoic chamber to make the recordings, in this case the large facility at the Building Research Centre, Watford. (Previous trials at smaller



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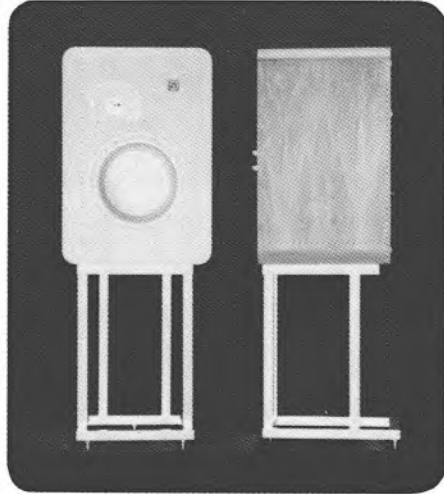
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# TECHNICAL INTRODUCTION

anechoic locations had revealed that noticeable colorations were added to male voice recordings).

The test procedure involved continuously running the pre-recorded tape containing short verbal or musical phrases interspersed with blank sections, the latter filled in on test by the live performers. A carefully worked out entry sheet was provided for each panelist so that he or she could mark within an agreed scaling and framework of comments and characterisation. In addition to numerical scaling for accuracy or naturalness-of-reproduction, other factors such as coloration and frequency balance were also assessed.

Live musical passages included acoustic guitar, snare drum, cymbal, xylophone, flute and bass guitar as well as male voice. Test score sheets were analysed in the same way as the data from the recorded-programme listening sessions.

## Laboratory Test Programme

For this new edition we used a recently established independent anechoic chamber in Cambridge, this hopefully soon to be a part of a versatile measurement facility. The measurement procedures were carefully analysed prior to testing the speakers in order to evaluate the necessary corrections were these necessary.

Despite the new chamber's large size it was nonetheless necessary to continue to add a low-frequency correction to the response trace, amounting to a small increase in bass extension below 100Hz in the case of most models. The correction has been drawn in for both 1m and 2m responses, the difference being more pronounced with the latter. Distortion for second and third harmonics was run at 96dB — a decently high level which is capable of stressing many speakers. Distortion was also measured at a new level of 86dB, this being more representative of normal listening levels.

We took the usual care over pair matching, analysing the effects of speaker grilles and also identifying and using the optimum listening axes and control settings where these were provided.

## The Characteristic Forward Response

This is considered a primary measurement, and seeks to present visually the forward radiating character of the loudspeaker, over a sensible forward solid angle and throughout the audible frequency range. Normally the fundamental response is that taken nominally on axis, usually

between the mid and HF unit. In certain circumstances however it is measured on the axis corresponding to the level of the listener's ear when the speakers are correctly sited and mounted. The uniformity or agreement of response traces taken off and around the main axis with those measured directly on the prime axis represent a crucial aspect of speaker performance, which determines whether good stereo imaging is possible, and whether the speaker will sound markedly different on- and off-axis.

For the hearing-related  $\frac{1}{3}$ -octave noise measurements, the readings are taken at a realistic 2 metres distance from the loudspeakers. The Characteristic Response set comprises: axial; 15° above in the vertical plane (below if relevant, eg in the case of a tall floor standing model); 30° in the lateral plane (both clockwise and anti-clockwise if the speaker is laterally asymmetric); 45° lateral. (Note that in previous issues and reprinted reviews the vertical measurement was 10° above axis, and the 45° lateral measurement was not included.)

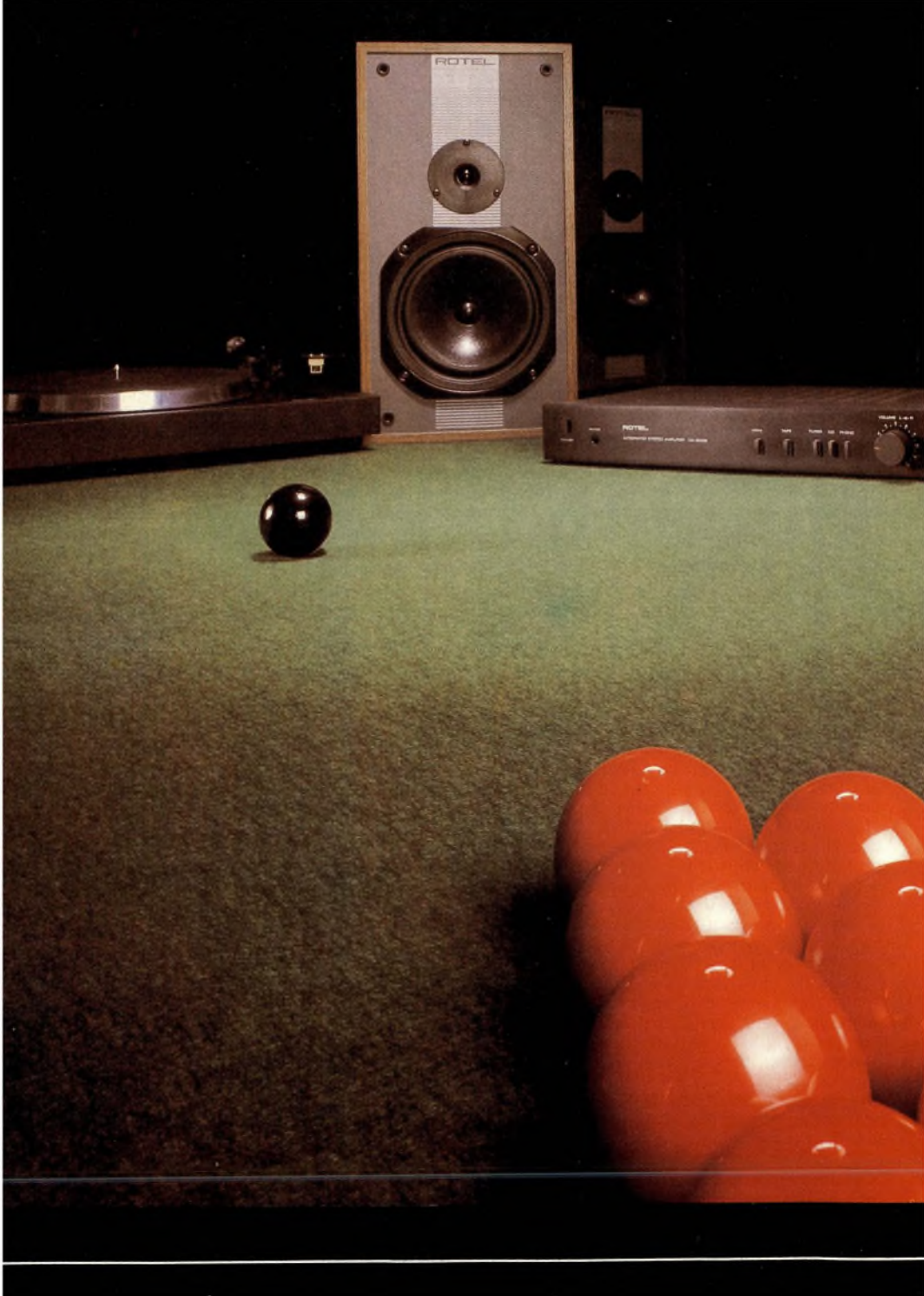
Recent research indicates that the perceived spectral balance of a loudspeaker is the result of a complex integration of the first group of sounds arriving within some 10-20mS. This period is in fact long enough to include reflected energy from adjacent boundaries — floor, rear and side walls. The character of these partially attenuated and decayed reflection, which are a product of the off-axis energy, adds to the direct sound from the loudspeaker.

The low frequency portion of the main characteristic response has been derived from an accurate sine wave analysis at 1m, frequencies above 200Hz representing the  $\frac{1}{3}$ -octave analysed portion.

The characteristics that need to be satisfied in order to return a good performance on this test are as follows:

1. A wide, even and balanced axial response, fitting comfortably within the major  $\pm 3$ dB amplitude limits from 80Hz-15kHz.
2. A 15° vertical off-axis curve deviating by less than 3-4dB from the axial curve up to 15kHz.
3. A 30° lateral off-axis curve deviating less than 3-4dB from the axial response up to 15kHz.
4. Good lateral response symmetry.
5. A 45° lateral off-axis curve showing a smoothly falling characteristic with increasing frequency.

A speaker whose frequency response varies strongly with axis variations is classed as inconsistent, and will give different results for





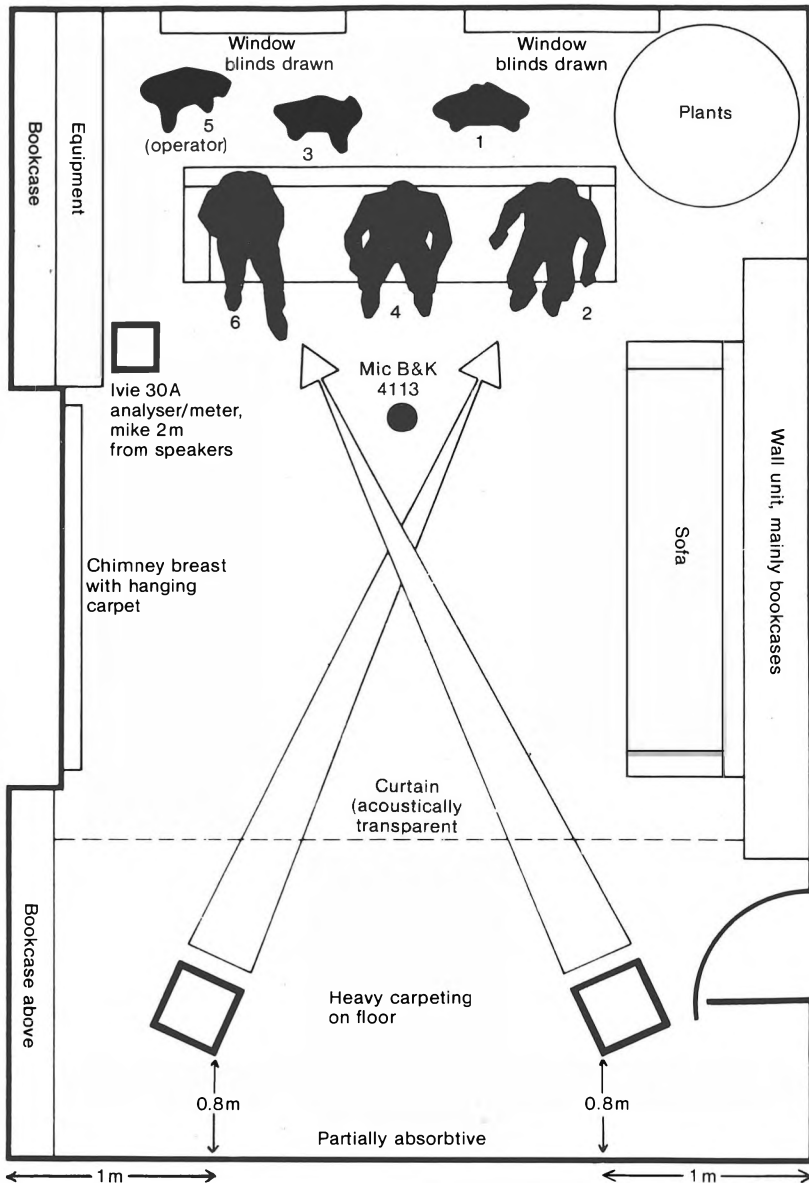
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**Listening room data**

**Actual dimensions:** 9' 6" H x 13' 9" W x 18' 4" L.

**(IEC mean recommended dimensions:**

9' H x 13' 9" W x 22' L).

**Actual reverberation time:** 0.3 seconds ± 20%.

100Hz; less than 0.6 seconds at 50Hz.

**(IEC recommended reverberation time:**

between 0.3 and 0.65 seconds, mean 0.45).

Substantial Victorian house; suspended floor and ceiling (the latter heavily loaded by speaker loan stock above); heavy carpeting (3 ply) on floor.

Over 50% of surface area of walls lined with book shelves; wall adjacent to loudspeakers reflecting, wall behind listening panel mainly absorptive. Dominant absorptive furniture, two large Chesterfield sofas.

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# TECHNICAL INTRODUCTION

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each listener position. It therefore cannot be subjectively assessed with any degree of accuracy or reliability.

## Reference curve

All loudspeakers (both left- and right-hand models) were measured on sine wave at 1 metre. This provided an accurate representation of the low frequency response. Furthermore by overlaying the curves of left- and right-handed speakers, the pair matching could be checked, and finally this measurement set a reference level against which the distortion reading could be scaled (see *distortion*), and the quoted lab sensitivity established.

A one watt level was the standard input, and established by a voltage of 2.83V rms on the speaker terminals. For this purpose the impedance was assumed to be a nominal 8 ohms.

## Listening room responses

As part of our long term aim of improving the correlation between subjective and objective results, we have again included response traces measured in the listening room. Experiments with a storage spectrum analyser showed that it might be possible to chart a picture of the average forward sound energy arriving at the listening area. Due to the 'comb filter' effect, this test cannot be conducted with a stereo pair of speakers energised simultaneously; instead, taking a sensible number of averages, the speakers were evaluated one at a time for responses corresponding to three listener positions (centre, left and right) the two speaker positions, left and right channels. Pink noise excitation was used, and each of the six responses is the result of four averages. The whole was algebraically summed and averaged using the Nicolet 444 computing  $\frac{1}{2}$ -octave spectrum analyser, which was modified to drive a Rion Y/t recorder to produce the published responses.

These curves should *not* be expected to give perfectly flat responses. At low frequencies there are some inevitable irregularities corresponding to resonances peculiar to my particular room; the characteristic hump at 60Hz is the main feature here. It was however fascinating to see how different sizes and positions of speakers changed the apparent severity of this room response effect. One could expect the near ideal speaker to run more or less flat up to 5kHz; beyond this the response should gradually fall away. Since the final curve is an average of the response over a range of lateral

angles, approximately  $\pm 30^\circ$ , some of the higher frequency off-axis loss typical of current high frequency drivers will be reflected by the characteristic. Sharper changes in slope will correspond to irregularities in a speaker's response or directivity, and are therefore suspicious.

Taken at about two metres with the speakers mounted on stands well into the room (unless stated otherwise), the averaged response will contain a reasonable proportion of direct to reverberant or reflected sound, and is a fairly good indication of the tonal and spectral balance perceived by the listening panel.

Certain more directional speakers change the direct-to-reverberant ratio considerably and complicate the interpretation of these graphs. For example, the Quad 63 shows apparently severe room interactions at low frequencies, more so than theory would predict, but the subjective bass quality was nonetheless comparatively uniform and extended.

For this issue a new HP computing analyser was put into service. Its room plots are reproduced by a digital plotter and some measurement data is automatically included, the scale factors being marginally different from the earlier responses. In particular, readers should note the new vertical scale of 5dB per major division, making the response irregularities look larger than before.

## Distortion

The availability of a swept tracking filter allowed continuous recordings to be made on both the 2nd and 3rd harmonic distortions at standard levels: 96dB was used for all the speakers excepting the very smallest bookshelf enclosures, where a reduction to 86dB was deemed appropriate. With an average sensitivity of 86dB/watt, typically just 1 watt was required for the standard level; since most HF units in such systems are attenuated, blown drivers are nowadays a rare occurrence. However, at a level of 96dB miniature speakers are generally in gross overload at low frequencies, and a 86dB test level is thus fairer in view of their more limited application.

It is generally accepted that 3rd harmonic distortion is more aurally obtrusive than 2nd, so we paid particular attention to the level of 3rd order effects in the midband, where the value should be significantly below 1%. Higher figures are permissible below 100Hz — say 2%, with up to 5% satisfactory at levels under 50Hz. 3rd harmonic distortion is an indicator of magnetic

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# TECHNICAL INTRODUCTION

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non-linearity — for example in crossover inductors — and is also related to the incidence of intermodulation distortion products. Accordingly, 2nd order values of perhaps double may be considered acceptable. A percentage scale is given on the graphs, referenced to midband 0dB only, so this will require rescaling if a chosen frequency is materially different from that reference level.

## Peak power distortion

While 96dB is 'loud' for continuous tones, speakers these days are rated for momentary power peaks, up to and beyond 100W. Swept continuous tone measurements at this level risks destroying most speakers. Accordingly short tone bursts at peak levels of up to 100W equivalent continuous power were used, using two selected frequencies. These were respectively 500Hz (near a crossover point for a three-way system and in the middle of the main frequency range for a two-way design), and 5kHz (in the HF range and close to a crossover point for most systems). Some 16 cycles were applied on a 2Hz repetition rate, a low enough level not to damage driver coils; or produce more than a few degrees centigrade temperature rise.

The burst length was sufficient for an FFT analyser (*HP3582A*) to capture and perform distortion harmonic analysis down to 0.3%, and to read the toneburst dynamic compression down to 0.1dB by transfer ratio techniques.

## Impedance

For the earlier reviews, using a form of constant current drive from a sweep oscillator (2kohm feed resistance), the modulus of impedance was plotted on a 25dB logarithmic scale, with the zero dB baseline set a 4 ohms. The +20dB line was then scaled at 40 ohms. The imaginary or reactive impedance component was assessed by continuously monitoring the phase, and 'worst case' combinations of phase and impedance were specifically recorded.

For the new reviews in the last issue the marked baseline is 0 ohms with a linear 0.5 ohm per division scaling. Note that the reviews revised and reprinted from the last edition have a different scaling, as a linear potentiometer was employed with 0.5 ohm per division and a 2.5 ohm baseline. This means that the first major division '10dB' from the baseline is 7.5 ohms.

In this edition, I must apologise for yet another change in impedance scaling. At the last minute the recorder I use developed a fault,

and a conventional 50dB log scale had to be used instead. Here the 20dB line represents 10 ohms, and the 10dB line 3.3 ohms, below which few speakers should fall. Due to this change in scale, impedance variations look smaller than previously.

## Constructional quality

The enclosures were inspected both inside and out to assess the quality of their construction, the grade of components used, and the general standard of their engineering. During all tests, any buzzes or rattles were noted and where possible their source identified.

## Sensitivity and power rating

From the reference curve, a mean mid-band sensitivity figure was recorded, this corresponding to the sound pressure at 1 metre from the enclosure, while energised by 2.83V (sine). A nominal 8 ohms draws 1 watt from the voltage, and lower impedance draws more power, on a pro rata basis. Since amplifiers (within their limits) are theoretically voltage sources, this method of specifying voltage sensitivity is a sensible one. Likewise, as no loudspeaker presents a constant impedance value, a power input sensitivity rating is rather a pointless one.

From the power handling, sensitivity and impedance data, a recommendation can thus be made concerning the loudspeaker's minimum and maximum amplifier power rating (per channel, 8 ohms). It should be appreciated that this is only a recommendation, and will be modified in practice by individual taste; *ie* a requirement for low or high listening levels as well as by the size and acoustics of the particular listening room involved. The minimum amplifier power that is quoted relates to a typical maximum sound pressure level of 96dBA (2 metres) from a stereo pair of speakers in an average room of volume 80 cubic metres.

It is almost impossible to specify a maximum power rating, as a complex relationship exists between the type of programme, the maximum power input (peak and average) and how long this maximum level is maintained. In this test we found most of even the smallest speakers could sustain a 500W peak, 250W mean power input on solo instruments in the midband, provided that its duration did not exceed 15 to 20 seconds. On highly transient signals a 500W peak could apparently be indefinitely tolerated if the mean power was low — in the case of the levels required to reproduce the live instruments, the average power was often below 5

# TECHNICAL INTRODUCTION

watts.

A strange contradiction was apparent in terms of amplifier size, with the larger models appearing to be safer than smaller ones! Take for example the case of the Spondor BC1. It incorporates a Celestion HF 1300 treble driver which is rated at not more than a few watts, and yet the system as a whole survived the high level test at a full 250 watts for over a minute, and easily tolerated 500W peaks. However, partner this system with a smaller 35-50W amp, and drive the latter beyond its limits into clipping, and there is a good chance that the treble unit will blow, as many BC1 owners will testify, having tried to use the speakers at a party! This example clearly illustrates the difficulty of defining speaker power ratings.

## Notes on frequency response testing

The repeatability of response measurements from one test facility to another is surprisingly poor. This obviously matters little for models whose response profiles resemble mountain ranges, but when a carefully calibrated model with tightly specified response limits is in-

involved, it is only too easy for an unfortunate combination of circumstances to result in a measured response that is apparently 'out of spec.'

Careful consideration of the factors involved does however enable sources of error to be identified and accounted for. They include the following:

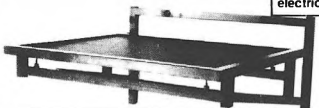
1. Slight but significant differences in microphone frequency response, particularly if 500Hz is chosen as a reference point with which to correlate subjective spectral balance judgements. This is unfortunately true of even the best 'lab reference' condenser microphones.
2. Proximity effects, whereby the range below 500Hz is elevated by 0.5dB or so at 1 m relative to the speaker's previously calibrated response at 2 m.
3. Non-anechoic environment effects.
4. Choice of axis is also critical, since the response naturally varies somewhat with mike position on the frontal axis.
5. Whether or not the grille is in position during measurement can also affect the results; some manufacturers quote specs. with the grill

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If you have none of the problems that make the TT1 so attractive, then the TT2 is the answer for you. This is a turntable table with a few extras. It has adjustable lockable spiked feet to make it perfectly level. These same feet are used to support the top shelf, which has metal discs fixed to the underside to ride on the tips of the spikes to ensure isolation with great rigidity. The TT2 is 20" tall, so you don't have to be a contortionist to change a record. It also has a lower shelf to take the electronics or what have you.



## S1

The S1 is a very rigid three-legged speaker stand, standing 17" tall, with a 7" x 7" platform for the speaker and stands on adjustable lockable spiked feet. Suitable for all medium sized cabinets.



## S2

The S2 is made to the same design as the S1, but stands 24" high. Suitable for the smaller ranges of speakers.

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- G. MAYOR HFP May 84



## S3

The S3 is also a three legged stand, but has a 11" x 11" speaker base and stand 12" high and is suitable for the larger speakers.



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# TECHNICAL INTRODUCTION

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removed.

In one case a combination of these factors resulted in a response curve that differed in balance and character from the manufacturer's own claimed tight limits, although it still met a  $\pm 2.0$ dB spec. (but only just) right up to 17kHz. This example illustrates that the tester must be aware of such effects in order to maintain a good level of accuracy in published responses and the interpretation thereof.

## Listening panel

For the new tests, the listening panel included the author (using an independent operator), Tony Faulkner, Ivor Humphries, Ken Kessler, Noel Keywood, Paul Messenger and the Editor, Steve Harris. Sessions for the last issue also included John Atkinson, Derek Hughes, David Inman, Peter Mapp, Robin Marshall and Adrian Orlowski.

## Location

Measurements were conducted at the Cambridge Electroacoustics Laboratory, while listening tests were carried out in the author's calibrated and near-IEC Standard room. Note that this room is appreciably 'dry', with an unusually even reverberation over the frequency range; in practice, domestic rooms are likely to be more reverberant as well as noticeably 'livelier' and brighter in the upper frequency range.

## Equipment used in listening tests

Burmester 828, Krell KSA100, Magnum A100 power amplifiers  
Sugden C128, Audiolab 8000C pre-amplifiers  
Monster Reference interconnects, Absolute Wire speaker cable, Michell and Monster terminations  
Cliff Stone, Stand and Deliver mineral-filled floor-keyed speaker stands  
Yamaha CDX1 Compact Disc player  
Lux PD300 turntable (modified, see *Turntables* issue No 35), Alphason HR100S arm, van den Hul MC1B cartridge  
Bruel & Kjaer 2203 sound level meter  
Revox B77 High Speed IEC open-reel recorder  
Dolby A361 'A' processors  
For earlier tests:  
Linn LP12 Valhalla turntable, Ittok arm, Linn Asak, Koetsu Black and Technics EPC205 IIII cartridges  
Sony CDP101 Compact Disc player  
Lucas ILV and QED C38 speaker cables

A&R SA200 power amplifier  
Quad 34 and Sony Espirit 901 pre-amplifiers  
Sony PCMF1 digital encoder.

## Programme material

For the latest series of tests, the programme was taken from the following:  
Schumann: Fantasy Op 12, Brendel (PH411 042-2, CD)  
Debussy: Quartet in G Minor, Orlando quartet (PH411 050-2, CD)  
Feste Romana: Respighi, Dutoit (PH410 145-2, CD)  
'Flesh and Blood' by Roxy Music (800 019-2, CD)  
'Hello, I must be Going' by Phil Collins (V2252, CD)  
'Walk Across the Rooftops' by Blue Nile (Linn LHK 1)  
'Easy Money' by Ricki Lee Jones (03296-2, CD)  
'This is Makewicz' with Phil Woods (Sheffield Lab 21, direct cut)

## Lab test equipment

B&K 2010 generator/analyser  
B&K 1901 harmonic controller  
Nicolet 100kHz FET analyser  
B&K 4133, 4165 precision 12.5mm condenser microphones  
B&K 1623 tracking 1/3 octave analyser  
B&K 2307 high speed level recorder  
B&K phase meter  
Ivie 30A real time 1/3 octave analyser  
Rion LR04 level recorder  
Hitachi 550 oscilloscope  
Baxendall sweep oscillator  
Shackman scope camera  
Hewlett-Packard HP8703 audio analyser  
Hewlett-Packard HP3561A and HP3582A Fourier analysers  
Hewlett-Packard HP200 and 89826A computers  
A&R Cambridge SA200 and Mission 777BU power amplifiers

## Acknowledgements

Special thanks are due to Marianne Colloms for typing and correcting the manuscript; to Paul Crook, listener, technical assistant, main sequence operator and general dogbody; to Tony Faulkner for loan of digital master tape programme; and to Mrs M. Barker for putting up with the noise.

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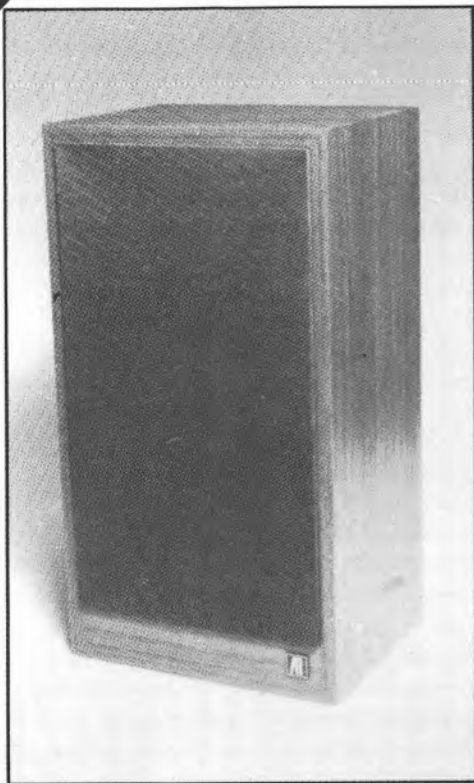
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# Acoustic Research AR48S/AR48LS

Acoustic Research, High Street, Houghton Regis, Bedfordshire LU5 5QJ. Tel (0582) 603151



For what it is worth, the origins of the *AR48* can be traced back to an earlier three-way model, the *AR5*. Both use similar sized enclosures and a common line up of 250mm bass, 100mm mid and small soft-dome tweeter, which in the case of the '48 comprises a 25mm dome unit. However, while the '5 was American-orientated and suited to bookcase mounting, with asymmetrically placed drivers, the *AR48* uses a vertical in-line array for optimum stereo performance, and its specification also advocates the use of open stands to give low coloration.

The enclosure contains a 38 litre volume sealed-box loading the integrated pulp cone bass driver which operates to 400Hz. A new and very highly damped pulp-cone midrange is fitted, employing a translucent plastic termination surround and back-loaded by a cylindrical cardboard enclosure. This driver works up to 2.5kHz, above which the ferro-fluid soft-dome takes over to above audibility. Only seven good quality

components are used in the crossover, with the unusual series/parallel configuration resulting in a saving of one inductor.

The cabinet is constructed of synthetic veneered chipboard, with no panel damping or special bracing, and input connections are via the usual AR screw down terminals, around which bare wires have to be securely wrapped. As with the budget *AR18*, the grille is no acoustic plus point; its 14mm unrebeated thickness does little for stereo imaging or the response. In the past AR used to fit vastly superior open cell foam grilles, but these appear to have gone out of fashion.

## Lab performance

Some untidiness was apparent on the reference 1 metre sinewave frequency response, which was partially emphasised by the grille. However the latter was not responsible for the lumpy tendency in the 400 Hz–3 kHz region, suggesting that the mid unit was not working as well as AR would have us believe: as pair matching was good (typically within 1.5dB overall), the effect was clearly not an isolated one.

Inspecting the forward characteristic, the 1.5kHz to 2kHz trough can be seen to be axis dependent, suggesting a mild phasing problem between the driver bands. The low frequency range was well damped, providing a 40Hz –6dB point, and a +/-3dB range of 50Hz to 20kHz. While fairly good consistency and integration was demonstrated by the forward response, the off-axis fall-off at higher frequencies was greater than usual.

The sensitivity was usefully higher than claimed at 88dB/W, but amplifier loading was classed as average in view of an impedance dip to 4.3 ohms, 700 Hz (a high power region). In fairness, however, AR do rate the '48 as a 6 ohms model. Its power handling was estimated at 100W, and a generous 106dBa maximum level is theoretically possible, with 15W per channel producing a satisfactory 96dBa.

A moderate 0.6dB of compression was noted on 100W pulses, with distortion at the 1% level, 500 Hz. Moving up to 5kHz the compression was negligible, but distortion had increased to 7.0%, 2nd, 3.0% 3rd, and 0.3% of 5th (the latter usually negligible). Drive beyond this level appeared unpromising. On steady state distortion 3rd harmonic was generally quite low at around 0.6% mid band, with 2nd harmonic at similar levels, and with low frequency distortion well controlled. As with the *AR18*, however, above 6kHz the tweeter exhibited distortion at around the 1% level even at 90dB, though this had relatively

harmless second order content.

The averaged room characteristic demonstrated some promising features, notably the relatively even and extended low frequency range, plus well controlled and near correct energy fall above 10kHz. However, a prominence around the upper mid 400Hz–1 kHz band measured some 4dB above adjacent regions, and this could with advantage be lower.

### Sound quality

On the live tests the panel were not convinced of this model's true accuracy, finding it fairly coloured. But it achieved quite a high score as its faults were fairly innocuous. A degree of 'hollowness', 'boxiness', and 'hardness' were apparent, with some loss of clarity, but the overall balance was fairly neutral, with a reasonable bass extension showing an even character. The bass sounded a little 'nasal' and 'thinned', but the speaker could withstand considerable peak inputs of up to 200W of electric bass guitar without serious overload.

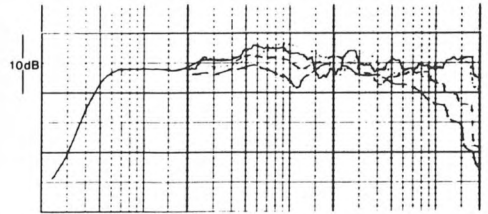
This picture was similar for the stereo sessions also, with the speaker sounding a trifle 'old fashioned' in terms of coloration levels, but at the same time considered easy on the ears. Lateral stereo presentation was to a good standard, although some loss of depth and 'see-through' ambience was experienced by most panelists. The midband was also a touch resonant on piano, for example, and loss of 'crispness' was felt on some transient signals.

### Summary

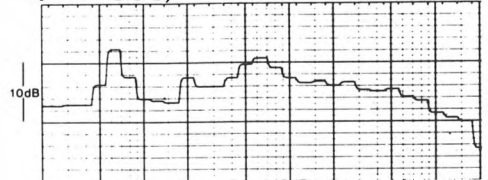
We were pretty keen on the 48S and the new LS version carried a dual improvement, namely a welcome price reduction and an improved grille. In the light of recent competition, it still deserves a 'recommended' rating.

#### GENERAL DATA

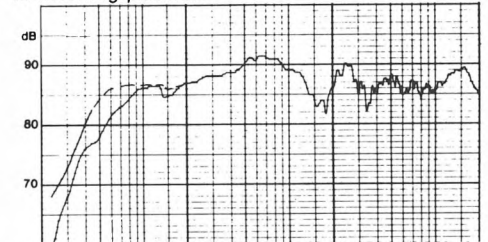
Size (h x w x d) .....	64 x 35.5 x 28cm
Weight .....	17.2kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	(15)–100W
Recommended placement .....	stand
Frequency response within $\pm 3$ dB (2m) .....	50Hz to 20kHz
Low frequency rolloff (–6dB) at 1m .....	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	88dB/W
Approximate maximum sound level (pair at 2m) .....	105dBA
Impedance characteristic (ease of drive) .....	average
Forward response uniformity .....	good
Typical price per pair inc VAT ....	£250 when reviewed, now £219



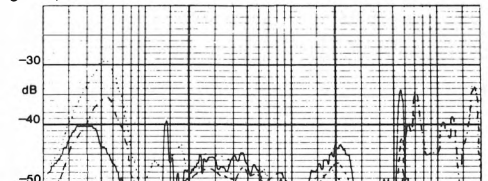
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



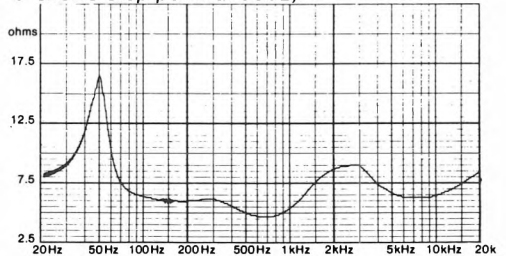
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



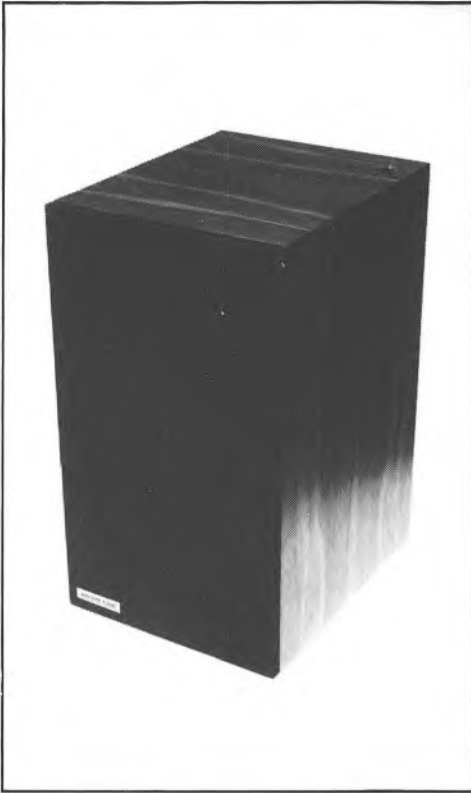
Harmonic distortions: solid 3rd 96 dB, dotted 2nd 96 dB, dashed 3rd 90 dB, chain-dashed 2nd 90 dB, ○ shows stop point at 96 dB.



Impedance (mod Z).

# Arcam One

A&R Cambridge Ltd, Denny End Industrial Centre, Waterbeach, Cambridge CB6 9PB  
Tel (0223) 861550



A&R's first venture into the field of loudspeakers, the *Arcam One* is a medium-sized, two-way bass reflex system aimed at the higher quality end of the market. The recipe is straightforward enough – a 200mm bass/mid unit plus 25mm soft fabric dome tweeter, but A&R's approach shows considerable care and attention to detail.

The tweeter is a modified Peerless design, mounted above an A&R-designed, Elac-built bass/mid unit. Constructed on a strong damped steel frame, the latter uses a generous motor system driving a synthetic flared cone formed from Cobex (a pvc material). The crossover is a high-quality, high power design, with 12dB/octave slopes and may be disconnected by the user via a terminal patch panel on the enclosure rear. Direct active connection to the two drivers is then possible, using matching A&R electronics.

Built from 19mm chipboard, the substantial enclosure is internally braced and loaded by a thin bituminous cladding. A 120mm deep ducted port is located on the rear and is fitted with a user-removable damping plug to allow fine adjustment of the lower bass output.

Externally, the system was well finished in a high-quality walnut veneer on all surfaces. The 12mm-thick grille panel has a step effect, although this is partially ameliorated by a foam strip around the tweeter. Against A&R's recommendation, we felt the grille was better removed, and it could do with some modification.

## Sound quality

A strong consensus of opinion favoured the *Arcam One*. Its numerical rating was high, backed by complimentary judgements and few criticisms. Bass was a trace boomy with the port plug removed (as suggested by A&R), while some mild boxiness was heard in the lower mid, and the upper treble occasionally hinted at fizziness.

Conversely, this speaker produced lively, open, balanced and transparent stereo images. Ambience, air and depth were well portrayed while natural perspectives and musical detail were also evident over the whole frequency range. Stereo images were stable and well focused, and transients were convincingly reproduced.

## Lab results

The reference 1metre response showed the mild improvement with the grille removed (dotted), and illustrated a smooth overall result. Sensitivity was above average at 88dB/W with a typical bass rolloff at 55Hz (porous plug in). Pair matching was good for these early samples. A minimum amplifier power of 15W per channel is suggested, and the general performance indicated a capacity of up to 150W of unclipped music programme, generating respectable 104dBA maximum sound levels.

At 2metres a well ordered and integrated forward response output was demonstrated. 15° above and below axis, responses dipped mildly at the 2.7kHz crossover frequency and the speaker median axis should aim accurately at the listener for the best results. The lateral responses were particularly good.

At a 96dB sound level, on a mono, the second and third harmonic distortion levels were typically around 0.8% to 1.5%, which was a good result. At 86dB the second harmonic

improved but third did not, and here the system is possibly somewhat worse than average, the cause probably being magnet pole linearity.

The impedance curve showed an easy, well controlled 8ohm amplifier load, and for interest's sake the result with and without the port plugged is shown.

Room averaged, (port open) the Arcam a fine result. The response showed a slight bass excess with quite good integration and depth, while the middle register was surprisingly smooth, with textbook rolloff at higher frequencies.

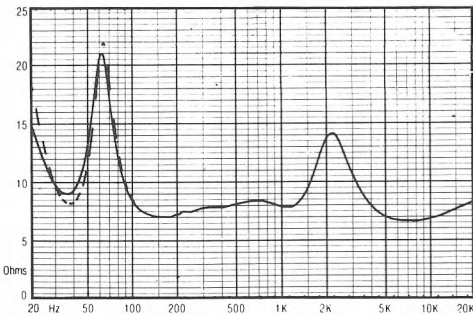
**Summary**

A&R have a convincing performer in this fine loudspeaker. The subjective scores, the quality of construction and finish justify a strong recommendation (we have not given 'Best Buys' to speakers over £275 a pair). The sound was clear and open, with fine musical detail and accurate stereo presentation. Distortion was satisfactory to good, power handling and maximum sound level fine and the system easy to drive.

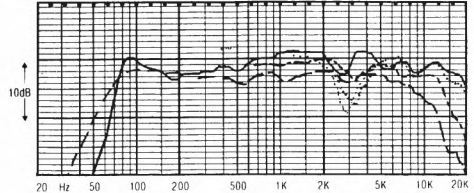
With A&R's acknowledged electronic expertise the active version could sound even better. To conclude, the Arcam *One* happily justifies its price tag.

**GENERAL DATA**

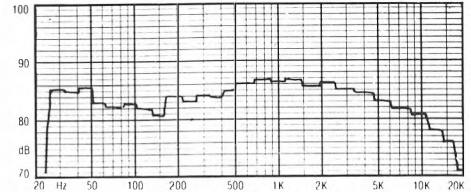
Size (height x width x depth) .....	47 x 27 x 33cm
Recommended amplifier power per channel (for 96dBa minimum per pair at 2 metres) .....	(15)—150W
Recommended placement .....	open stands
Frequency response, within ±3dB, at 2 metres .....	60Hz to 20kHz
Low frequency rolloff (– 6dB point) at 1 metre .....	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre .....	88dB/W
Approximate maximum sound level (pair) at 2 metres .....	104dBa
Impedance characteristic (ease of drive) .....	very good
Forward response uniformity .....	good
Typical price per pair, inc VAT .....	£299



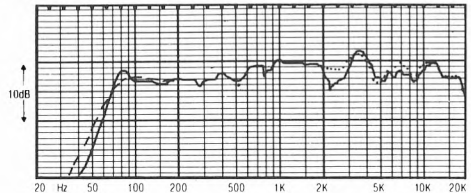
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



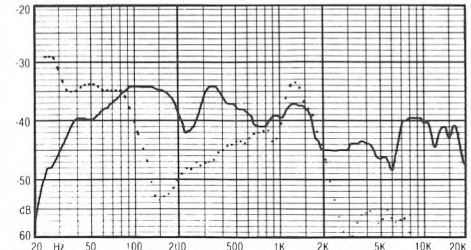
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



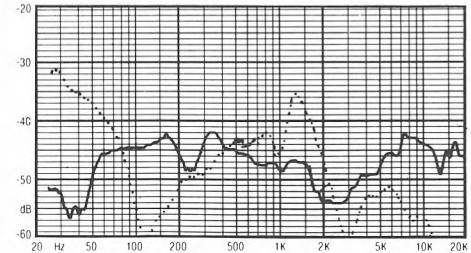
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



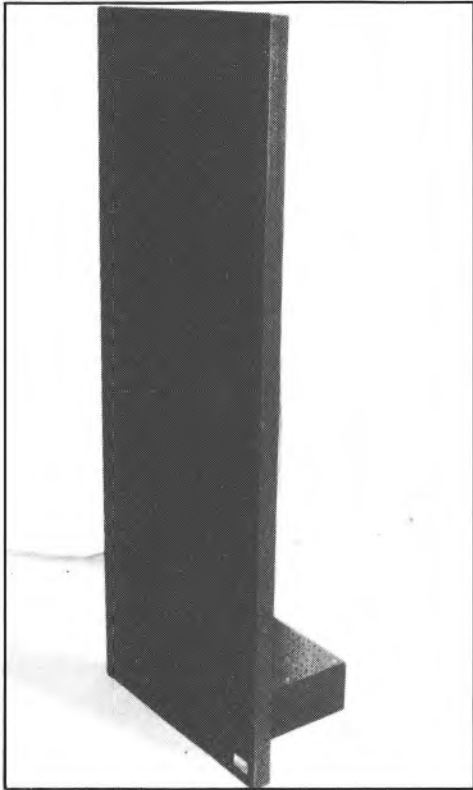
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Audiostatic ES200

Presence Audio, Eastland House, Plummers Plain, Horsham, West Sussex RH13 6NY  
Tel (044485) 333



Built in Holland, this panel electrostatic speaker is a little larger than the Quad 63. While the latter has most of its area as radiating surface, the Audiostatic takes the form of a large wooden baffle flanking a central, fairly narrow electrostatic element running the full height of the enclosure. To some degree this provides a line source with the baffle augmenting the room drive at the lower frequencies. The effective width of the source reduces with increasing frequency, maintaining a good lateral off-axis response. This is achieved by the use of a sophisticated transformer step-up system, called 'Mirror-Drive'. A low voltage 'mains plug' power supply feeds power to the speakers, this stepped up internally to the high polarising voltage. Heavy and stable enough for floor mounting, these speakers benefit from use on low rigid frames, around 10-15cm high, and the agent also

recommends the use of floor spikes. Connections are via sturdy 4mm socket binding posts. As with all open-back systems, use well away from the rear room wall (at least 1.5m) is mandatory and in fact large rooms are preferable. Overall constructional quality and finish are excellent, and Audiostatic also produce compatible sub woofer systems.

## Sound quality

It was clear that a definite limitation was present in the bass power handling and on several of the rock tracks, powers over 50 watts were ruled out. The speaker was felt to sound imbalanced with a forward midrange plus a lack of richness and 'scale' in the upper bass/lower mid. However this response complemented some sources to an incredible degree. BBC announcers were unbelievably life-like, with their usual 'chestiness' perfectly controlled. Aside from the tonal imbalance, the sound was very pure, transparent and full of detail, and succeeded in sufficiently impressing the panel to achieve a respectable score. Bass was fairly extended, but a touch lumpy and muted, while the treble was generally very good if slightly prominent in the extreme upper range.

Stereo images were well focused and, given appropriate material, the depth effect was also substantial. Undoubtedly this is an analytical speaker.

## Lab report

Pair matching was good over most of the range save for a 1.5dB difference in sensitivity, this averaging 80.5dB/W. With a peak power capacity of 50-75W, this speaker was not capable of high sound levels, the maximum being typically 93dB for a stereo pair at the listening position.

Taken at 1m, the frequency response is somewhat misleading due to microphone proximity to such a large baffle, this affecting the low frequency balance. A mild mid range plateau was followed by a dip at 1.5kHz and then a very smooth treble response disturbed by a mild prominence at 1.5kHz.

Anomalies in off-axis responses prompted us to take an additional 15° off-axis curve for this model. Even then, the output fell rapidly above 5kHz. The forward energy peaked at 1kHz, compensating for the measured axial dip. It was also very axis-sensitive in the vertical plane, with the 15° off-axis response collapsing above 1kHz, so the listener should

aim to be on axis. The light tonal character of this model can also be seen here.

Distortion at 96dB/1m was very good above 200Hz, particularly as regards 3rd harmonic. Below 200Hz, the speaker was clearly working hard, distortion rising to 3% 3rd harmonic. At 86dB, distortion fell below 0.1% above 150Hz; even at 50Hz neither 2nd or 3rd exceeded 1.5%, which is an excellent result. At moderate levels this is an outstandingly clean loudspeaker.

Barely dipping to 4.5 ohms at 20kHz, the impedance was typically 10 ohms, and is regarded as a relatively easy amplifier load.

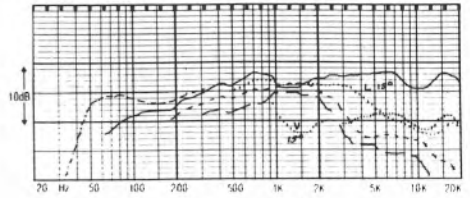
The room response measurement correlated remarkably with the subjective reports — an uneven, depressed bass with prominent voice band mid range, and excellent treble but with a 'string in the tail' around 12-16kHz, the isolated step visible on the graph.

### Summary

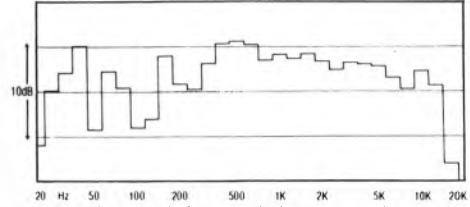
This is a costly speaker with an idiosyncratic performance. The main mid and treble performance is superb but the tonal balance is 'off'. The bass is weak in power as well as inadequate in level, and the speaker is also very insensitive. However it is definitely not a write-off, and with its audiophile pretensions it is well worth trying. It might suit some customers requirements — fabulous on piano and string quartets, and pretty good on non-rock bass.

### GENERAL DATA

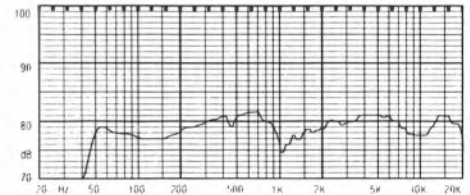
Size (height x width x depth).....129.5 x 53 x 23cm  
 Recommended amplifier power per channel  
 (see text).....100W  
 Recommended placement.....well clear of rear wall  
 Frequency response, within  $\pm 3$ dB at 2 metres.....see text  
 Low frequency rolloff (-6dB point) at 1 metre.....45Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....80-82dB/W  
 Approximate max sound level (pair) at 2 metres.....93-95dB  
 Impedance characteristic (ease of drive).....good  
 Forward response uniformity.....fair  
 Typical price per pair, including VAT.....£1397



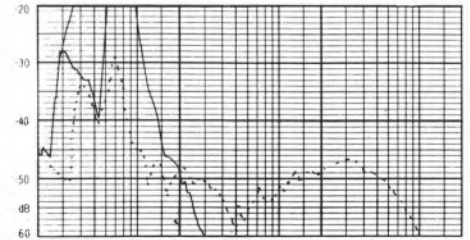
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



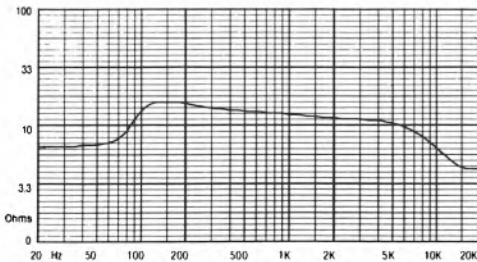
Averaged forward characteristic response in room



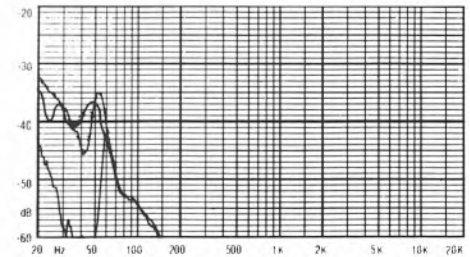
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

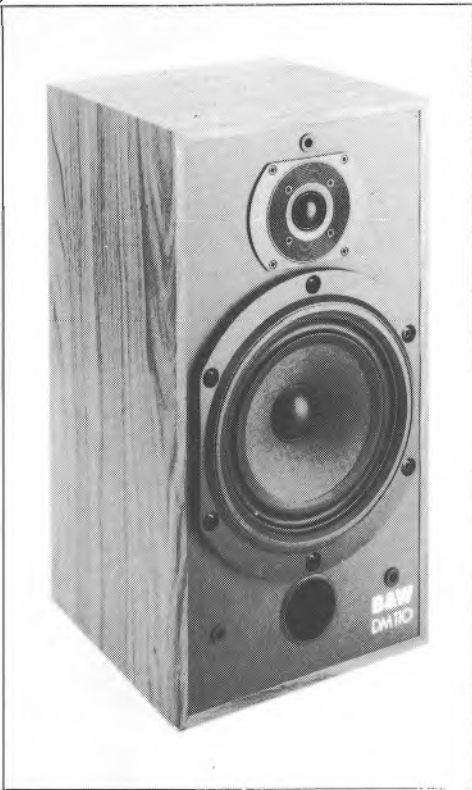


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

# B&W 110

B&W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex  
Tel (0903) 205611



Released since the publication of the last *Loudspeakers* issue, the 110 has been highly successful and was therefore an essential entry this time round. Built to a tried and tested formula, its success would seem due to a skilful balance of performance, engineering and fine value. A two-way model of some 22 litres internal volume, it is reflex loaded by a fair-sized (5cm diameter) port, backed by a 7cm tube.

Bass and midrange frequencies are handled by a flared pulp cone 220mm unit, this built on a substantial diecast frame with six hole fixing. A B&W-built unit is also used for the treble, this a new series plastic foil unit with a 25mm soft dome and cast plate.

The enclosure is well finished in a 'walnut' vinyl material, while the grille and its thick non-rebated frame can be detached. 4mm socket/binding posts are fitted at the rear. The

crossover is said to be 4th order acoustic Butterworth, this achieved by a good quality 2nd order internal network, in conjunction with the driver's acoustic responses. Acoustic foam is used to provide internal absorption.

## Sound quality

Despite its budget price the 110 scored 'above average' — and remember that the average price among all speakers tested is double that of this model. A good midrange was solidly backed by a lively, articulate quality and the speaker showed a pleasing transparency with good rendition of fine detail. Tonally it was well balanced, with just a hint of untidiness at the response extremes; in the extreme treble, a touch of tizz was evident while the bass extreme sounded a little underdamped. Some box coloration was present despite the fine overall effect, and this occasionally made itself apparent. Stereo images, particularly with the grille detached, were well focused, and the 110 made a surprisingly good attempt to recreate depth of image. High powers were also handled very well.

## Lab report

An excellent pair match was shown, certainly within  $\pm 0.5\text{dB}$  limits over the whole range. The 'grille on' reference response was very good indeed, marred by a ripple at 5kHz to 8kHz, this removed by the simple expedient of detaching the grille. Sensitivity was a high 89.5dB/W with a response of  $\pm 2\text{dB}$ , 65Hz to 19kHz — remarkable. The  $-6\text{dB}$  LF point was typical for the type at 56Hz, and the system is well tuned.

A 350W peak programme signal was handled without damage but 100W peak would be a fairer rating, allowing a generous maximum sound level of around 104dB/A for a stereo pair, near disco levels! Out at 2m the forward response family of curves was very good, bar the 15° vertical off-axis response. This suggests that fairly high stands should be used, with the treble units close to ear level. Good driver integration was shown here particularly in the lateral axis.

Even at 96dB sound pressure level, the speaker produced only moderate distortion levels of under 0.3% midband, and generally more of the less harmful 2nd than the 3rd harmonic. At 86dB and above 200Hz 3rd averaged 0.2%, and 2nd still less. These are very fine results.

The impedance curve gave no cause for concern and essentially represents an 8 ohm



system of typically good behaviour; no decent amplifier should find this speaker a problem.

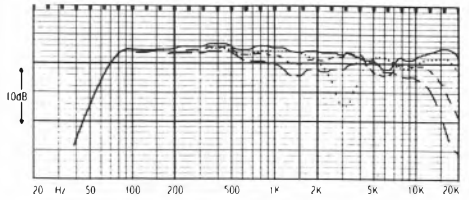
In the listening room, the computer averaged response was impressive too. Good output can be seen down to 40Hz with a notably even and well matched midband, while the treble rolloff also conformed to an even axial output.

**Summary**

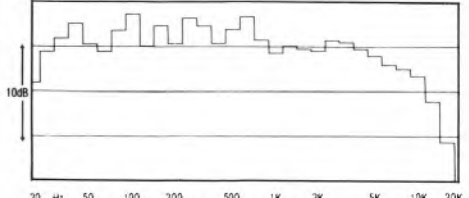
This well engineered loudspeaker provides a good sensitivity with low distortion. The amplifier load is good, the responses even and the tonal balance most presentable. The sound quality is most competitive and the power handling exceptional, while its lively, transparent quality pleases consistently. Overall this is a clear candidate for Best Buy status.

**GENERAL DATA**

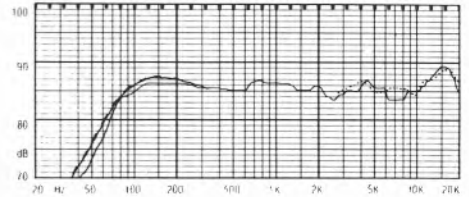
Size (height x width x depth).....	49 x 26 x 25cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(10)—200W
Recommended placement.....	Open stands
Frequency response, within ±3dB at 2 metres.....	59Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	56Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	89.5dB/W
Approximate maximum sound level (pair) at 2 metres.....	107dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, including VAT.....	£105



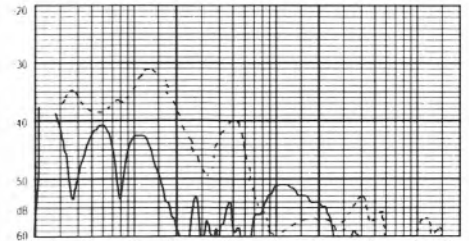
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



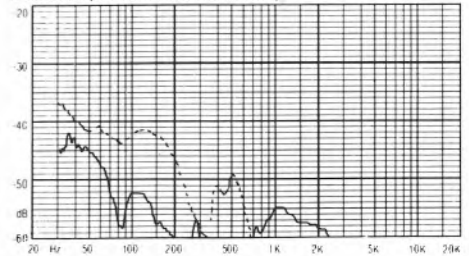
Averaged forward characteristic response in room



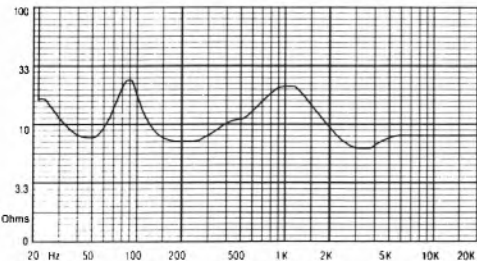
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

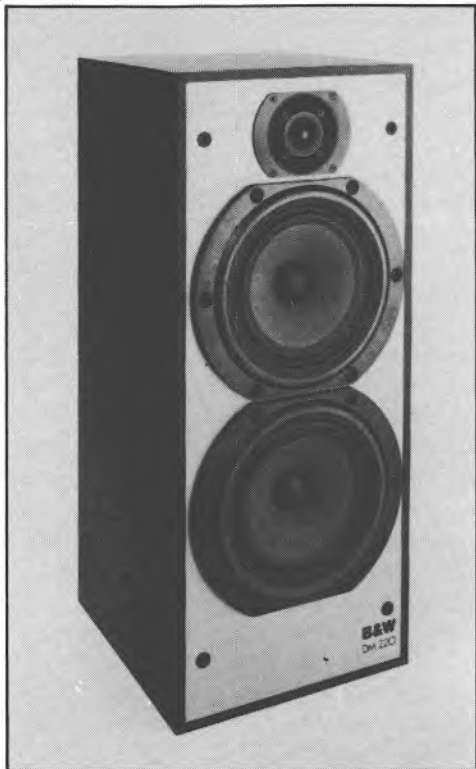


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# B&W 220

B&W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex  
Tel (0903) 205611

RECOMMENDED



As the number suggests, the *DM220* is a double-sized version of the *110*. Its larger 50 litre enclosure houses two 220mm bass/mid units in a sealed-box system, these built on strong diecast frames with six-point fixings. Their critically flared pulp cones have good excursion capability and are heavily doped on the rear faces. The treble unit is B&W's own ferrofluid damped 25mm soft plastic dome, with the main crossover at around 3kHz. The lower bass unit is electrically rolled off in the low midrange, to give a variant of three-way working. The 'walnut' vinyl finished enclosure is solidly made from 15mm chipboard, and the plain 15mm thick grille panel is unrebated. Electrical connection is via 4mm socket - binding posts and internal damping is provided by a generous volume filling of animal wool. The good quality crossover employs a total of six elements plus a resistor for sensitivity control.

## Sound quality

Sometimes an extension of a basic system design can let the side down, but this was not the case with the *220*. Building on the solid foundations established by the *110*, the *220* went on to add a smoother, slightly more extended bass, with a hint of extra detail in the upper mid, and extraordinary power handling. Stereo images showed good depth and atmosphere, and it also focused well especially with the grille removed. On occasion a hint of brightness in the treble was noted but the overall tonal balance was considered to be pretty neutral. 'Boxy' coloration was held to moderate levels and the midrange quality was to a high standard, and better than many traditional, so-called monitor speakers. The overall rating was slightly above the average.

## Lab report

Mean sensitivity was high at 90dB/W, and very good pair matching was demonstrated. The grille produced some response irregularities, extending from 2kHz upwards and the output was certainly smoother with the grille detached. Then it met fine  $\pm 2$ dB limits from 60Hz to 20kHz. The  $-6$ dB bass rolloff point was 52Hz, which was good for the size and sensitivity.

At 2m the response family was very tidy, with only the  $15^\circ$  above curve showing mild phase loss at crossover. Used on a stand of 20-30cm high the treble axis will be near ear level, and will cause no problems. The lateral off-axis responses were particularly good, and the overall response met  $\pm 2$ dB limits 60Hz to 20kHz.

Accepting 400W peak without collapse, the *220*'s maximum power rating for undistorted music is around 100-150W. High sound levels of 105dB were possible from a stereo pair in a typical room. Measured at 96dB spl, some 2nd harmonic distortion was present in the treble response, peaking at 1%, 4kHz. The results for 2nd harmonic were good, this also true at low frequencies. At 86dB spl the distortion was in general much improved though the 2nd harmonic was still apparent in the lower treble, now around 0.6%. For the compression signal, 20W at 40Hz, the mid again dropped a modest 1.1dB with  $-25$ dB 3rd harmonic and  $-41$ dB intermodulation. System resonance was at 73Hz. Impedance was maintained at more than 5 ohms with a smooth characteristic which justified a 6 ohm designation and so the speaker presented a straightforward amplifier load.

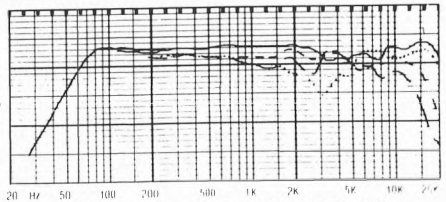
The room-averaged response showed a remarkable 'fit' with the room. Output was present, if a little attenuated, to below 30Hz while the open midrange was also evident, but was well controlled, and the overall effect near ideal.

**Summary**

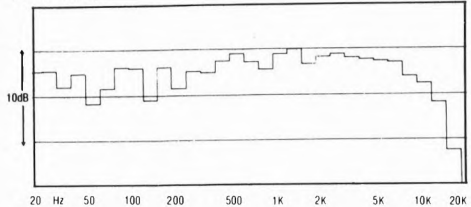
While not quite offering the same value as the 110, the 220 has done well. It improved on the 110 without any drawbacks bar some probably unimportant second harmonic distortion in the treble. Its dynamic range was exceptional, stereo good and the bass both powerful and extended. The mid was very good too, and a strong recommendation is appropriate for this model.

**GENERAL DATA**

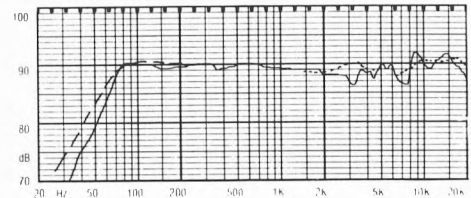
Size (height x width x depth).....68 x 29 x 34cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(10)—200W  
 Recommended placement.....open stands  
 Frequency response, within ±3dB at 2 metres.....55Hz-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....52Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....90dB/W  
 Approximate maximum sound level (pair) at 2 metres....108dBA  
 Impedance characteristic (ease of drive).....good  
 Forward response uniformity.....very good  
 Typical price per pair, including VAT.....£189



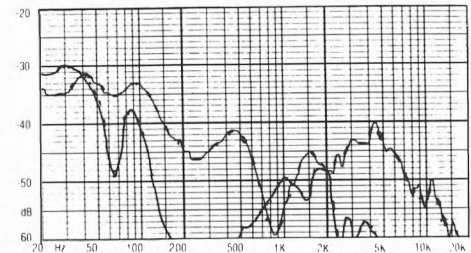
Forward characteristic response (1/3 octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral).



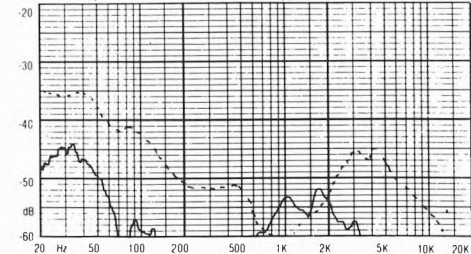
Averaged forward characteristic response in room



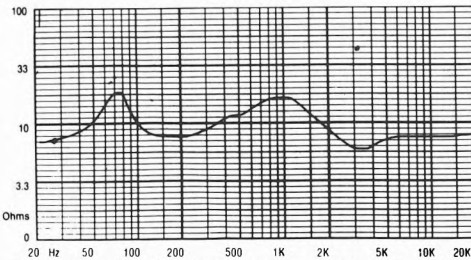
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



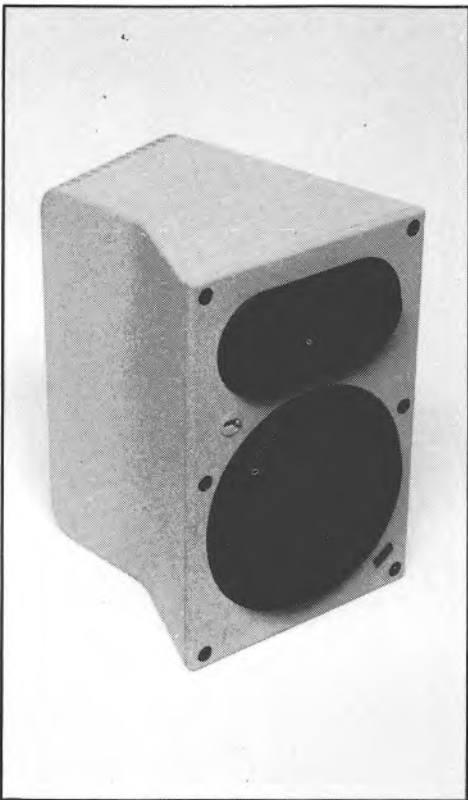
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# B&W LM1

B&W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex  
Tel (0903) 205611



B&W's *LM1* micro speaker is an unusual fully-styled product intended for general purpose duty in a variety of environments – from shelf mounted domestic main systems, to kitchen or bathroom extensions, to mobile rigs on wheels or on the water. Full mounting kits are available for exposed or in-panel fixing to decent safety standards. The *LM1* may be purchased in this alternative form, or retro-fitted. The speaker has a small front-panel switch with two settings, '0' and '+', and as our initial trials indicated that the sound when set at '0' was too recessed, the results here relate to the '+' position when wall mounted.

Smallest of the enclosures in this issue, the *LM1* has an internal volume of just 2.5 litres, giving sealed-box loading to a synthetic woven bass/mid unit of B&W design. B&W also make the tweeter, a 20mm soft dome. Generous magnets are used, and the design employs

several die-castings extensively, including the enclosure itself. This is finished in hardwearing Nextel 'suede', which comes in range of colours – charcoal, brown, beige, blue and red. It is intended to be corrosion-resistant, and to endure – 10° to 90°C temperature extremes, operating quite happily within a 10-80°C range. Overall constructional standards and finish were very good for a speaker in this price range.

The main crossover employs some 13 high-quality components, and in addition to its durable exterior, this model is practically indestructible through misuse, by virtue of its electronic overload protection.

## Sound quality

For its size, the *LM1* was clearly trying hard, although in an absolute sense, its performance fits in the 'satisfactory' category – not a particularly good result for the price. Understandably, low bass was notable by its absence, leaving the upper bass in relief, while tonally it sounded a trifle thin and forward, with an 'artificial' quality noted by several listeners – possibly due to the unusually small size and construction. It provided a lively sound with good frontal detail and stereo focus, but depth effects were noticeably restricted. Some 'cuppy' coloration was also evident, perhaps not surprising since the space within the enclosure is about breakfast cup size!

## Lab results

The 1metre reference response showed the difference between the '0' and '+' (preferred) upper response. On the former, the sensitivity was only 81dB/W with a lower-mid suckout, and for wall mounting the more 'forward' response at '+' , with its 87dB sensitivity was preferred. A – 6dB rolloff at 80Hz was noted, a limitation of the small size. The speaker could accept up to 100W inputs quite happily, generating up to 101dB sound levels which is quite loud enough. Pair matching was to a good standard.

Considering the 2metre forward response, the shelf above 50Hz averaged 5dB, which was probably too great, this accounting for the 'thin' tonal quality even when wall mounted. The 15° above-axis result was poorer than that taken below, so the system should be used with the tweeter aimed at or a little above ear level. Otherwise, the set of responses was well integrated.

At 96dB the distortion levels were moderate for such a small box at generally below 1%, and rather better in the midrange. Worthwhile

reductions in percentage distortion were evident at 86dB where the results were better than average.

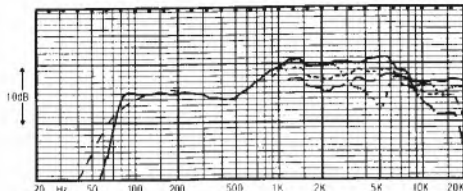
On '+' the impedance dipped to 5.4 ohms, 7kHz, but typically read 6 ohms – a reasonably good amplifier load. It was noticeably easier to drive on '0' but it then needed more power to fight the low sensitivity. The room-averaged curve confirmed the upper-mid plateau, and illustrated a smooth overall characteristic with fair bass extension to 70Hz or so.

### Summary

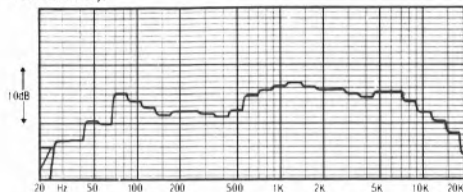
By basic *Choice* standards the *LM1* does not qualify for a recommendation. However, if its unique qualities of very small size, first-rate engineering content and finish, environmental tolerance and power capacity are all taken into account, the *LM1* becomes a special case well worth considering for special situations. If price is not a prime consideration, then the *LM1* can probably be described as one of the best micros made, offering a most tolerable sound domestically, while at the same time remaining unobtrusive, hidden away on a bookcase.

### GENERAL DATA

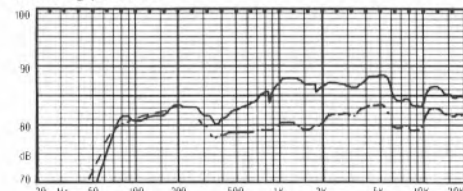
Size (height x width x depth)	24 x 15.5 x 20cm
Recommended amplifier power per channel	
(for 96dB minimum per pair at 2 metres)	(15)–100W
Recommended placement	shell/wall mounting
Frequency response, within $\pm 3$ dB, at 2 metres	see text
Low frequency rolloff (–6dB point) at 1 metre	80Hz
Voltage sensitivity	
(ref. 2.83V, or 1W into 8ohms at 1 metre)	86 5dB/W
Approximate maximum sound level (pair) at 2 metres	101 dBA
Impedance characteristic (ease of drive)	satisfactory, see text
Forward response uniformity	good
Typical price per pair, inc VAT	£200



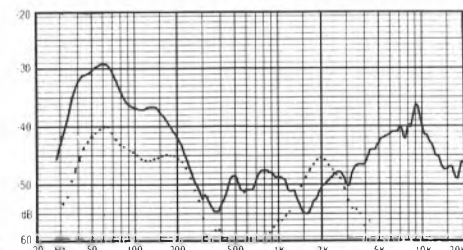
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



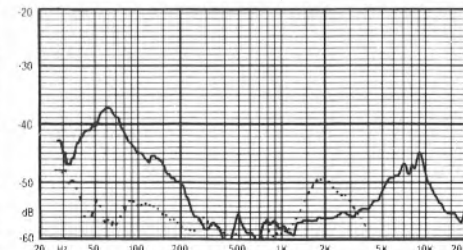
Averaged forward characteristic response in room at listening position.



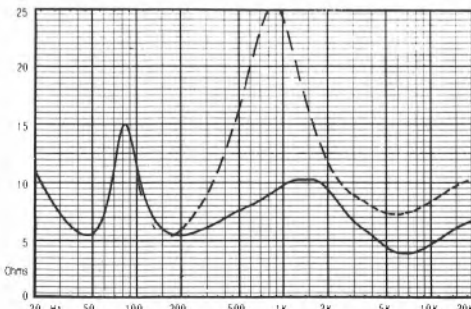
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance characteristics give an indication of amplifier loading.

# B&W 1200

B&W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex  
Tel (0903) 205611

RECOMMENDED



This quality compact derives from the earlier *DM12*, which did well in previous issues. This new version continues the concept of full APOC driver protection and as such the speaker is near 'unburstable'. Two key developments have been added; firstly, the tweeter has undergone refinement and the new 25mm soft plastic dome is ferro-fluid damped and possesses improved characteristics. Secondly, by the use of a passive time delay network in the crossover, the effective sound starting point for the tweeter has been aligned to fall back into place with the delayed bass output. Now both in phase and in time, an idealised 24dB/octave acoustic Butterworth crossover may be used, conferring benefits to driver integration as well as the system polar response.

The 11 litre enclosure has a circumferential brace, and is strongly built, mainly from 20mm

board, bitumen damped and well finished externally in walnut veneer. The 180mm Bextrene coned bass unit is heavily damped and built on a diecast frame with a generous magnet. A good quality 10 element crossover divides the input at 3kHz with electrical connection made via 4mm socket/binding posts.

## Sound quality

At the outset the panel results indicated a significantly above average performance but showed mixed feelings about the speaker. For example while it sounded quite open and neutral in tonal balance, on occasion it could sound somewhat muddled and lacking life. Conversely, it gave fine stereo images with a good depth impression and well placed left-to-right effects. Bass was tidy but lacked some attack, as well as extension. Some 'fizz' was apparent at times in the upper treble, this noticed on the rougher programme sections. It coped well with the high power input in mechanical terms but it did not get very loud nor did it excite the panel very much, tending to sound compressed as well as lacking in dynamics. The overall impression was that of a tidy, 'civilised' miniature.

## Lab report

Pair matching was slightly out, as one system had a tweeter 1dB more sensitive than the other, which is a significant flaw at this price level. Despite the foam edge, the grille disturbed the treble, and the sound was better with the grille removed. Sensitivity was moderate at 86dB/W with a -6dB low frequency point at 60Hz also modest. At 1 metre the 70Hz to 20kHz range required  $\pm 3.5$ dB limits.

With 100W as a sensible power limit, maximum sound levels of 101dB were available from a pair in a room. Out at 2 metres the family of off-axis responses was quite respectable though not as tidy as one might have expected from the 'time-aligned' design. Note that at 30° off-axis, the treble 'sting' at 15kHz is almost gone, and this would be the preferred listening axis for many.

At 96dB level the 2nd and 3rd harmonics were average, distortion peaking at 3% at low frequencies and at 1% at 500Hz. By 86dB the distortion had considerably reduced and 3rd had descended to very low levels. Compression at 40Hz, 20W, was 1.3dB with a low level of intermodulation at -54dB, this a fine result.

The impedance curve suggested a 10 ohm

rating, the trend indicating an easy amplifier load. Sealed box system resonance was fairly high at 90Hz, this explaining the restricted bass response.

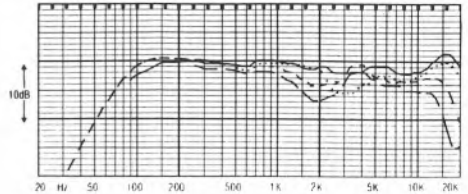
Finally, the room response gave some explanation of the mixed panel results. The presence energy loss around 2.5kHz is associated with the slightly 'dead' quality; the sharp 'corner' at 12.5kHz with the 'fizz', and the 100Hz prominence allied to a premature rolloff below, with the bass quality. Compare this with the DM220, for example.

**Summary**

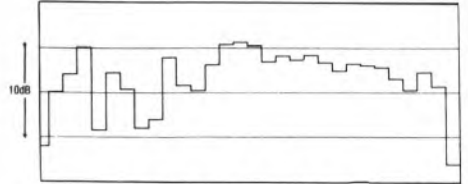
This neat little monitor has good stereo and low coloration on its side; conversely it does not get particularly loud, has restricted bass and shows some sound quality variations with different programmes. The overall build quality, technical standard and panel ratings indicate recommendation, but a careful audition is advised.

**GENERAL DATA**

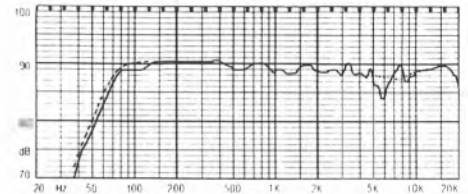
- Size (height x width x depth).....36 x 22 x 28cm
- Recommended amplifier power per channel (for 96dB/A per pair at 2 metres minimum).....(15)—100W
- Recommended placement.....open stands
- Frequency response, within ±3dB at 2 metres.....70Hz-20kHz
- Low frequency rolloff (-6dB point) at 1 metre.....60Hz
- Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....86dB/W
- Approximate maximum sound level (pair) at 2 metres....101dB/A
- Impedance characteristic (ease of drive).....excellent
- Forward response uniformity.....good +
- Typical price per pair, including VAT.....£230



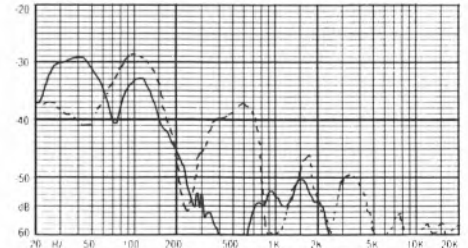
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



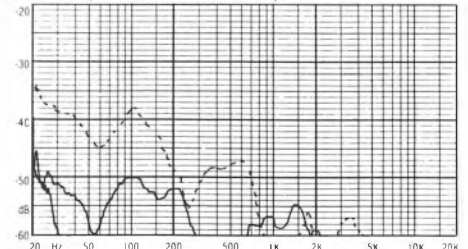
Averaged forward characteristic response in room



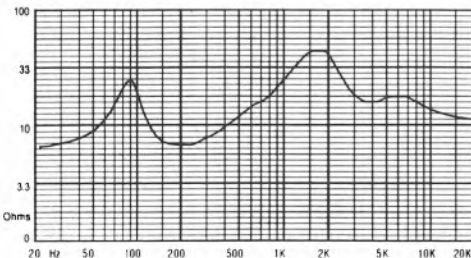
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# B&W 1400

B&W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex  
Tel (0903) 205611



Like the *1200*, this new speaker is derived from a well established predecessor, in this case the *DM14*. A narrow fronted enclosure, this speaker is akin to a sort of stretched *1200* with an additional matched driver placed below the original two, essentially to augment the bass power handling. Built from 20mm thick board, the cabinet has added internal bracing and bituminous damping which both serve to improve the acoustics, and a fine external appearance is assured by the natural wood veneer.

The vertical driver line-up comprises one 25mm B&W soft dome plastic tweeter plus two 180mm diecast frame bass/midrange units; the bottom one is rolled off in the lower midrange so as to direct its action towards the bass. The mid to treble crossover is around 3kHz. Heavily-doped Bextrene cones are adopted for the main drivers, these equipped with

generous magnets. The complex, good quality crossover includes the APOC overload protection scheme with a muting relay and a time delay compensator to synchronise the treble and midrange outputs.

Like the earlier *DM14* and the current *1200*, this is a sealed box system. Electrical connection is via 4mm socket/binding posts. The *DM14* also comes complete with a matching robust stand, this screwing to the speaker underside and supplied in the speaker pack.

## Sound quality

Achieving a basically 'average' standard, the *1400* was if anything liked a little less than the *1200*. It offered a little more bass power handling and maximum level but was not considered to be very convincing when played loud — here it sounded a degree muddled and compressed.

Clean and uncoloured in the normal sense, the *1400*'s stereo image was well focused in the lateral plane, but panelists felt that a loss of stereo depth occurred. The bass lacked real extension and showed some upper range lumpiness while the mid had a hint of 'cuppy' coloration. The treble was fine in general but marred by a 'zing' at the extreme of its range. Strings sounded good however, though piano reproduction was somewhat 'thin' and boxy.

## Lab report

Pair matching was very good, to within  $\pm 0.25\text{dB}$  except for a small area around crossover where a 1dB difference was noted. The axial response was surprisingly lumpy for such a highly developed speaker. Sensitivity was estimated at 86.5dB/W while  $\pm 2.5\text{dB}$  limits sufficed for a 63Hz to 20kHz frequency range. Prominences were noted at 100Hz, 3.5kHz and 15kHz. The  $-6\text{dB}$  bass rolloff came at 50Hz, which is typical for the size. A peak programme capacity of 200W was measured, and maximum sound levels of around 105dB were possible from a pair. Out at 2 metres, the responses were a little smoother and showed a well balanced set of off-axis curves, illustrating good driver integration. The response humps at the extremes of the frequency range still remained however.

Driven to a 96dB sound level, the distortion was low above 200Hz, at typically 0.3% for 2nd and 3rd harmonic; 2nd peaked around 100Hz at 4%, which was a fairly harmless level. With a reduction in level to 86dB, the distortion quickly improved, with very low levels of 3rd harmonic and 2nd above 200Hz. On the inter-



modulation test, the compression at 40Hz was mild at 1.3dB.

The impedance averaged 12 ohms, and barely fell below 10 ohms above 400Hz, dipping only in the very low bass, and the speaker must therefore be classed as easy to drive. System resonance was 82Hz.

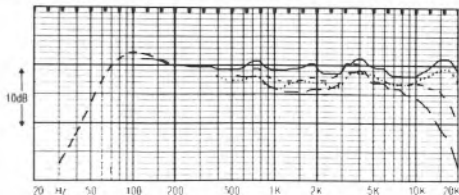
The room-averaged response confirmed the mildly 'lumpy' characteristic and the sudden treble rolloff caused by the upper treble prominence, but the general room balance remains quite good.

**Summary**

This competent design is placed in the 'worth considering' category. It has much to commend it including the supplied stands, but at the price it was felt to have fallen short of the required recommended standard, possibly due to the response unevenness. Of the two new B&W models, we felt the DM1200 was better value.

**GENERAL DATA**

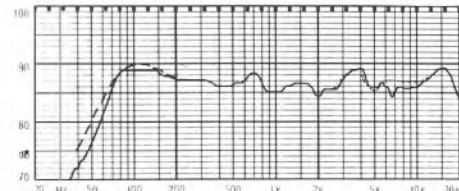
Size (height x width x depth).....	60 x 25.5 x 30cm
Recommended amplifier power per channel (for 96dB/BA per pair at 2 metres minimum).....	(20)—200W
Recommended placement.....	on stands supplied
Frequency response, within ±3dB at 2 metres.....	60Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	50Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	86.5dB/W
Approximate maximum sound level (pair) at 2 metres.....	105dB/A
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good +
Typical price per pair, including VAT.....	£395



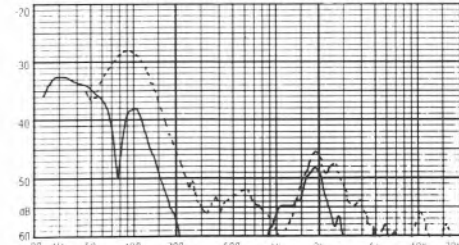
Forward characteristic response (1/3 octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral)



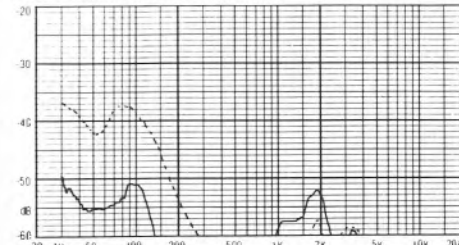
Averaged forward characteristic response in room



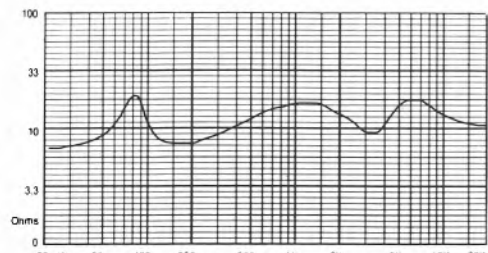
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

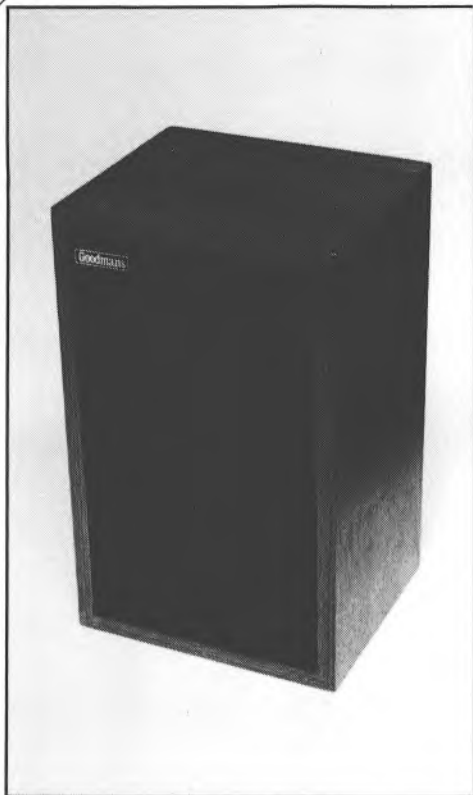


Impedance (mod Z), Impedance characteristics give an indication of amplifier loading.

# BBC LS3/5a

Goodmans Loudspeakers Ltd; Swisstone Ltd (Rogers); Spondor Audio Systems Ltd

RECOMMENDED



Three manufacturers are now making this BBC design, as always keeping to a strict recipe – all manufacturers licensed by the BBC to produce LS3/5As must stick to the Corporation's tight specifications. Goodmans and Spondor are newcomers to the craft, although Spondor's founder, Spencer Hughes, played a major part in the 3/5a development when he was at the BBC many years ago. Designed as a miniature broadcast monitor for cramped spaces, it has stood up to much larger competition for more than 10 years now, by offering a fine sound quality in its own right. It suits mounting on high stands well clear of room walls at approximately ear level.

A sealed plywood box of 5½ litres volume, the 3/5a is a two way system employing selected KEF drivers, which comprise a 110mm Bextrene cone bass/mid range and a 19mm plastic dome treble unit. An elaborate and

costly crossover is employed to equalise the drivers to a strict specification, this including sensitivity matching, while an absorbent felt ledge surrounding the treble unit minimises reflections from the closely fitting grille.

The boxes from all three companies were excellently finished in natural veneer, the multiply enclosures fully battened internally and lined with bituminous damping and foam.

## Sound quality

The LS3/5a has consistently done well in previous live-versus-recorded sessions and fairly well on analogue programme sources. However, this time around it did not fare so well with the new digital master material.

Problems which were only hinted at when using stereo analogue material were now clearly apparent, making the design sound more dated than we had expected. Several areas attracted criticism – the bass lacked extension and sounded boomy in the upper bass register, while the mid had a noticeably hard, nasal quality and the treble seemed forward with a grainy, 'zitty' effect at the extreme top end. Some tubby, wooden and boxy colorations were also evident, while its only moderate rendition of stereo depth was apparent, as in the past, by comparison with certain less expensive designs.

It continued however to provide good voice detail and articulation, with a reasonably accurate tonal balance. Comparison between the Goodmans and Spondor versions showed great similarity while an original model from Audiomaster (no longer in production) used in previous tests sounded slightly dimmer by comparison, with less mid nasality. However the difference was small by speaker standards.

## Lab results

Sensitivity was low with this design, here measuring 81.5dB/W, necessitating a minimum of 30W per channel. A 50W maximum is suggested although with care 100W amps may be used. The bass rolloff – 6dB point measured 57Hz, quite good for the size while pair matching was very good (all three current makes) and the impedance curve never dipped below 7.5 ohms, qualifying it as an easy 10 ohm load.

Modest 96dBA maximum sound levels are possible from a pair, but taking a 96dB distortion plot was not thought advisable. At 86dB, however, moderate 2% levels were seen at low frequencies improving to around 0.8% in the mid and treble, a satisfactory result.

Reference curves were taken for the Goodmans and Spendor samples and showed good agreement with the reference unit, though the 1.2kHz prominence seems to have become more pronounced over the years. This perhaps reflects a change in the B110, although it is still within specification. By modern standards the response looks a trifle lumpy, though in its time the system was regarded as a very smooth performer.

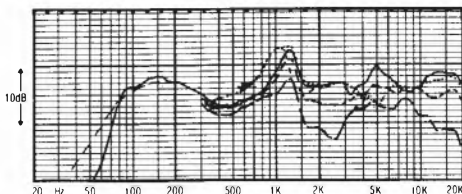
At 2metres the 1.2kHz prominence was rather obvious, and while the responses were clearly well integrated the speaker's 'lumpy' nature was evident. Computer averaged in the listening room, the low frequencies integrated well, but the mid prominence remained, and the upper treble was excessive. Measured in the room, a gentle rolloff is to be expected above 8kHz rather than the uniform results shown here.

### Summary

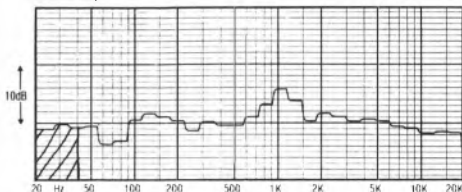
At risk of offending the BBC, I feel that the 3/5a is due for a revision; as a working broadcast tool it no doubt does its job, but as a piece of value engineering it is beginning to fall behind. Other speakers have shown a progressive reduction in price as well as an improvement in sound quality, but the LS3/5a has steadily increased in price more or less in line with inflation. But this time, inconsistently perhaps, the LS3/5a's scores just regained it a recommendation!

### GENERAL DATA

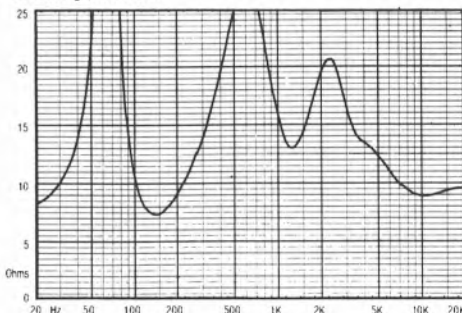
Size (height x width x depth) ..... 30 x 18.5 x 16cm  
 Recommended amplifier power per channel  
 (for 96dB minimum per pair at 2 metres) ..... (30)–50W  
 Recommended placement ..... open stands  
 Frequency response, within  $\pm 3$ dB, at 2 metres ..... see text  
 Low frequency rolloff (–6dB point) at 1 metre ..... 57Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 81.5dB/W  
 Approximate maximum sound level (pair) at 2 metres ..... 93dB  
 Impedance characteristic (ease of drive) ..... excellent  
 Forward response uniformity ..... good  
 Typical price per pair, inc VAT ..... £210



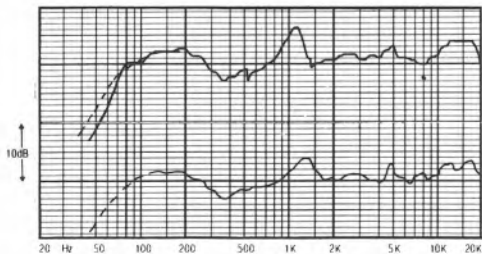
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



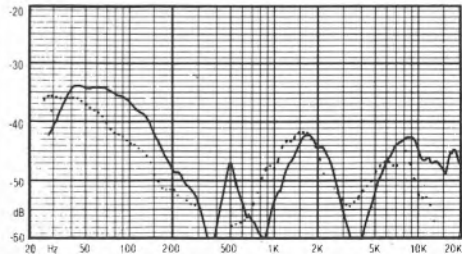
Averaged forward characteristic response in room at listening position.



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



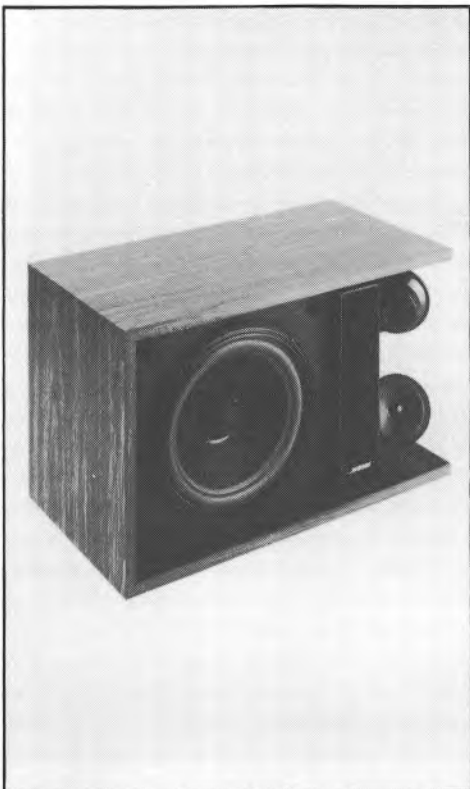
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Bose 301

Bose (UK) Ltd, Unit G2, Trinity Trading Estate, Sittingbourne, Kent  
Tel (0795) 75341



This loudspeaker's predecessor employed a single treble unit with a small variable angle baffle plate in front, the latter providing some variation of the directional response. In the new model two treble units are used, fitted to an angled recess behind the grille sections. These two units are 75mm paper cone drivers, one facing forwards and one towards the rear. The object here is to improve the energy output into the room at higher frequencies and to encourage some rear wall reflections. The enclosure is reflex-tuned with a 12.5cm long port, 5cm in diameter, and the 15 litre box is driven by a pulp coned 200mm bass-mid driver, this built on a steel frame. Diffraction and multiple reflections seem to be encouraged by the complex grille work around the tweeters, and internal absorption is relegated to a small quantity of wadding. The crossover simply comprises a single  $3\mu\text{F}$

capacitor, augmented by a 10 ohm power resistor and the design presumably relies on intrinsic acoustic rolloffs on the part of the drive units.

The sturdy enclosure is built of 15mm thick particle board with a vinyl finish and spring clips are used to take the wire connections. This speaker is intended for shelf mounting, but also appeared to work pretty well on stands when operated in the horizontal position with the tweeters outermost.

## Sound quality

This speaker produced some of the most mixed reactions I have ever encountered; some panelists thought very highly of it while others found it not to their taste at all.

It offered a strange mixture of qualities and defects, impressing with its open, lively and 'gusty' character. Mid tonal balance was good, the treble surprisingly detailed and the bass powerful, if a touch heavy. It performed with good sense of scale, producing wide uncritical stereo images, but conversely it suffered from some boxy coloration, a noticeable lack of stereo depth plus various anomalies of frontal focus. These were noted by critical listeners as a 'notchy' or 'phasey' effect, while others failed to comment on this aspect at all.

## Lab report

It should be noted that the axial frequency responses effectively show a 3dB loss in the treble range as the second tweeter output, normally room integrated, does not register in the anechoic chamber. Sensitivity was about average at 87dB/W while power handling was around 200W although 100W is probably a more sensible maximum, allowing levels in rooms of up to 101dBA. Pair matching was about average and the -6dB point came in at a typical 50Hz. If anything, the response was more even with the grilles in place.

The approximate total response was slightly 'rich' with a mildly depressed treble. Out at 2 metres the responses were taken with the speaker treble uppermost; hence the '15° above' curve represents a position almost on axis with the treble showing a consequently stronger response. Overall the driver integration was fairly tidy at crossover, but treble interference and reflective patterns were evident in the trace crossing points. Driven to 96dB, 3rd harmonic distortion was held below 1% while 2nd reached 5% at 150Hz, probably

due to axial motor assymetry. The latter improved greatly at 86dB, though the 3rd harmonic showed little improvement remaining about the average level. A fair 1.43dB of power compression was shown, with -43dB intermodulation.

The impedance curve confirmed the easy-to-drive 8 ohm characteristic, impedance always remaining above 6.5 ohms. The system was tuned to 48Hz.

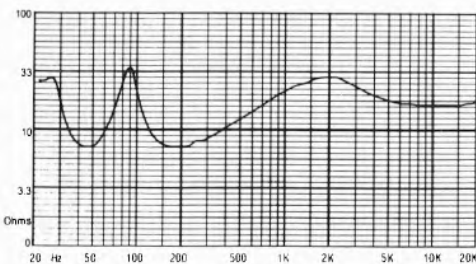
The room response curve was probably the most valid measurement for this dispersive system, and revealed that in energy terms at least, it had a slightly rich but even and well balanced character. Bass was extended to 30Hz while the treble rolled away smoothly in the approved manner.

### Summary

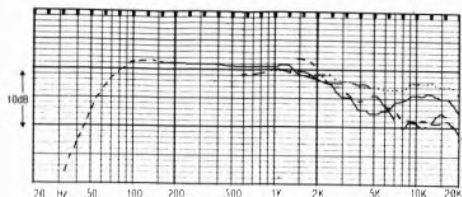
The results indicate that this speaker should be given some consideration. If you favour low coloration, and well focused stereo images, with coherent depth then the 301 will not satisfy; but despite all this, enough panelists liked it to make it worth trying and the overall character was indeed good. In terms of engineering quality versus price, though, it must be said that the 301 is a bit expensive by UK standards.

### GENERAL DATA

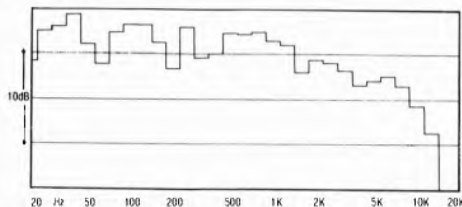
Size (height x width x depth).....43 x 27 x 23cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(15) — 100W  
 Recommended placement.....on high stands  
 Frequency response, within ±3dB at 2 metres.....see text  
 Low frequency rolloff (-6dB point) at 1 metre.....50Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....87dB/W  
 Approximate maximum sound level (pair) at 2 metres...102dBA  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good (see text)  
 Typical price per pair, including VAT.....£225



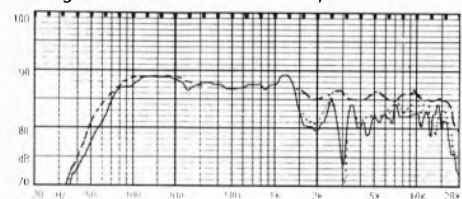
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



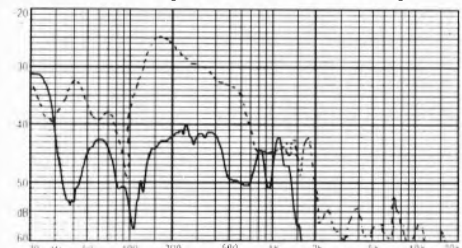
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



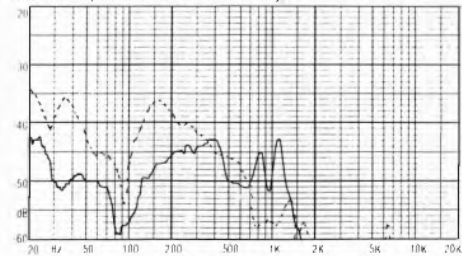
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity) Dashing corrects for chamber LF, dotting shows response without grill



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Bose 901

Bose (UK) Ltd, Unit G2, Trinity Trading Estate, Sittingbourne, Kent  
Tel (0795) 75341



Since the original 901 was first introduced around 10 years ago, it has evolved from a moderate efficiency sealed box design, to a higher sensitivity reflex type, but the basic format remains the same. A compact non-rectangular box, it employs nine series-parallel connected 105mm paper-cone drivers, these Bose manufactured. Four are mounted on each of the two rear facets while the remaining unit is placed offset on the front panel. Unfortunately there is insufficient space to cover the Bose 'direct/reflecting' philosophy in detail here; save to say that the manufacturers state that in a concert hall, eight-ninths of the sound reaching the listener is reflected and only one-ninth direct. The 901 is intended to recreate that proportion. (This ignores the difference in acoustics between a hall and a domestic situation, never mind a rock studio). The drivers are built on three-point-fixing plastic frames

and are wide range, but require heavy electrical equalisation, here provided by a control box fitted in a tape monitor loop or between pre- and power amplifier. The box also offers some variation in bass and tonal balance, but for the main tests it was left at 'normal'. The ports use plastic mouldings to increase the available air velocity and thus the bass output. True figures for sensitivity are difficult to specify in view of the equalisation, and the anechoic curves are only for guidance, since the anechoic room cannot integrate the total output; in fact the room curve will be better here.

## Sound quality

Used as directed by the manufacturers, the 901, on our blind behind-curtain tests, scored somewhat lower than the cheaper 301, this being below average and rather disappointing for the price. The objective comments centred around an obvious boxy coloration, poorer than the majority of the speakers tested, and which overlaid almost all sounds we tried, masking depth and seeming to concentrate the image into two left/right zones. Central focus was also comparatively weak. The bass was quite powerful but did not seem very even or articulate, while on occasion the treble had a grating 'speakerish' quality. One panelist commented that the sound was more like that of a public address system rather than a domestic hi-fi speaker. On the high level tests it could certainly play loud but was rather harsh and raucous. Later experiments with the equaliser settings failed to make much difference to the sound quality ratings.

## Lab report

The results require careful interpretation. Fed 1.5V at 1kHz, the 901 produced around 90dB, indicating a high sensitivity of approximately 93dB/W. The axial reference response covered the output from the single forward-facing driver, the upper trace being the output from the rear array. Despite the use of an equaliser, the driver responses did not look very promising, the irregularities suggesting uncorrectable driver breakup. The direct sound from the frontal driver will of course of necessity be audible within the total sound field. At 2 metres on the frontal axis, the forward responses were well ordered as would be expected from a single small drive unit.

At 96dB spl, the distortion was moderate in the midband although it rose to 8% of 2nd at

40Hz. At 86dB, 2nd harmonic improved, and 3rd did not change much. On the intermodulation test, the compression was very small at 0.3dB but at only 30dB down the intermodulation product was poorer than average.

The impedance characteristic dipped almost to 5 ohms, but was fairly non-reactive; conversely the low frequency region was subject to considerable bass boost, and was thus worsened with respect to amplifier drive. It cannot be considered an easy load under full drive. The system was tuned to 45Hz but the driver cabinet resonance was up at 155Hz.

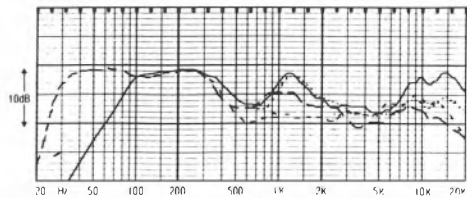
In the computer averaged room response the 901 should have come into its own but in fact this was far from the case. Extreme treble was lacking and the lower midrange was both prominent and lumpy. The room match was poor at low frequencies with an isolated peak at 40Hz, the boosted cabinet port frequency.

**Summary**

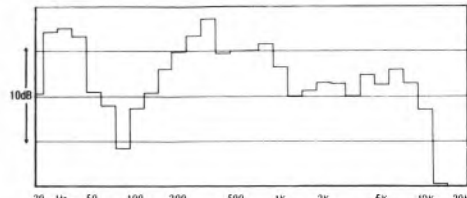
Costing well over £1,000 the 901 was disappointing, and fell well below our accepted standards for response evenness and coloration levels. For the direct/reflecting principle to make a worthwhile attempt at convincing our listening panel, we feel the 901 needs to be a better speaker than this and we are even uncertain as to its suitability for p.a. use, owing to the level of coloration that was evident on vocal material.

**GENERAL DATA**

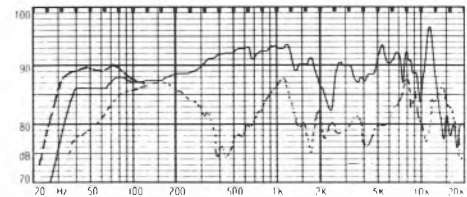
Size (height x width x depth).....70 x 33 x 13cm  
 Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....(50)—200W  
 Recommended placement.....on stands, away from rear wall  
 Frequency response, within ±3dB at 2 metres.....see text  
 Low frequency rolloff (-6dB point) at 1 metre.....30Hz (approx.)  
 Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....93dB/W  
 Approximate maximum sound level (pair) at 2 metres...110dBA  
 Impedance characteristic (ease of drive).....difficult  
 Forward response uniformity.....good  
 Typical price per pair, including VAT.....£1250



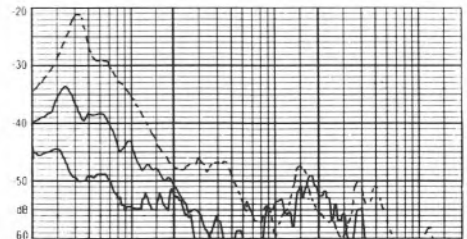
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



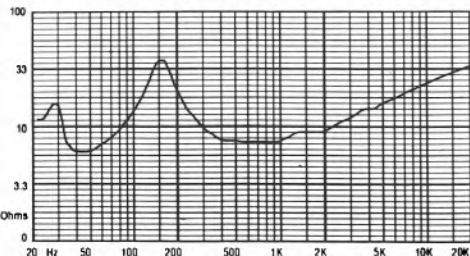
Averaged forward characteristic response in room



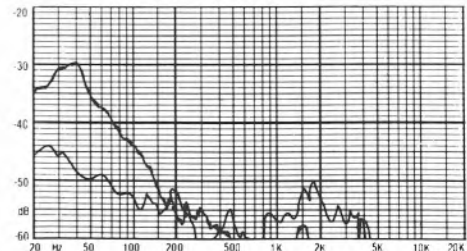
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Boston A40

Hi-Fi Markets, Cousteau House, Greycaine Road, Watford WD2 4SB  
Tel (0923) 27737



Recently introduced into this country, Boston Acoustic speakers are made in the USA relatively close to the Acoustic Research facility, though the two companies are not linked in any way. The A40 is a compact two-way model of just 8litres internal capacity, a sealed box or 'infinite baffle' design with a light fibre wadding filling.

Nicely finished in a vinyl hickory effect covering, the A40 has a well-designed grille, with a narrow aspect, internally bevelled adjacent to the tweeter in order to minimise diffraction effects. The carcass itself is built of plain, undamped 14mm chipboard and electrical connection is via spring clips.

Bass and midrange frequencies are handled by a 165mm frame unit, with a thin steel chassis and modest ferrite magnet. The cone is a light, straight-sided paper pulp type, which is partnered by the Audax 12mm tweeter, a versatile

and yet inexpensive ferro-fluid cooled model. The crossover is nominally a simple 6dB/octave type, using a single inductor, capacitor and resistor, these of moderate power capacity.

## Sound quality

Scoring below average the panel results were not too promising for the A40. A 'phasey' quality was commented on by several panelists and appeared to dilute the stereo image precision, while stereo effects in general were not as stable as usual, and depth was restricted.

The A40 also lacked bass extension, though what bass there was was reasonably 'quick' and articulate, if of restricted power handling. Colorations were noted, including hollow and boxy effects, although these were not too serious. On occasion however a metallic ringing quality was apparent in the lower treble.

Somehow the A40 just did not 'gel' and provided little inspiration for the panel. They felt it to be rather ordinary overall, although in fairness one panelist liked it a lot, so it could suit particular individuals.

## Lab results

On axis at 1metre the reference responses showed that the grille worked well and changed the response little. Likewise, pair matching was shown to be pretty good. Sensitivity was as claimed at 88dB/W, somewhat compromised by the 4ohm impedance characteristic, and like the AR28, the response was lifted above 400Hz to equalise the output for 'shelf' mounting, this the optimum placement for the A40. Bass rolloff was a little high at -6dB, 65Hz.

A reasonable 100dBA maximum sound level should be possible, bearing in mind the power capacity of 10W minimum to 50W maximum.

Examining the 2metre forward response, the 15° above-axis trace showed evidence of a phase/crossover dip at 5kHz, this 7dB deep and suggesting that the system be placed at ear level for the best results. At 4.5kHz the lateral falloff was greater than expected for the small size, suggesting some integration weakness here and possibly accounting for the stereo sound criticisms. Otherwise, the forward output was satisfactory.

At 96dB the second harmonic distortion peaked to 7% at 20kHz, which was pretty harmless as it held to below 2% elsewhere. Third harmonic remained at typically 0.3%, while things improved at 86dB with second now averaging 0.5%, a good result.



Impedance dipped to below 4.5ohms at 200Hz, this indicating a more difficult than average amplifier load. The room-averaged response shown is for stand mounting, and while the low frequency integration was fortuitously good, the balance was clearly mid-dominant and centred on 1kHz, which will not be fully corrected by wall mounting.

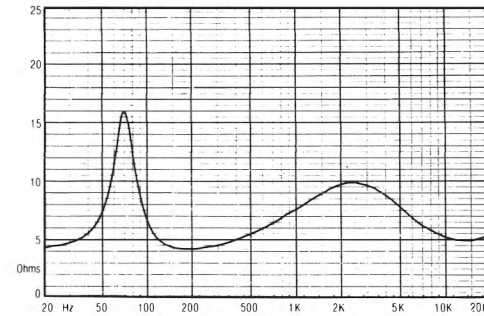
**Summary**

A simple, medium-power two-way design such as this must try hard to succeed in the competitive UK market, and from these results the A40 just does not make the grade. While satisfactory in most respects, the performance versus value for money equation is not in its favour.

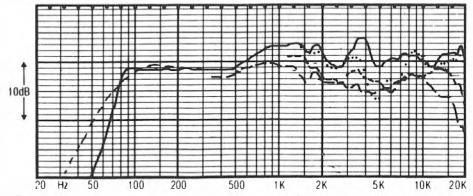
*(Note: A revised version promising improved performance was unfortunately not available in time for this issue — Ed).*

**GENERAL DATA**

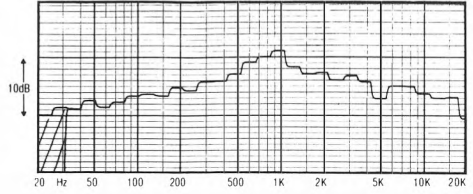
Size (height x width x depth) .....	34 x 21 x 18cm
Recommended amplifier power per channel (for 96dBa minimum per pair at 2 metres) .....	(10)—50W
Recommended placement .....	stand or shelf
Frequency response, within $\pm 3$ dB, a 2 metres .....	70Hz to 20kHz
Low frequency rolloff (-6dB point) at 1 metre .....	65Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre .....	88dB/W
Approximate maximum sound level (pair) at 2 metres .....	100dBa
Impedance characteristic (ease of drive) .....	satisfactory
Forward response uniformity .....	satisfactory
Typical price per pair, inc VAT. ....	£100



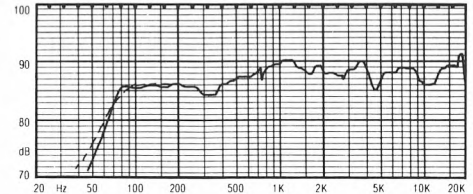
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



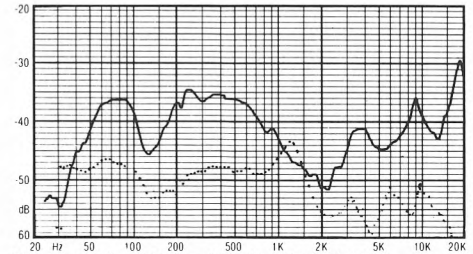
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



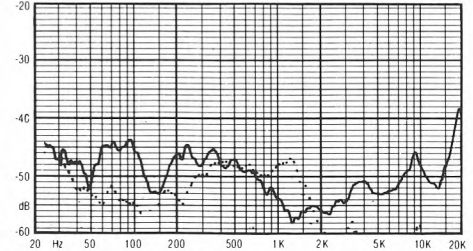
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



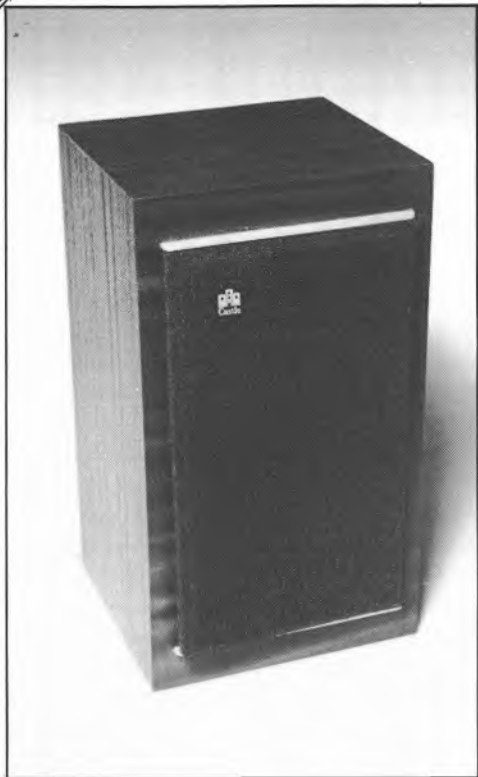
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

## Castle Clyde

Castle Acoustics Ltd., Shortbank Road, Skipton, N. Yorks. Tel (0756) 5333



This diminutive speaker has a *Richmond*-like specification, and at £80.00 a pair, the price is even comparable with that of a *Richmond* some five years ago! Castle take a pride in building the majority of the components for their systems themselves, the *Clyde* being no exception, and the Castle designer has shown great skill in tailoring his speakers to give relatively uniform frequency responses irrespective of size or cost.

Possessing a 9.8 litres internal volume, the system is reflex-loaded by a small ducted port, 28mm long by 37mm in diameter, which does more for the power handling than the bass extension. Both drivers are made by Castle; the lightweight pulp-cone bass/mid unit is built on a 130mm frame, and is partnered by a unique 30mm plastic cone/dome tweeter using a phase-corrected diaphragm. The undamped chipboard cabinet is also made by Castle themselves, having a fully finished teak veneered exterior with alloy trim; plus an acoustically favourable

foam grille. A 4-element crossover is fitted with fuses for each driver, accessible through the bass unit aperture.

Flush-mounted spring clip terminals are used for electrical connection, and an acoustic foam lining provides absorption within the enclosure. If Castle are true to form, the system should be fairly sensitive as well as capable of decent sound levels for its size.

### Lab performance

The test samples showed a good pair match, measuring typically  $\pm 1$ dB: a fine result for a speaker in this price category. Sensitivity was indeed high at 89.5dB/W, and was uncompromised by the impedance/amplifier loading, the latter rated as 'good' and averaging 9 ohms. As expected the low frequency range was somewhat curtailed with a  $-6$ dB point at 64Hz, but the axial reference response was inspiring, meeting fine  $\pm 2.5$ dB limits overall, and showing a promisingly even balance.

Under  $\frac{1}{3}$ -octave analysis at a 2m measuring distance the output was excellently uniform and integrated; in this respect the system illustrated almost a textbook performance. However the tonal balance showed a gentle rise in output with increasing frequency, with a mild but discernible hump in the treble region centred on 15kHz.

The high sensitivity allowed steady state distortion measurements to be carried out over the whole range at both 90 and 96dB. Above 150Hz, aside from isolated peaks at 1.8kHz and above 10kHz, distortion held to below 0.3%. While a 100W pulse at 500Hz was approaching overload, with 4% 2nd and 8.0% 3rd harmonics; this in fact represents some 108dB which is a very high sound level. At 5kHz the 100W pulse gave no trouble at all, with a typical value of 1% for both 2nd and 3rd harmonic.

The averaged room response in energy terms did suggest some mid prominence between 600Hz and 1.5kHz, but the overall trend above 1.5kHz was very good, and close to the theoretically ideal characteristic. While the low frequency range had some depression coupled with an early rolloff below 50Hz, it was otherwise fairly uniform.

With comfortable sound levels achieved on as little as 10W per channel, this speaker will happily accept 50W unclipped programme without blowing fuses, thus allowing up to 102dB sound levels, which is quite loud considering the box size. At some penalty to the stereo imaging, it will also in fact perform quite well on an open shelf or bookcase, and does not become too 'rich' or 'boomy' in such a location.

## Sound quality

The *Clyde* achieved good scores on the live comparisons. Although it was felt to sound a little 'small' with a degree of 'forwardness' in the midband, negligible accompanying 'loudness' or 'shout' was apparent, and the general effect was smooth and well integrated with good detail and natural tone colour. On occasion the treble could sound a little 'sibilant' and 'edgy', while some coloration was also identified, mainly of the 'boxy' kind.

Promising scores were also obtained on the stereo tests, where the imaging was found to be clearly defined with some depth and good lateral precision over a wide listening angle. Low bass notes were lacking in power, but the balance was surprisingly good if tending to be slightly 'light' and 'middy' in character, and the overall effect was almost as smooth as the remarkable responses indicate. Note however that the latter are of course unable to show the mild 'boxy' coloration and slight upper treble 'tizziness' that we experienced.

## Summary

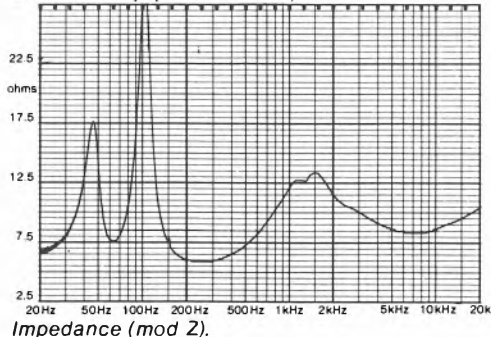
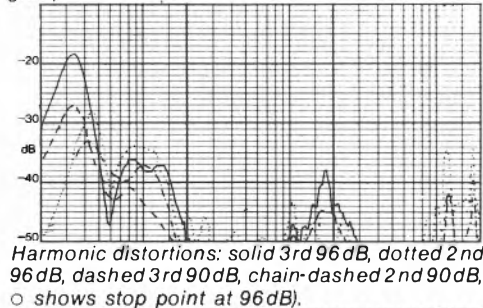
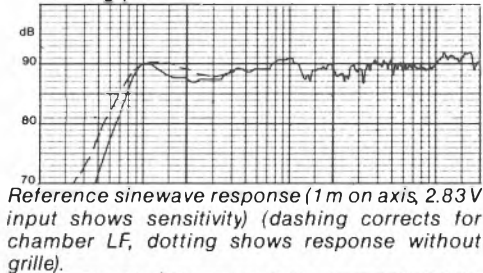
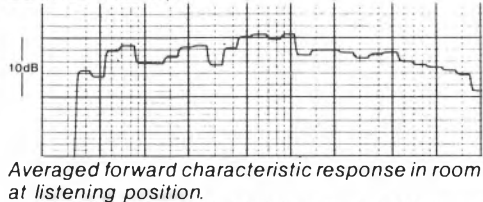
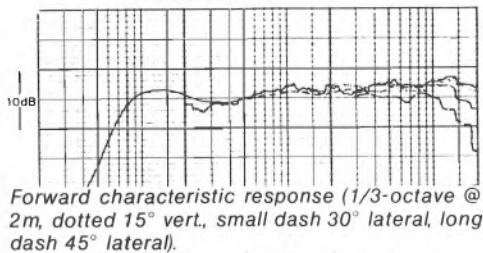
Once again we find a Castle speaker in the Best Buy category. This tidy little box packs a surprising 'punch' in terms of a clear even and lively sound, offering a high sensitivity, easy amplifier load, high dynamic range and moderate distortion, plus fine finish and engineering. At the price and size one can hardly quibble with the lack of deep bass, and the *Clyde* compares well with some of the best miniatures ever made at any price.

## Update

A new full length grille has now been fitted, dispensing with the alloy trim.

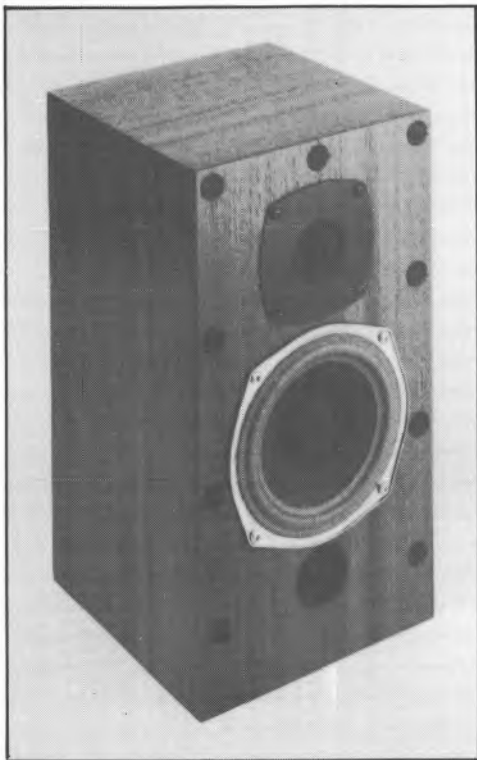
### GENERAL DATA

Size (h x w x d) .....	37 x 21.5 x 22cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) .....	(10)-50W
Recommended placement .....	open stand
Frequency response within $\pm$ 3dB (2m) .....	75Hz to 20kHz
Low frequency rolloff (-6dB) at 1m .....	64Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	89.5dB/W
Approximate maximum sound level (pair at 2m) .....	102dBa
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	excellent
Typical price per pair inc VAT .....	£80 when reviewed, now £105



# Castle Trent

Castle Acoustics Ltd, Shortbank Road, Skipton, N Yorks  
Tel (0756) 5333



A newly-developed Castle loudspeaker, this one was finally given its name during the course of this review. Selling for around £110, the *Trent* is in some respects a modern version of the Richmond, a model that was popular some years back. It comprises a two way system, finished in natural veneer, with the bass/mid handled by a 130mm frame unit fitted with a light pulp cone and made by Castle themselves. The tweeter is another in-house product, their established 35mm annular plastic-coned design. The 9 litre enclosure is reflex tuned by a 5cm long port, 3.5cm in diameter, and the enclosure built from 15mm chipboard, is foam lined. There is a 2nd order four-element crossover with clip-in fuses for both drivers. A foam grille of good acoustic properties is fitted, while electrical connection is via plain 4mm sockets. The *Trent* is small enough for shelf mounting but could also be used on open stands.

## Sound quality

Scoring below average, the *Trent* suffered from a fairly consistent line of panel criticism over a wide range of programme. The bass was considered to lack extension or articulation, while the tonal balance in the midrange was 'thinned' giving a lightweight, pinched impression. Finally the treble was considered to be a touch bright and untidy with more edge and 'zit' than from many recent tweeters. Its tonal quality in fact reinforced the impression that this was a small box.

On the other hand the traditional Castle virtues were in evidence; such as the smooth well integrated response, the excellent midrange clarity and transparency, stable stereo imaging with sharp central focus. In the depth plane a loss of space and ambience was evident, and it did not stand up too well to high level inputs, suggesting that 50W is the maximum rating.

## Lab report

Tested for pair matching, the *Trent* showed good agreement for the bass and mid, with a moderate 0.75dB shift in the treble. Absolute sensitivity depends on where one draws the base line, but in this case 89dB is about right, which is an above average rating. The reference curve did indeed suggest that there was some upper-mid and treble left. Low frequencies extended to 73Hz, -6dB, which is quite restricted. Out at 2 metres the response trend was maintained, getting to a 2.5dB plateau above 1kHz, which is not conducive to a neutral tonal balance. As usual with Castle speakers, the driver integration was excellent with first-rate off axis responses.

Limited power capacity was noted in the subjective tests and this was confirmed by the distortion measurement sequences. The intermodulation signal produced complete overload at 20W, 40Hz, while the swept harmonic plots taken at 96dB (about 8 watts input) showed considerable distortion. The 3rd harmonic rose in the crossover region while 2nd was poorer than the average overall; even at 86dB, the distortion results were below average with little improvement in the mid band.

Tuned to 75Hz, the speakers impedance characteristic approached 6 ohms at only one point, namely 300Hz, and elsewhere it remained at the 10 ohms average level. It should represent a fairly easy amplifier load.

Turning to the computer-averaged room

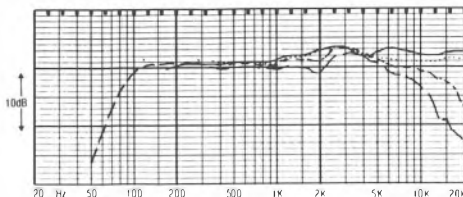
response, the speaker's main problem can be seen to be in the forward upper mid/treble range and in the slow, premature rolloff in the bass to lower midrange. Even at 63Hz the mean loss is 5dB relative to the upper mid, and the thin tonal quality is clearly shown as is the lack of bass extension in the room.

### Summary

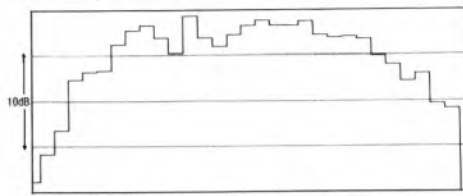
The results suggest that Castle have not balanced this new model as well as usual. Taken overall it scores a 'worth considering' rating, as some basic qualities are certainly present, although they could not win through. It might suit a dim cartridge and room, and would be helped by shelf rather than open stand mounting, but its thin sound emphasised its lack of bass and robbed the sound of a sense of balance, scale and weight.

### GENERAL DATA

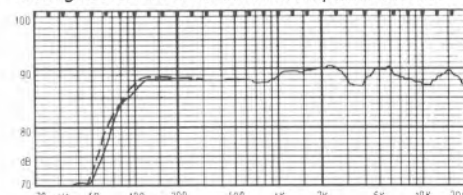
Size (height x width x depth).....	33.5 x 10.5 x 21cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(10)—50W
Recommended placement.....	on stands or shelf
Frequency response, within $\pm 3$ dB at 2 metres.....	80Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	73Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	89dB/W
Approximate maximum sound level (pair) at 2 metres.....	101dBa
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	excellent
Typical price per pair, including VAT.....	£110



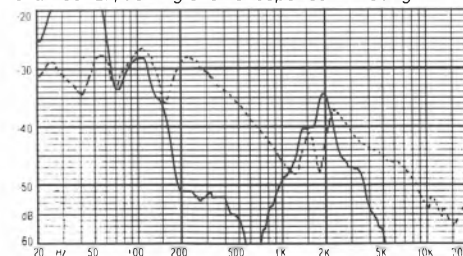
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



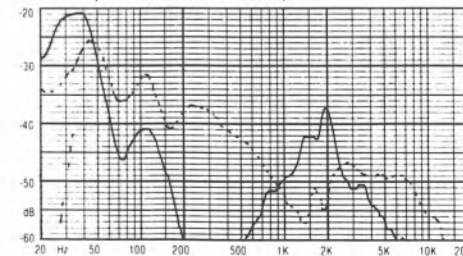
Averaged forward characteristic response in room



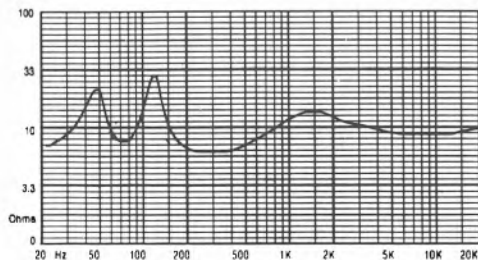
Reference sine wave response (1k on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



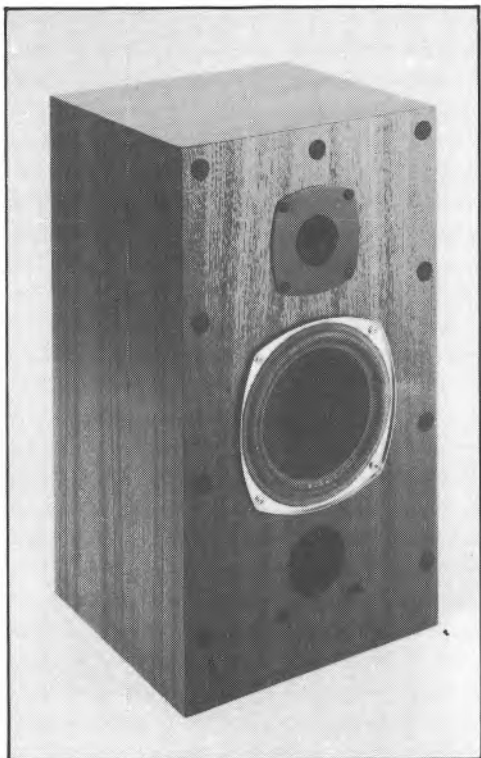
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Castle Tyne

Castle Acoustics Ltd, Shortbank Road, Skipton, N Yorks  
Tel (0756) 5333



Another recent introduction from Castle, the *Tyne* is bigger all round than the *Trent* with a 17 litre internal volume, tuned by a sizeable 5cm diameter port. This time the bass/midrange unit frame size is 150mm, or 5½ inches — still quite a small driver. Built on a steel pressing, this unit uses a light pulp cone driven by a fair-sized magnet energising a 25mm motor coil. Treble is handled by the usual 35mm plastic cone unit, representing an annular radiator. The enclosure is built of 15mm chipboard, finished in real wood veneer, and Castle have continued their practice of fitting foam grilles, which though at present unfashionable do confer good acoustic properties. The interior is foam lined while the small four-element crossover is of normal commercial quality. Clip-on wiring is used and the usual two Castle fuses are present to protect the drivers. I have yet to blow the fuses on any *HFC* tests so they

must be set right at the damage limits, for conditions of severe abuse or amplifier fault. Plain 4mm sockets are used for electrical connection.

## Sound quality

The *Tyne* received a mixed response from the panel. In tonal balance terms it was preferred to the *Trent* and was thought to be more natural, but the bass was on the dry and muted side, and some listeners complained of a 'stingy' quality high in the treble register. Listening panels will suffer peaky-sounding treble no longer — once one has been accustomed to good treble the older standards become far less acceptable. A touch of midrange peakiness and box coloration were also in evidence.

On the plus side, it portrayed fine detail well, and gave sharp stereo focus. But depth and ambience effects were muted, and the speaker did not sound either very exciting or dynamic on the appropriate material. It overloaded above 150W and 100W would seem to be a sensible maximum input, though it was pretty loud at this level.

## Lab report

Pair matching was very good for the two speakers, whose characteristic sensitivity averaged 88.5dB/W. The -6dB bass rolloff was measured at 55Hz, which was about average. The panel were right about the treble, with its rising peaky trend above 10kHz, but otherwise it was quite uniform. Out at 2 metres the off axis response family looked very tidy with the dipping output at 15° also off axis suggesting that the speaker should be on a fair sized stand to bring the cabinet top close to the listener's ear level. Close  $\pm 2$ dB limits were met from 70Hz to 20kHz.

At 96dB sound pressure level, the harmonic distortion was about average though the peak in third harmonic in the midrange was unusual. Distortion at low frequencies was quite well controlled. At the lower 86dB spl, distortion improved greatly, to a 'good' level. But it could not however cope with the 40Hz intermodulation signal resulting in 4dB of mid band compression. Tuned to 45Hz, the impedance curve showed an average of 10 ohms, with no dip even to the B.S. lower limit, and it was therefore regarded as an easy load for a normal amplifier.

The room curve was fortunate in that it clearly revealed the energy prominence in the

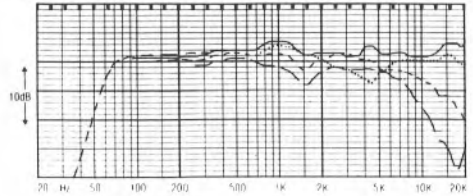
midrange, this less well shown in the anechoic traces. The bass was reasonably extended to 50Hz, and somewhat depressed compared with the mid, while in the treble, the 20kHz third octave was in fact too high and should have rolled away more smoothly.

**Summary**

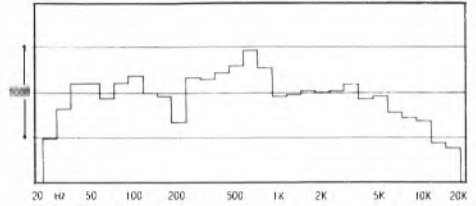
Although an improvement over the *Trent*, the *Tyne* does not set a particularly good standard either. At £120-130, the competition from the larger 200mm bass coned speakers is fierce and Castle have just not made the grade with this one. However, while the *Tyne* falls short of recommendation it is still worth considering. I suspect that perhaps a new soft dome tweeter would help matters here — perhaps Castle's design is beginning to show its age — and I feel sure our disappointment was heightened by the fact tht we have come to expect such good things from this manufacturer.

**GENERAL DATA**

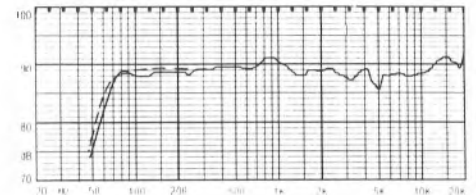
Size (height x width x depth).....	44 x 25 x 24cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(12)—100W
Recommended placement.....	on stands or shelf
Frequency response, within ±3dB at 2 metres.....	65Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	88 5dB/W
Approximate maximum sound level (pair) at 2 metres....	103dBa
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair, including VAT.....	£130



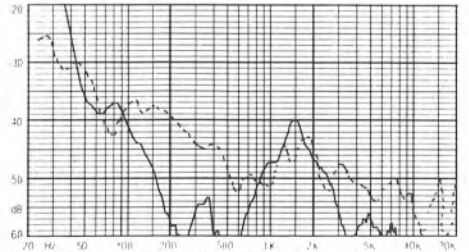
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



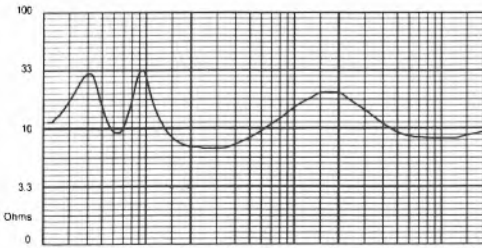
Averaged forward characteristic response in room



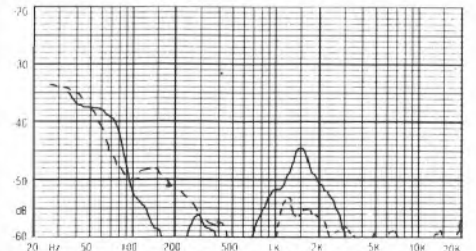
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



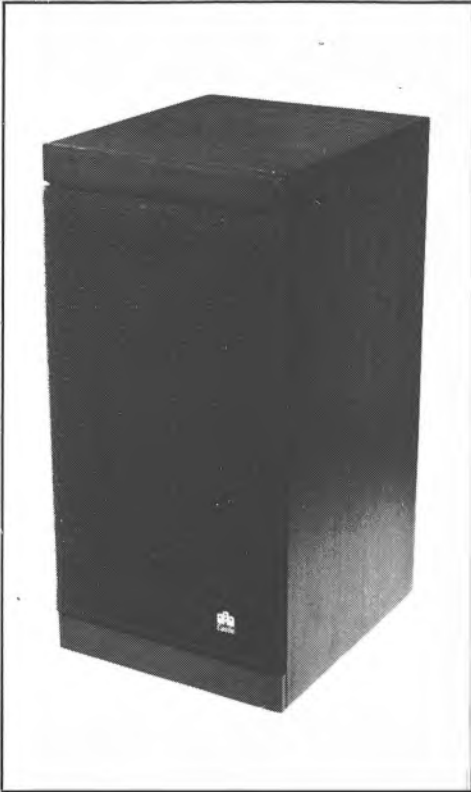
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Castle Lincoln

Castle Acoustics Ltd, Shortbank Road, Skipton, North Yorkshire  
Tel (0756) 5333



A compact, finely finished loudspeaker, the *Lincoln* can be said loosely to inherit the position established but now vacated by the discontinued *Richmond*. In contrast to the vast majority of cheaper designs, which have gone for vinyl covering, the *Lincoln* retains a real wood-veneered cabinet, with an expanded reticulated foam grille of good acoustic properties.

The 15litre chipboard enclosure is reflex-tuned by a decently sized port, 55mm in diameter by 70mm deep. This system loads the 145mm diameter steel framed pulp cone bass/mid unit, while treble is handled by another Castle driver, this a 30mm plastic unit possessing annular radiating geometry. Operating at around 3.5kHz the high-quality crossover comprises eight elements plus two power resistors, and a decently large magnet energises the bass unit, promising a good

sensitivity.

Interior box details include a cross brace and thin bituminous damping pads, the whole lined with a thick grade of polyurethane acoustic foam.

Castle specify a 50W power rating, in conformity with the 8ohm impedance standard, and placement on open stands is also recommended, though at a pinch shelf mounting is possible, in view of its compact dimensions.

## Sound quality

With an 'average' rating overall, the *Lincoln* can be seen to have achieved a fine result at a price which is about half the group average.

Plus points included a clear, open sound with lively, integrated detail, and although the bass lacked some definition, it was firm and free from boom. The treble was well extended and even.

However the speaker did demonstrate mild boxy and hard colorations, with some lispiness in the treble. Low bass was attenuated and some of the stereo depth impression was absent, although on the other hand, frontal stereo was well focused with good left-right stability.

## Lab results

Remarkable pair matching was shown to within  $\pm 0.5\text{dB}$  over the entire frequency range. An 88dB/W sensitivity was indicated, with a flat bass response extending to  $-6\text{dB}$ , 53Hz. Up to 100dBA should be possible from a pair in a typical room.

From the 2metre forward response group the *Lincoln* can be seen to present a highly uniform characteristic with an axial response extending from 60Hz to 20kHz, within fine limits. In the lateral plane the 30° off-axis response showed more falloff than is usual for the speaker size, suggesting that the driver phase integration was not quite perfect at the crossover point, although the result is nonetheless good.

Happily meeting an 8ohm specification, and with a minimum value above 6ohms, the *Lincoln* was classed as an easy amplifier load.

At 96dB, the speaker was in overload below 50Hz (not surprising in view of its size), but above that frequency, distortion, both second and third harmonic, was moderate, averaging around 1%. With the exception of the 2kHz region where third harmonic was fairly constant, a reduction in level to 86dB brought with it a substantial decline in distortion which measured typically around 0.2% over much of



the range, which was a good result.

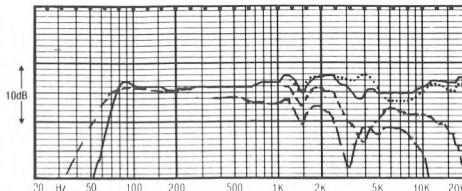
Assessed by room averaging, the *Lincoln* maintained its uniformity. The treble rolloff was nicely rounded, the mid smooth and the low frequency integration well controlled down to the 45Hz working limit.

### Summary

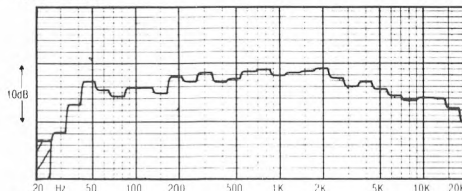
For some panelists the *Lincoln* did not quite 'gel' as a total sound but it remains a fine, well balanced, well designed and well constructed system, offering good value for money. Other attributes include an easy amplifier loading, and an above average sensitivity, and is certainly well worth hearing. Castle continue to demonstrate their ability to produce fine speakers and the *Lincoln* is recommended.

### GENERAL DATA

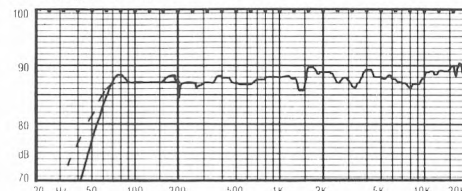
Size (height x width x depth) ..... 44 x 22 x 27cm  
 Recommended amplifier power per channel  
 (for 96dB minimum per pair at 2 metres) ..... (15)—50W  
 Recommended placement ..... open stands  
 Frequency response, within  $\pm 3$ dB, a 2 metres ..... 60Hz to 20kHz  
 Low frequency rolloff (-6dB point) at 1 metre ..... 53Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre ..... 88dB/W  
 Approximate maximum sound level (pair) at 2 metres ..... 100dB  
 Impedance characteristic (ease of drive) ..... very good  
 Forward response uniformity ..... good  
 Typical price per pair, inc VAT. . . £ 135 when reviewed. now £ 169



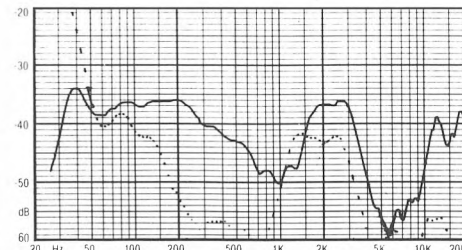
Forward characteristic response ( $\frac{1}{2}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



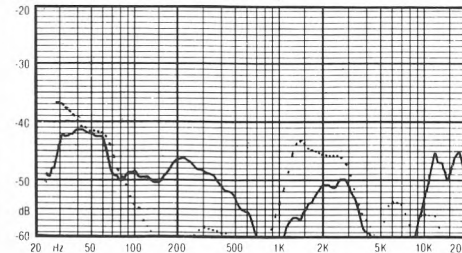
Averaged forward characteristic response in room at listening position.



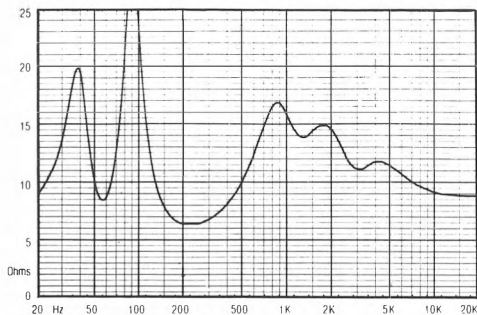
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



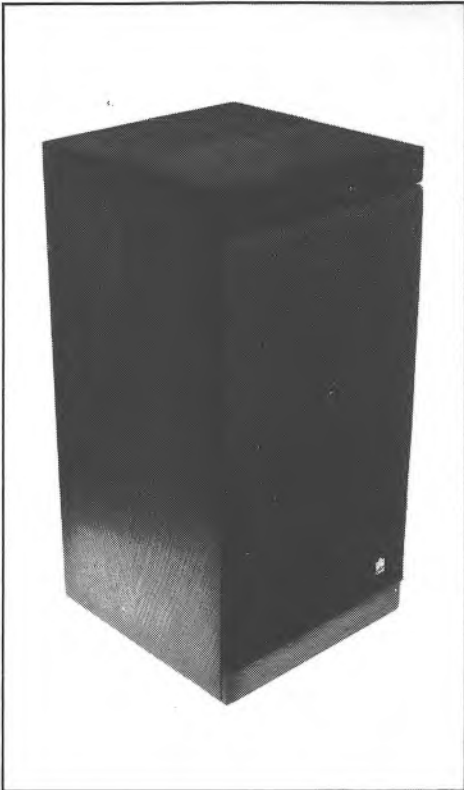
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Castle Pembroke

Castle Acoustics Ltd, Shortbank Road, Skipton, North Yorkshire  
Tel (0756) 5333



Although basically a compact design the *Pembroke* nonetheless encompasses a bass-reflex-loaded volume of some 32litres. Its design recipe is in fact derived from an earlier model, the successful *Kendal*, but with the application of Castle's continuing refinements plus a new style of cabinet. The enclosure has a shaded stain/varnish finish with the black foam grille flanked by horizontal veneered bars at the top and bottom of the cabinet.

A 200mm bass/mid unit is married in a vertical in-line arrangement to a 30mm plastic cone tweeter, both drivers being of Castle's own manufacture. The bass unit is constructed on an aluminium cast frame, with a substantial magnet. The good quality crossover operates at approximately 3kHz and is of 12dB/octave basic order, although this is adjusted to 'fine tune' the driver responses.

The heavy enclosure is braced and damped,

the interior lined with an acoustic absorbent. A conventional moulded rear connector panel is fitted with plain 4mm sockets – as opposed to the preferred 4mm socket/binding posts more suited to 'special' cables. Internal fuses, accessible behind the bass driver, protect against sustained amplifier overload – a system used on previous Castle models.

## Sound quality

As we have come to expect from Castle, this speaker gave a good account of itself during the listening tests. Favoured by all the panelists it produced a consistently smooth sound, free from fatiguing effects. Tending to mild richness tonally, it was felt that the bass could have been a little drier while some boxiness and plumminess in the lower midrange was also noted, although this was not serious. The treble could also demonstrate a little 'breathiness' in the upper range.

Overall the sound was 'big', with good bass power and extension. Stereo images were quite well focused although they showed some loss of depth and transparency. Frontal detail was however good with a pretty natural tonal balance. In fact, it sounded as smooth as the remarkable lab test results would indicate!

## Lab results

Pair matching was good except around the 14kHz area where significant 2dB errors were observed. The grille had no deleterious effect on the sound however. Sensitivity was rated as above average at 88dB/W, providing maximum sound levels of up to 103dB/A, and a 10-100W amplifier power range is considered appropriate.

Bass was quite extended – to 44Hz, –6dB – and quite uniform in anechoic terms. Overall the response in the 70Hz to 12kHz range was quite remarkably smooth with only  $\pm 1$ dB ripples apparent.

Out at 2metres, a very good forward output was demonstrated showing great consistency, phase control and integration. Can you believe a  $\pm 1.5$ dB response from 60Hz to 20kHz here? John Collinson, Castle's designer improves his mastery of the response curve year by year!

At 96dB, second harmonic distortion typically measured 1-1.5%, with third rather lower than that except at 2kHz. Third harmonic was little altered at the lower 86dB level, but second was much improved to 0.3% and better. With third harmonic often at the 0.15% level, the *Pembroke* essentially gave good results for

distortion.

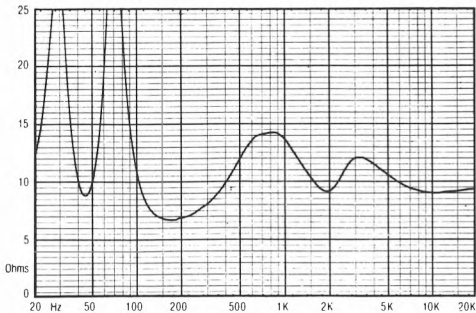
Impedance never fell below 6.4ohms, making it very easy to drive by any amp of good repute. The computer-averaged room response also looking very promising, with the low frequencies integrating well with the room, down to 40Hz. The mid register was also very smooth and while the lower treble seemed slightly depressed, the upper treble was in fact marginally too well extended, hinting at the upper 'edge' heard on audition – a fine result however.

**Summary**

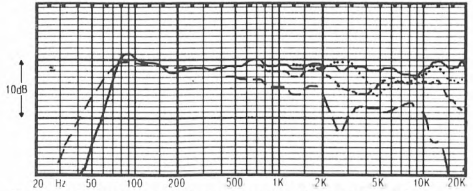
Comfortably 'recommended', this traditional-looking speaker offers a sweet, smooth sound with an excellent overall balance of engineering-based performance. For the size the bass is good, and the system will also play loud when required, being easy to drive. In fact some purchasers may prefer this speaker to others which come more highly recommended by the panel as a whole – this will depend on taste and to some extent the choice of programme as the *Pembroke* suited classical works slightly more than it did rock.

**GENERAL DATA**

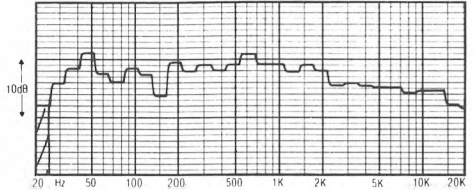
- Size (height x width x depth) ..... 55 x 27.5 x 30.5cm
- Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres) ..... (10)—100W
- Recommended placement ..... open stands
- Frequency response, within  $\pm 3$ dB, a 2 metres ..... 50Hz to 20kHz
- Low frequency rolloff ( $-6$ dB point) at 1 metre ..... 46Hz
- Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 88dB/W
- Approximate maximum sound level (pair) at 2 metres ..... 103dBA
- Impedance characteristic (ease of drive) ..... very good
- Forward response uniformity ..... very good
- Typical price per pair, inc VAT . . . £175 when reviewed, now £215



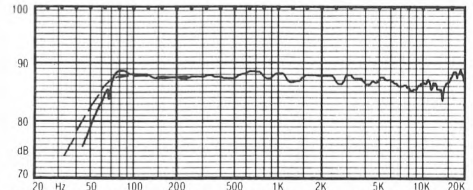
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



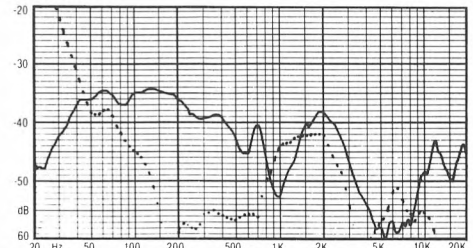
Forward characteristic response (1/2 octave at 2m, dotted 15° lateral, small dash 30° lateral, long dash 45° lateral).



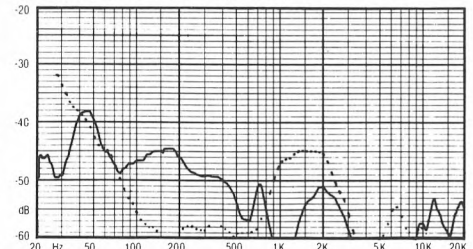
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

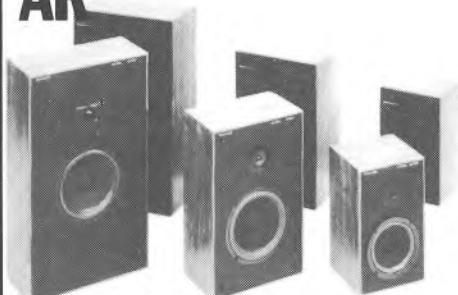


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

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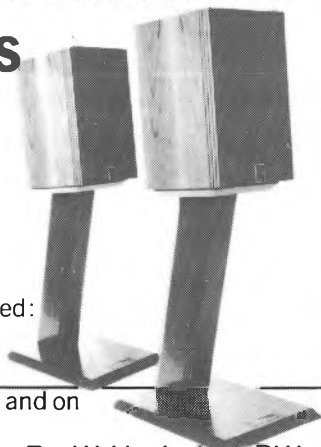
Best Buys: KEF Coda and KEF Corale

## Rogers



Best Buy: Rogers LS7  
Recommended:  
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## A **Bedtime Story**

by D. G. Perriam

Once upon a time there was a small loudspeaker called the Mission Baby 70. It tried very hard to sound like its bigger brother — the 700 but even though it was cheaper the reviewers didn't like it — they called it names like "honky and boomy" and this made Baby 70 very sad. So one day it went to Uncle Farad and said, "Please Uncle Farad I want to play music and make people happy." Uncle Farad said, "But Baby 70 its not possible to make you sound as big as the other Mission loudspeakers — we haven't got the technology yet." But as Baby 70 didn't know what technology meant he started to cry. Now if there's one thing Uncle Farad can't stand it's seeing a loudspeaker cry, so he shut himself in the anechoic chamber for several weeks.

One day a man with a beard came out of the chamber and started handing out cigars — "We've got a new baby," he said proudly handing 70 mk 2 around for everyone to see. "But it's the same size as mk 1" they all said, but Farad just grinned because he knew what was in the new cabinet. By this time mk 2 has been hooked up to the new 775 turntable and the new 778 amp while Farad was in the chamber he had some other ideas as well and they all sat down to listen to the first Mission Record Playing System.

When mk 2 had finished playing a selection of classics, pop and rock everyone agreed that he didn't sound like a small loudspeaker anymore — in fact when they closed their eyes he sounded as big as the 770s, well almost. Mk 2 sat on top his rigid stand with a broad grin on his face and said proudly, "And I'm still less than a £100 a pair" and everyone cheered because now even the poor people could listen to music and live happily ever after.

*If you like happy endings get the beginnings right, come and listen to the Mission System at Hightown Audio — I'll give you advice and personal service on all Mission products.*

see you soon  
Derek Perriam



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Yamaha

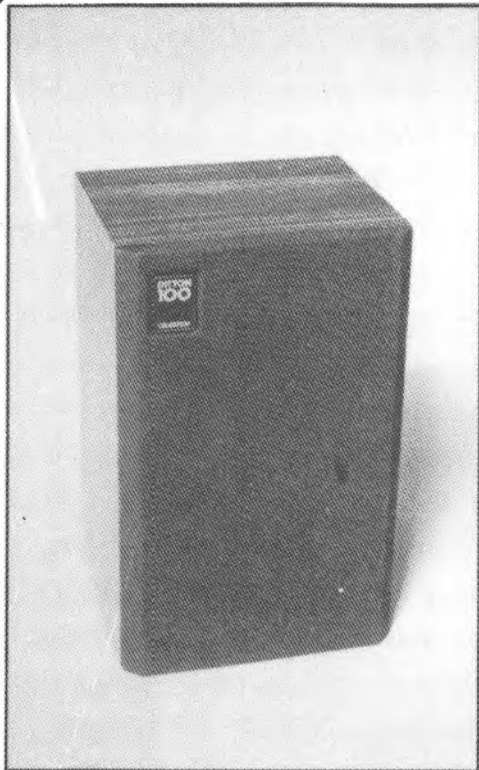
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**RING 0709 70666 FOR A DEMO**

# Celestion 100

Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP. Tel (0473) 73131

RECOMMENDED



The latest Celestion model, the 100 is an ultra-compact, sealed-box design, with a 7 litre internal volume loading the 170mm bass/mid driver. This is built on a pressed steel frame using an unusual flared pulp cone of advanced design, which is light enough to offer a usefully high sensitivity even though only a modest magnet is involved. The treble register is covered by a new version of Celestion's 2.5mm soft-fabric dome, which it is claimed has benefitted from laser analysis in improving its performance. A good quality 4-element crossover is employed, with spring-loaded clip terminals.

The enclosure is a conventional chipboard box constructed using the cost-effective mitrefold technique and finished in a good quality synthetic veneer. The driver panel looks good with the grille off, which is fortunate since the speaker sounds better that way. 12mm roboted board is used for the driver baffle but the proximity of the port to the treble unit can give rise to possible undesirable diffraction effects.

One would expect that boxes of this size would be suitable for shelf mounting, and the midrange characteristic of the 100 indicates that this should indeed be the case.

## Lab performance

At 1m measured on the nominal mid/treble axis under anechoic or free field conditions, the 100 showed a dip 6dB deep at 7kHz. However removal of the grille did wonders for the response, as shown by the dotted line, and clearly this is one speaker crying out for a sensible foam grille. With the grille removed, the response met  $\pm 2.5$ dB limits 90Hz-18kHz, which is not bad at all for a budget model. The sensitivity checked out at slightly above the average at 88dB/W, though the bass response was restricted, measuring 6dB down at 76Hz.

At 2m, the  $\frac{1}{3}$ -octave characteristic showed evidence of a loss in output around 6kHz, the overall curve having a 'humped' appearance with prominences located at 130Hz, 2kHz and 14kHz. (In practice however the response is a little better than this, since these measurements were taken with the grille on.) The off-axis curves suggest that the speaker output is well integrated and not over-critical of listener axis.

During the distortion tests, the 100 happily survived a 100W power input at 500Hz and 5kHz, with minimal amplitude compression and harmonic distortion levels of 5.0% 2nd and 0.8% 3rd at 500Hz, 2.8% and 1.1% respectively at 5kHz. Moderate levels of distortion were present over much of the band at both 96 and 90dB sound levels steady state. Second harmonic was typically 1.0% and third 0.4%, these increasing to 3.0% below 250Hz.

The impedance curve demonstrates a rather high 100Hz system resonance, and an average rating for amplifier loading which stems from a dip to just above 5 ohms, 6kHz, a region of high programme energy. However a satisfactory maximum sound level of 100dBA could be achieved in a listening environment with inputs up to 50/W channel.

Assessed by  $\frac{1}{3}$ -octave averaging in a listening room, the 100 was judged a trifle 'forward' in the midband, with the steep rise from 300Hz to 600Hz part of this effect. Bass fell significantly below 80Hz, and the extreme treble was also deficient, though not seriously so.

## Sound quality

The 100 fared quite well on the live comparisons. The bass output was clearly curtailed in the lower registers, with a slightly 'nasal' quality resulting from emphasis of the harmonics of the funda-

mental notes. While the sound was quite lively with a good impression given on sharp transients, the midband was described as 'boxy' with some 'hardness'. Overall the effect could have been smoother.

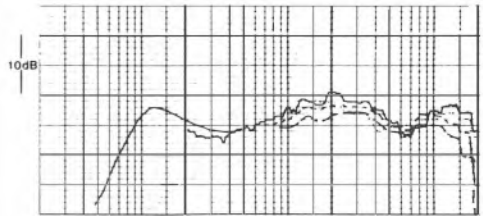
On the stereo sessions it was not so well regarded, although in view of its budget price the grading was reasonable. The upper treble was considered a trifle prominent, while the sound lacked 'weight'. Although it gave a reasonable impression of ambience, and the stereo presentation was quite good, it often sounded 'louder' than expected, which is not a good sign so far as mid smoothness and balance are concerned.

### Summary

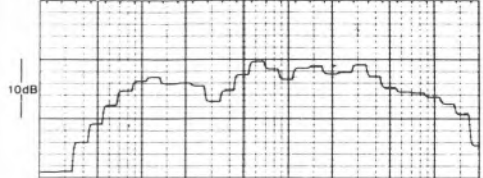
This small and inexpensive speaker is quite presentable, particularly when used without the grille. At £80.00 it justifies a recommendation on value grounds and is worth trying. On the debit side the frequency balance was none too even, distortion was poorer than average and the bass response was rather limited. But it possessed a lively character, was capable of good rendition of detail, and also worked quite well when wall-mounted.

### GENERAL DATA

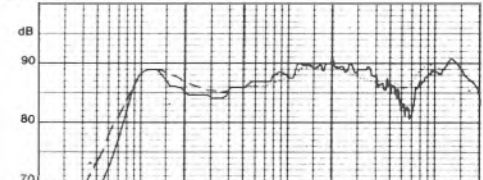
Size (h x w x d)	33 x 21 x 18.5cm
Weight	4.4kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)-50W
Recommended placement	open shelf
Frequency response within $\pm 3$ dB (2m)	85Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	76Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	88dB/W
Approximate maximum sound level (pair at 2m)	100dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£ 80



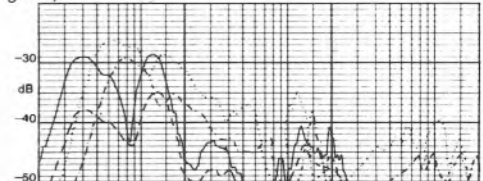
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



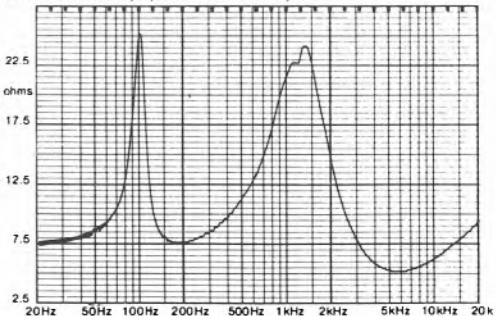
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

# Celestion SL6 and SL600

Celestion International Ltd, Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP  
Tel (0473) 73131



Along with the established *SL6*, this review covers the more recently developed *SL600* model, which features a special alloy honeycomb enclosure and selected drivers. Both are of essentially identical performance, but price and sound quality differ greatly due to the advanced cabinet used for the model *600*.

A two-way miniature box sealed box design of 12litres internal volume, the design employs a die-cast, Kobex-coned 165mm bass/mid unit fitted with a generous magnet. The special 37mm copper-dome tweeter has an integral motor coil former and offers a high power capacity. Both units are of excellent quality, having benefited from new design and constructional techniques plus laser analysis.

A high power 12dB/octave crossover is fitted, this on separate bass and treble boards in the case of the *SL600*. Each crossover is matched to a specific tweeter to correctly align the 21kHz

compensation network.

The *SL6* cabinet is of heavy 17mm MDF, this braced and bitumen damped, with 4mm socket/binding post connectors and a thick unrebated grille, which in our opinion is best discarded on acoustic grounds. By contrast the *SL600* has an ultra-light, ultra-rigid alloy honeycomb box, with special multilayer graded acoustic absorption within. The very high material cost is in fact the main reason for the higher price. Plain 4mm sockets are provided for connection and the grille is omitted. The *SL6* is covered in real veneer while the *600* is finished in a handsome charcoal colored Nextel with gold legends. Special stands are available, supplied as standard with the *600* and as extras in the case of the cheaper *SL6*.

## Sound quality

The *SL6* scored well above average. It provided a rich, slightly dulled sound (in fact our samples were duller than usual), with some boxiness and recession in the presence band. Stereo imaging was very good with fine central focus and fine impression of depth while the treble was outstandingly smooth and natural. The bass did not reach to the very lowest notes but was well balanced, detailed and articulate. It proved unfatiguing with a 'distant' presentation, and conveyed a good musical impressions.

The *SL600* (with a correct, brighter balance) scored better still, with a remarkable, almost 'holographic' stereo precision maintained over the entire spectrum. Coloration was very low, detail abundant, and the overall effect one of airy transparency and subtlety. The bass was reasonably extended, 'quick' and well differentiated, and high scores were awarded – clearly this speaker was an exceptional device.

## Lab results

Both speakers results are shown at 1metre for comparison, the tighter balance and integration of the *600*'s selected components apparent here. Sensitivity was low at 82-83dB/W with a maximum sound level of 96dBA and a 30-150W power capacity range. The -6dB rolloff point was at 55Hz, good for the size.

At 96dB the *SL6* was working hard, with second harmonic distortion at 2.5% even in the midband, but third harmonic rose quickly below 100Hz. At 86dB the distortion levels were considerably reduced to a satisfactory level, with second and third at similar levels of between 0.3 and 1.0%.

Forward responses for the *600* show excel-



lent integration and good uniformity, with the 15° above-axis result particularly good. A slightly below-ear-level listening position would be ideal. The balance was still slightly rich, with a full midrange.

Generally 8ohms, the impedance fell to 4.5ohms at 15kHz but was still considered to be a fairly good amplifier load – low-resistance cable is recommended.

Room-averaged, the output showed a near perfect interface with the room at low frequencies, having a slight presence droop, a mildly rich treble balance and a smooth rolloff.

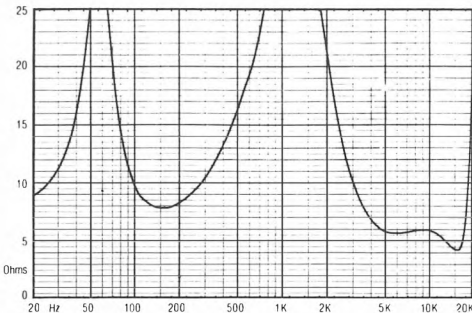
**Summary**

Reassessed for this edition, the SL6 is still a remarkably musical, if slightly coloured, performer for the price. Tighter response tolerances in manufacture should prevent the appearance of the ‘duller’ examples encountered in the past.

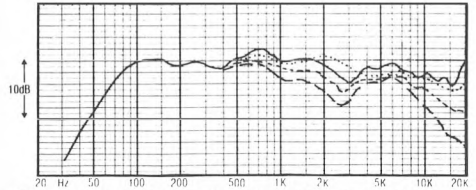
Arguably one of the finest speakers its size ever produced, the SL600 has also undergone manufacturing improvements, and despite a somewhat shaky start, the performance of production samples should now be fully up to standard. Compatible mass-loaded stands (Cliff Stone) are now available, and these enhance the performance, which is fully commensurate with the price!

**GENERAL DATA**

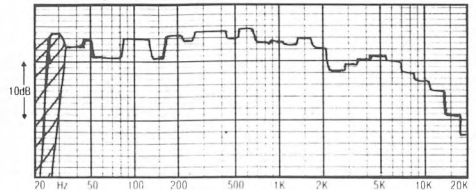
Size (height x width x depth) .....	37 x 20 x 25.5cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres) .....	(30)—150W
Recommended placement .....	open stands (Celestion)
Frequency response, within ±3dB, at 2 metres .....	60Hz to 20kHz
Low frequency rolloff (–6dB point) at 1 metre .....	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) .....	82.5dB/W
Approximate maximum sound level (pair) at 2 metres .....	98dBA
Impedance characteristic (ease of drive) .....	fairly good
Forward response uniformity .....	very good
Typical price per pair, inc VAT .....	SL6, £260, stands extra SL600, £599 inc. stands



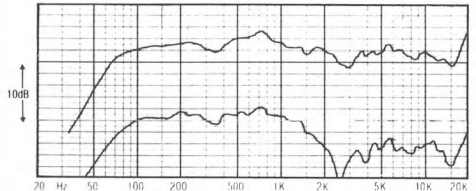
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



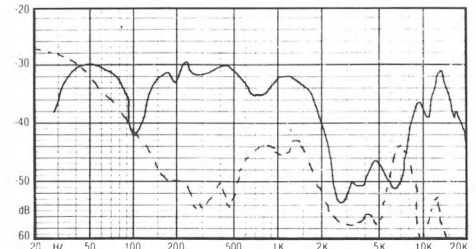
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



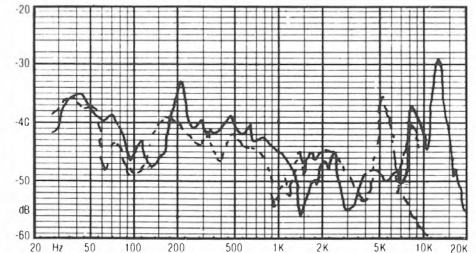
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input) Upper trace, SL600, lower trace SL6.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# RECOMMENDED

## Diesis Solitaire

Diesis Loudspeakers, 5 Glebe Close, Rayleigh, Essex  
Tel (0268) 774035



Diesis is a small British company with cabinet making experience, which is reflected in the excellent natural wood finish of this product. A miniature design, the *Solitaire* is virtually hand made, and fits in the upper price territory for the type. Measuring 35 by 20.2 by 26cm deep, the sealed box has an internal volume estimated at 12 litres. In this two way design the treble is handled by an Elac 25mm polyamide dome, while the 165mm bass unit is made by SEAS, with a pulp cone that Diesis treat with a damping compound. The simple three element crossover has three additional resistors for attenuation and electrical damping purposes.

Strongly constructed of double skinned chipboard, the front panel is a thicker grade of 20mm MDF; but the 6mm grille panel is unrebrated and stands slightly proud of the panel. The interior is lined with two grades of

foam, and is hard-wired with good cable. Electrical connection is via 4mm socket/binding posts, and although this model is small enough for shelf mounting it will in fact perform best on open stands, probably not too far from a rear wall.

### Sound quality

The *Solitaire* did well on test proving to be a tidy and civilised performer. Despite its small size, it coped with the maximum 350W programme input though it did begin to sound a little ragged at this level, and 100W is probably a sensible maximum.

This speaker possessed a clean midrange, if a touch lightweight, producing a well integrated sound with a natural tonal balance. All areas of the range proved unobtrusive and good stereo focus was evident with quite good depth. The only area of criticism, apart from a lack of really low bass, was a loss of the full dynamic impact of the material — at times it sounded just a little dry and over controlled.

Coloration appeared low on most programme, except on solo piano, where some mild boxiness was noted.

### Lab report

At 1 metre the reference response described a uniform characteristic with a modest 85dB/W sensitivity. Maximum level was of the order of 100dB for a stereo pair. Pair matching was good, except in the 5-12kHz range where tweeter sample differences amounted to 2dB, more than expected.

The grille was not beneficial to the response, imposing a dip at 3kHz as well as some upper range ripples; grille off was preferable. Bass rolloff was quite average, the -6dB point being at 57Hz.

At 2 metres, the forward response family showed some driver overlap at the crossover region, with the best sound obtained on axis. A mild peak was present above 15kHz while the midrange showed mild forwardness. But  $\pm 3$ dB limits sufficed for a 65Hz to 20kHz response.

At 96dB sound pressure level, the *Solitaire* was clearly working hard, with a fair amount of 2nd and 3rd harmonic distortion. At the reduced 86dB spl, distortion fell below 1% over most of the range, which was a more satisfactory result.

It gave good intermodulation figures, with -40dB of side band tone and just under 1dB of mid band compression. System resonance was

82Hz, a bit high for the price. The impedance curve suggested a smooth 8 ohm load, meeting the B.S. standard.

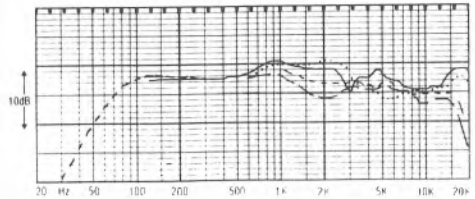
In the room the average response confirmed the lightweight balance, but only just. The mid was slightly prominent but the overall curve was quite well balanced.

**Summary**

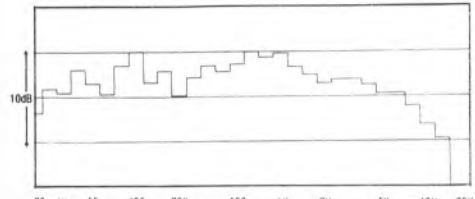
This well-crafted miniature has a modest dynamic range. The sound is pleasantly neutral, with a generally good performance, if slightly lacking in bass power and extension. The quality control on tweeter matching needs watching but otherwise the performance of the *Solitaire*, the first Diesis model to appear in *HFC*, justifies a recommendation.

**GENERAL DATA**

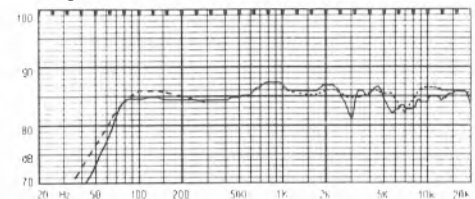
Size (height x width x depth).....	35 x 26 x 20cm
Recommended amplifier power per channel	(for 96dBa per pair at 2 metres minimum).....(20) — 100W
Recommended placement.....	on stands or shelf
Frequency response, within ±3dB at 2 metres.....	65Hz-20kHz
Low frequency rolloff ( - 6dB point) at 1 metre.....	57Hz
Voltage sensitivity	(ref. 2.83V or 1 watt into 8ohms at 1 metre)..... 85dB/W
Approximate maximum sound level (pair) at 2 metres.....	100dBa
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good +
Typical price per pair, including VAT.....	£220



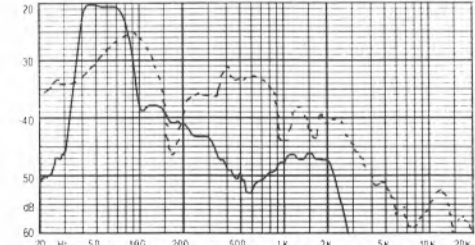
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



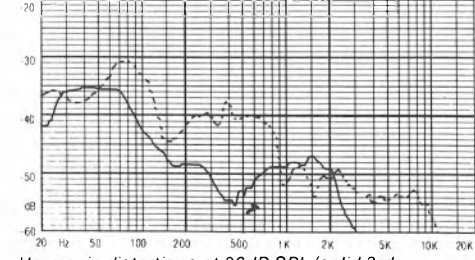
Averaged forward characteristic response in room



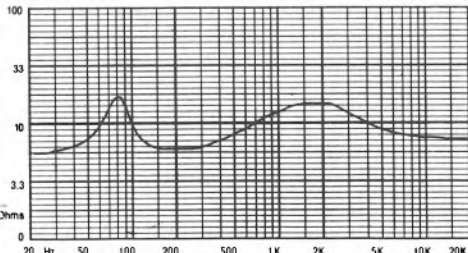
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

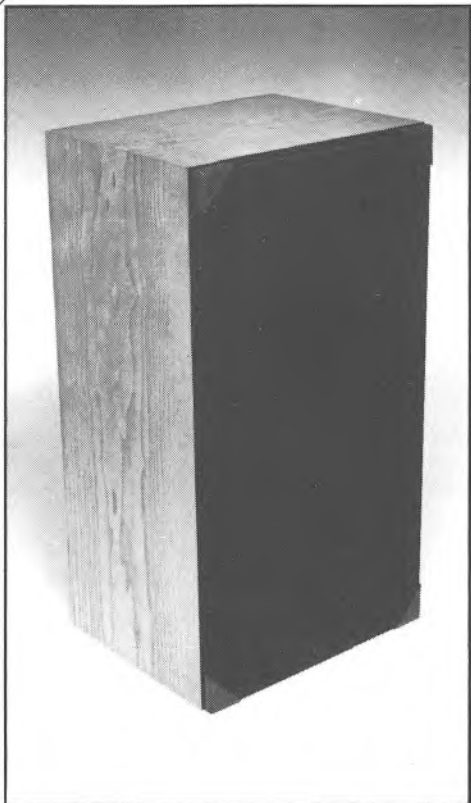


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

## Gale GS402a

DW Labs Ltd, PO Box 43, Dunstable, Beds LU6 2NZ  
Tel 0582 872138

RECOMMENDED



The GS402 is the first new model to come from Gale for some years now and represents a development of the 401, incorporating a new tweeter. The latter comprises a well-respected 25mm soft-dome unit from Philips, but many other details remain unaltered.

A sealed box enclosure of some 40 litres, each 402 employs two heavy coned long throw 200mm bass drivers working in parallel, located towards each end of the cabinet. A 100mm doped pulp cone midrange (Peerless) and the tweeter are aligned horizontally in the central area of the front panel. Thus two methods of positioning the speakers suggest themselves. Standing the speakers in a conventional vertical position, with the treble units outermost, will give the best lateral dispersion in the mid- and lower ranges, but at the expense of the mid-treble. Alternatively, the famous horizontal position can be adopted, resulting in rather a

wide-looking box mounted on a high stand. In this case the stereo in the upper crossover range is improved to the detriment of the lower ranges (see forward output graph).

A new grille made of cloth tensioned by steel bars and set off by triangular corner plates also confers good acoustic properties. The corner plates come in a range of different colours. The crossover is well constructed and ventilated to the outside to minimise overheating, which is a good idea. The sturdy cabinet has internal bracing, is filled with mineral fibre and well finished externally, with 4mm binding posts used for electrical connection. The tweeter is separately fuse-protected, and has a phase-correcting front plate.

### Sound quality

The new Gale scored well in the listening tests, and, surprisingly, it was not felt to differ appreciably in overall attainment whether horizontally or vertically disposed — while some sound quality differences were apparent, these did not alter the overall high scoring. However stereo was not its strongest point — images were a little wide and somewhat defocused centrally, with only moderate depth.

Colorations were considered to be mild, comprising slight sibilance, boxiness and a subtle 'oddness' on human voice.

On the plus side however it was considered 'big hearted', with a powerful large scale presentation and abundant clean bass (slightly excessive), reproducing a detailed acoustic of a lively nature and a well balanced tonal effect. The output was felt to be smooth, well controlled and of good quality.

### Lab results

The samples supplied demonstrated a weakness in that the pair match was below par, with a 2dB imbalance above 1kHz, this capable of detracting from the stereo focus and general consistency. Sensitivity was above average at 88dB/W, but was compromised by the low impedance. Bass was fairly well extended to -6dB, 48Hz with some overhang, but with a gentle rolloff to lower frequencies. The grille worked well, having no significant output effects.

Average impedance was 6ohms but there were several areas closer to 4ohms, and in view of the small reactive content, a 'just satisfactory' rating was deemed appropriate for amplifier loading.

With the speaker disposed horizontally, the 2metre forward response set showed a weak-

ened lateral output due to the breadth of the radiating area, this recovering well above 5kHz. The 15° above-axis response showed some loss, suggesting that the mid driver represents the optimum radiation axis. The response looked lumpy and yet the averaged output suggested a smoother sound — this should be confirmed by the room response. Sure enough, the room characteristic was quite promising with good bass extension, the output notably even over the range with a desirable gentle rolloff towards the highest frequencies.

At 96dB the distortion was average on second harmonic above 500 Hz but below this frequency very good results were obtained. At 86dB the second harmonic improved greatly while third remained very low throughout — a fine performance here.

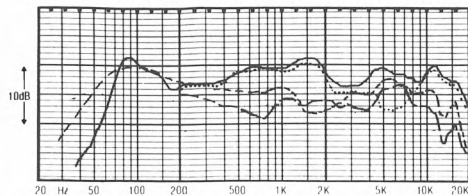
### Summary

The latest 402a was checked both by full auditioning as well as a measurement of both room and axial responses. Overall, not much change was evident and the speaker continued to do pretty well in the listening tests where it scored rather above average, as it should do, considering the price. Pair matching was also improved by comparison with last time. Its rich powerful bass, good clarity and generous power handling means that a recommendation is continued.

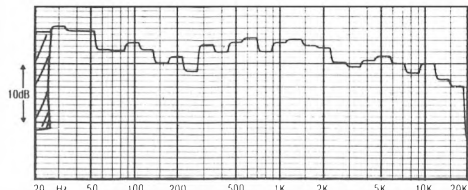
*(Note: The 402A is now available, at extra cost, with '401 style' chrome ends).*

### GENERAL DATA

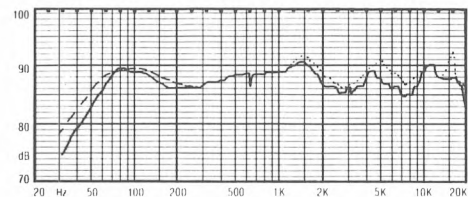
Size (height x width x depth) .....	33.5 x 61 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres) .....	(25)—200W
Recommended placement .....	on matching stands
Frequency response, within ± 3dB, at 2 metres .....	50Hz to 18kHz
Low frequency rolloff (− 6dB point) at 1 metre .....	48Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) .....	88dB/W
Approximate maximum sound level (pair) at 2 metres. ....	106dBA
Impedance characteristic (ease of drive) .....	satisfactory
Forward response uniformity .....	fair
Typical price per pair, inc VAT .....	£430



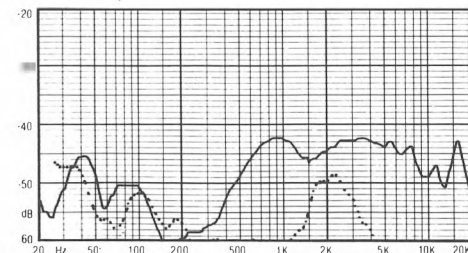
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



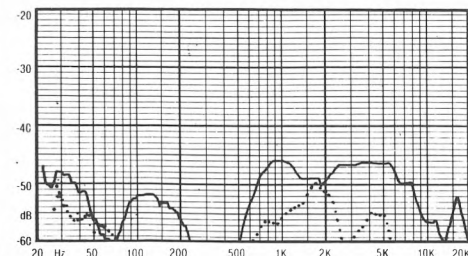
Averaged forward characteristic response in room at listening position.



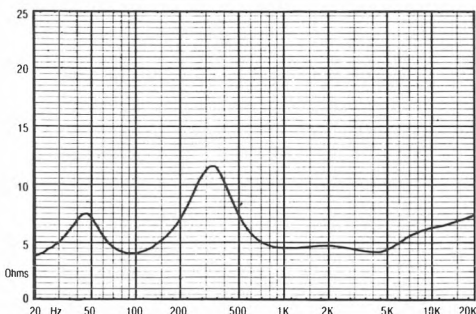
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



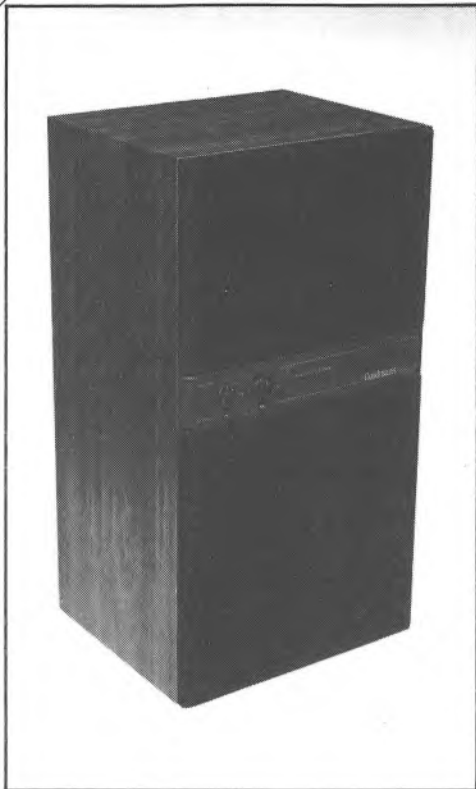
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Goodmans Mezzo

Goodmans Loudspeakers Ltd, Downley Road, Havant, Hants  
Tel (0705) 486344



The *Mezzo* is the middle sized model in Goodmans new 'M' series of moderately priced speakers, and revives the name of a model popular many years ago.

Price may be on the low side, but the specification certainly is not, this model comprising a substantially built 37 litre bass-reflex enclosure with a three-way driver system. The design is striking with a horizontal bar across the upper third of the divided grille carrying level controls for the mid and treble, plus a line of LED lamps for the peak power level indication. The 80mm cone midrange unit and the 25mm soft dome tweeter are mounted side by side in the upper section — neither this arrangement nor the 15mm thick grille baffle edges are conducive to good lateral dispersion, or to low diffraction. A larger-than-usual 250mm pulp cone bass driver occupies the lower section of the enclosure, bass loaded by a small

reflex port.

Externally, the rigid chipboard enclosure is well finished in a synthetic vinyl print. The commercial-quality crossover is basically of 12dB/octave form, employing eight elements plus power resistors. Thick foam blocks provide acoustic absorption for the interior, whose panels are otherwise undamped. Both 4mm sockets and DIN electrical connections are provided on a moulded panel.

## Sound quality

In spite of its dispersion handicap, the *Mezzo* acquitted itself well on the listening tests, comfortably achieving a score worthy of HFC recommendation. It was considered lively and well balanced, with good detail in some regions, while the bass was powerful with quite good extension if a little plummy. The treble was quite pleasant and free of obvious vices, and the mid-range sounded open if trace boxy, while 'cuppy' coloration was also audible.

Opinions about this speaker did however vary a little, mainly due to the somewhat inconsistent stereo. Only moderate depth was portrayed, the central focus seeming rather diffuse by comparison with the group average. Despite this, the *Mezzo* had a pleasant character not usually encountered at its price level.

## Lab results

On the median axis, measured at 1metre, the output looked unpromising, but as we shall see the overall forward response was rather better. The dotted graph shows the effect of removing the upper grille and we in fact preferred the sound in this condition. Mean sensitivity was above average at 88dB/W, with a quite extended -6dB bass rolloff at 46Hz, and in conjunction with a 100W peak power handling, substantial 104dB sound levels were possible. Pair matching was fairly good.

Fine distortion results were obtained at 96dB; around 1.5% second harmonic at low frequencies and just 0.3% for both second and third above 200Hz. At 86dB both showed a further reduction to very good levels.

At 2metres, the off-axis responses were fairly well grouped apart from the 30° lateral, with the general characteristic slightly 'rich', possessing a gentle suckout at 3kHz.

Assessed by computer room averaging, the output was rather more consistent than anticipated, and correlated well with the smooth impression gained on the subjective

tests. Technically this model produced some confusion, this due to its anomalous dispersion.

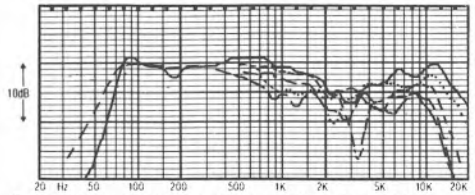
Failing to meet the 8ohms spec, the Mezzo showed an impedance dip to 5ohms, but its modest reactive content and average value of 7ohms meant that it remained quite easy to drive.

**Summary**

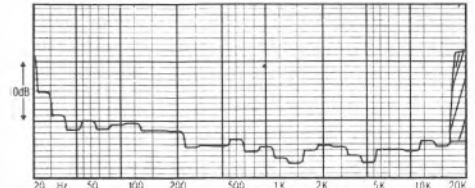
This larger-than-average speaker is good value for money, offering a pleasant, uncritical 'big' sound. The bass extended deeper than usual while high sound levels with low distortion were possible. If stereo precision is not too important then the Mezzo would be a strong contender, and in any case at its realistic price level, it carries a firm *Choice* recommendation.

**GENERAL DATA**

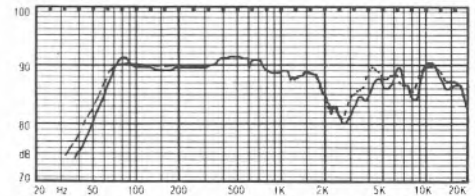
Size (height x width x depth) .....	60 x 32 x 26cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres) .....	(12)—100W
Recommended placement .....	open stands
Frequency response, within ±3dB, at 2 metres .....	see text
Low frequency rolloff (–6dB point) at 1 metre .....	46Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) .....	88dB/W
Approximate maximum sound level (pair) at 2 metres .....	104dBA
Impedance characteristic (ease of drive) .....	good
Forward response uniformity .....	satisfactory
Typical price per pair, inc VAT .....	£130



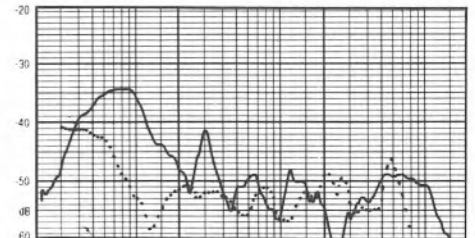
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



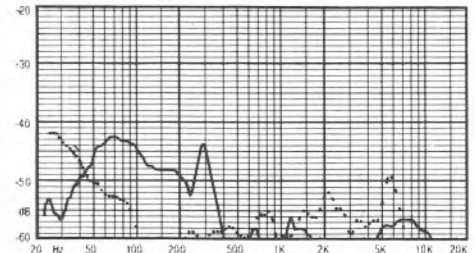
Averaged forward characteristic response in room at listening position.



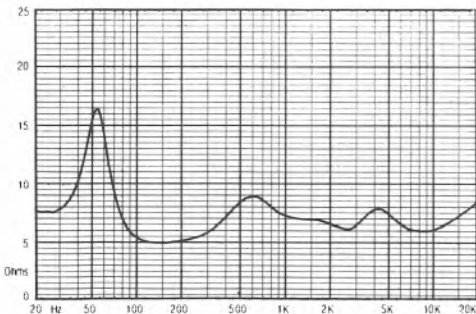
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



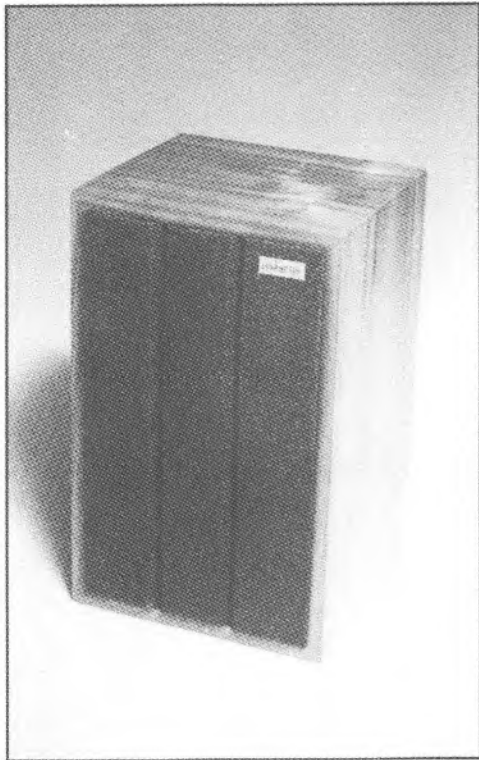
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Harbeth ML

Harbeth Acoustics, 2a Nova Road, West Croydon CR0 2TL. Tel 01-681 7676



Harbeth's new model the *ML* is a miniature two-way sealed-box system of some 9 litres internal volume – a little larger than an *LS3/5A*. It has a tidy appearance and is finished in a fine quality real walnut veneer. The front panel is constructed from 12mm multi-ply, but the remainder of the carcass appears to be of chipboard, and no panel damping is used (presumably working on the assumption that where such small and thick panels are involved, no benefit would accrue from applied damping). An acoustically absorbent foam lining is however present, and the grille is also made of a special black non-absorbent grade of foam, of good acoustic transparency.

The front baffle was fixed in position using 8 screws, but no sealant was applied, resulting in mild air leaks with our samples. The two drive units comprise the ubiquitous 25mm fabric dome unit from Audax, and an exclusive 110mm polypropylene cone bass/mid unit made by Chartwell to Harbeth's specification. It uses a steel frame and generous magnet plus a special nitrile-rubber surround.

The high quality five-element crossover has laminated core inductors and plastic film capacitors; the treble inductor also doubles as a ratio-matching auto-transformer, allowing fine adjustment of tweeter sensitivity. No resistors are used.

## Lab performance

Good pair matching was shown to within  $\pm 1$  dB over most of the range. However the axial reference curve showed a distinct prominence in the response at around 700Hz, while the range below this was stepped down by a further 4dB from 500Hz. In a slightly less extreme form such a characteristic might suggest a suitability for wall mounting. Furthermore the response above 4kHz is rather uneven. Based on the upper range level, the sensitivity averaged 84 to 85 dB/W, which is below the mean for the group. The bass characteristic lacked extension, with the  $-6$ dB point charted at 70Hz, and though this would be augmented by a wall position, Harbeth suggest the use of open adjustable stands clear of walls.

The dip at 4kHz was suspected to be a phasing problem, and on the 2m characteristic response both  $15^\circ$  above (A) and below (B) curves were taken. 'B' shows a significant improvement, suggesting that when the listener is above the speaker axis, the speaker should be inverted, but otherwise the system should be elevated slightly above ear level. The characteristic response nevertheless showed a distinctly prominent region from 1.2kHz to 4.5kHz, plus another hump at 15kHz, and neither looked promising for the subjective balance. In the optimum axis, the lateral uniformity was relatively good.

The distortion results were unexceptional, remaining around 1% up to 2kHz and reappearing above 6kHz, although below 100Hz the figures were better than average for such a small system. However on 100W peak input at 500Hz it was not too happy, with 10% of 2nd harmonic and 1.5% of 3rd, though the compression at 0.2dB was slight. At 5kHz compression was reduced at 0.1 dB, with better figures of 1.2% for 2nd and 3rd harmonics. But as bass inputs in excess of 50W caused gross distortion on the listening tests, 50W has been set as the maximum realistic power input, with 20W as a recommended minimum.

Fed 50W a modest 96dBA maximum sound level was possible in our listening room. The *ML* is rated as a very good amplifier load, with some of the sensitivity limitations attributable to a high impedance, which typically measured 12 ohms with a 9.5 ohm minimum.

Averaged over the listening room area, this speaker's output reflected an upper midrange



dominance extending from 400Hz to 2kHz, together with a gently falling low frequency response below 400Hz. The 50 Hz region was 6–8dB below the midband, which is too low for full recovery by wall mounting, and in any case would result in poorer stereo and a less uniform overall response.

### Sound quality

The results of the listening tests tended to confirm the measurements. On the recorded stereo programme the result was described as 'thin', with an uneven treble giving 'sibilant' effects and a 'breathyness', for example on woodwind. Some 'boxy' coloration was also evident, though partially disguised by the 'forward' upper-mid balance. Ambience rendition was poor, though some panelists felt the speaker provided good detail. The bass register was both lacking in power and showed a restricted bandwidth.

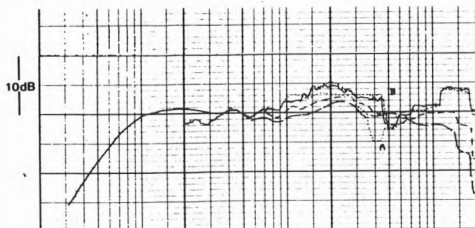
On the live comparisons the 'light' balance proved an advantage on the dominant percussive solo material, as is often the case. Nevertheless criticisms of a 'boxy' quality coupled with a 'zingy' treble were made, and the system often showed 'hardness' in the midrange.

### Summary

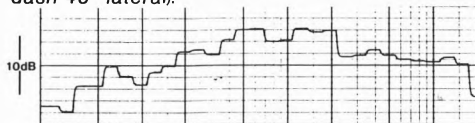
The performance of this new Harbeth does not justify recommendation. The system is comparatively expensive at £190.00 a pair, and does not compare favourably with the 3/5A, which is more accurate, and broadly comparable in terms of size, price, power handling and bandwidth.

### GENERAL DATA

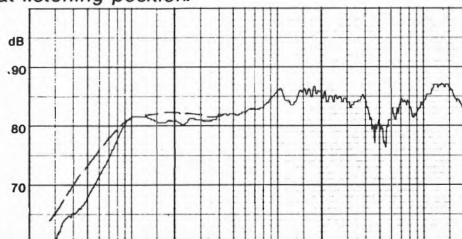
Size (h x w x d).....	34.5 x 21.5 x 19.5cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(20)–50W
Recommended placement .....	high stand or open shelf
Frequency response within $\pm 3$ dB (2m) .....	90Hz to 20kHz
Low frequency rolloff (–6dB) at 1m.....	70Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms) at 1m.....	84dB/W
Approximate maximum sound level (pair at 2m) .....	96dBa
Impedance characteristic (ease of drive) .....	very good
Forward response uniformity .....	good below axis
Typical price per pair inc VAT .....	£190



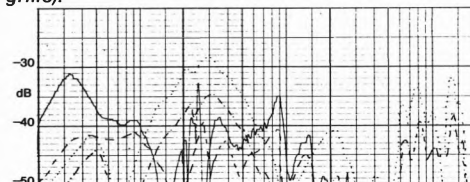
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



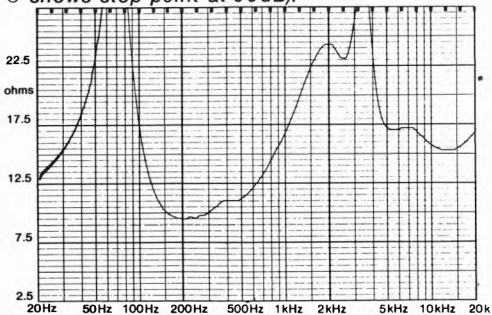
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).

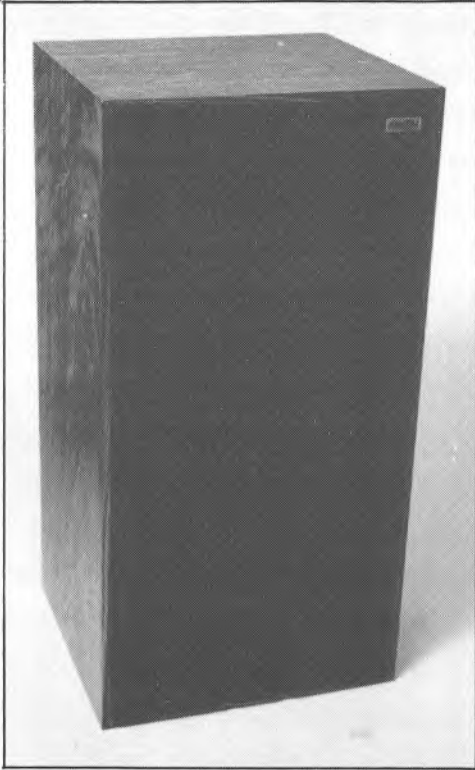


Impedance (mod Z).

# Harbeth HL1 III

Harbeth Acoustics, 1a Birchanger Road, South Norwood, London SE25 5BA  
Tel 01-654 9549

RECOMMENDED



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 battening. 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  $\pm 3$ dB 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  $\frac{1}{3}$ -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 low coloration still set this speaker apart from the common crowd. It has been a couple of issues since we reviewed the *HL1* – then it was considered good enough for recommended listing. In view of rising standards, the *HL1* cannot necessarily be expected to hold its place indefinitely, but we still hold the design in favourable regard and feel it well worth trying.

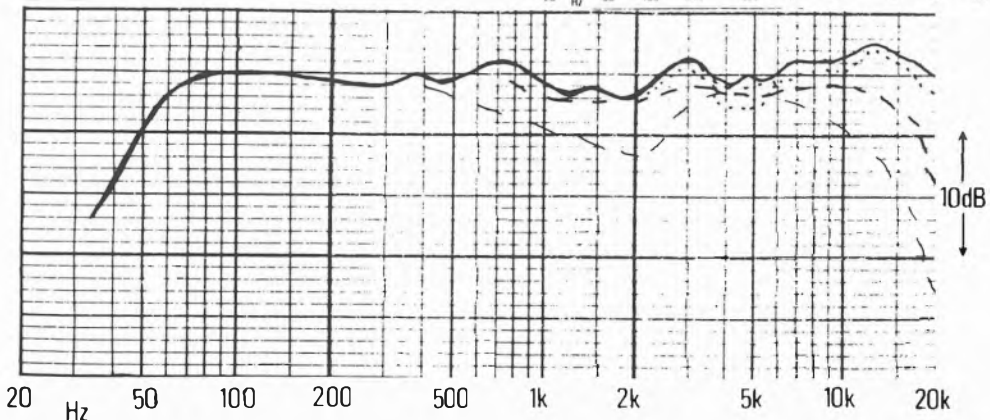
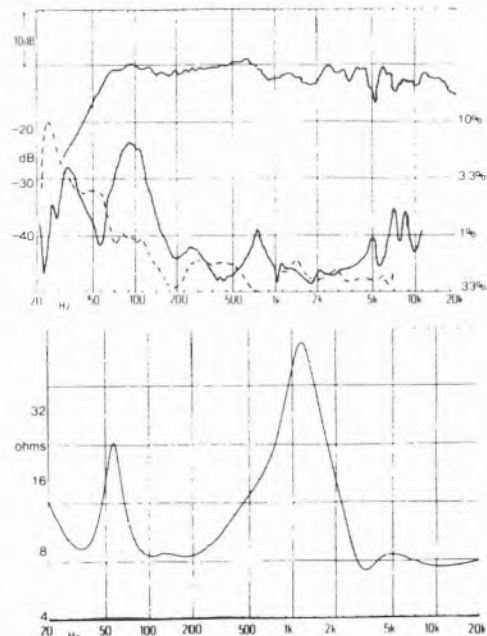
(Note: We have been informed that a *Mk IV* version will shortly be available and the manufacturer's aim is to continue the existing high *HL1* standards with this his new model.)

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  $\pm 3$ dB (2m) ..... 63Hz to 18kHz  
**Low frequency rolloff (-6dB) at (1m) ..... 46Hz**  
 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 ..... £395 when reviewed, now £34.  
 \*Check text

Top: Frequency response, 1m sine wave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB

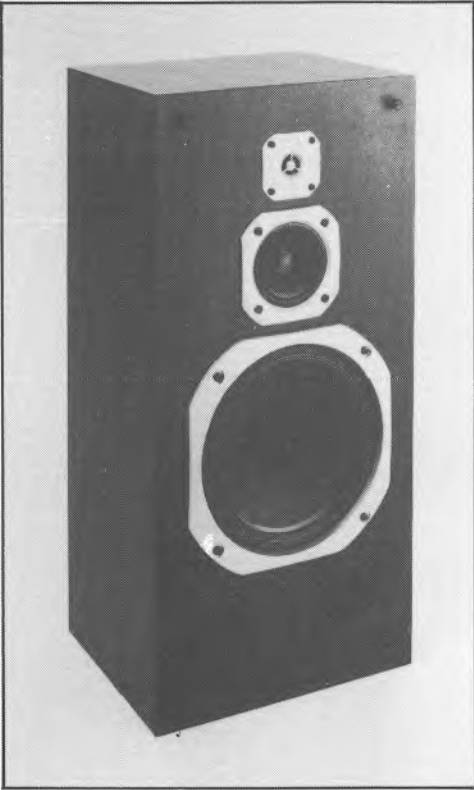
Middle: Impedance (modulus)

Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical)



# Harman T3000

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



Custom-built for Harman in the UK, this loudspeaker is a budget three-way model reckoned to be one of the best 'music centre' components. Somehow it found its way into this issue, and we were interested to see how it fared against far more costly and august competition. Its 25 litre box is reflex tuned to a high 80Hz by two ducted ports, 5cm deep by 4.5cm diameter. The enclosure is vinyl surfaced and comprises a plain light chipboard construction, rather resonant as a result. The drive units are also lightweight in construction, and include a 200mm paper cone bass, a 100mm paper cone mid and the Audax 12mm plastic cone tweeter. The crossover network simply comprises two capacitors — a 4.7 $\mu$ F for the mid, really 'low treble', and a 2.2 $\mu$ F for the high frequencies. The bass driver even lacks a proper surround for suspending the cone. Internal absorption is by a single layer of fibre

at the rear and the unrebrated grille is 25mm thick. Spring clip terminals are provided for electrical connection and most of the money seems to have been spent on the plastic decoration for the drivers.

## Sound quality

In so far as its performance was disappointing, the T3000 proved a useful reference for setting the lower 'limit', helping to order and scale the results from the blind listening tests, but otherwise, its poor rating was consistently confirmed by all the panelists.

Its plus point was that it could get pretty loud, and it also had a lively, open balance, but the minus points included poor bass with negligible extension, a megaphonic coloration on voice plus serious boxy, wooden and nasal colorations and tizz in the treble.

Almost no stereo depth was heard, though image focusing was not too bad. One perceptive listener even commented that it was more like hearing a collection of noises than the separate strands of a piece of music. Its also proved fatiguing, and was quite aggressive when played loud.

## Lab report

This speaker was very sensitive, typically measuring 94dB/W. Pair matching was acceptable, while the -6dB bass rolloff was rather high at 76Hz. The axial response was sufficiently ragged for the removal of the thick grille to make little difference to the output,  $\pm$ 5dB limits sufficing for a 75Hz to 20kHz range, this rather light in balance with a bass 'boom' at 130Hz.

Out at 2 metres the forward response family was poor with wide deviations on the various axes. At 15° above it showed serious phase loss over several octaves of treble. Distortion was poorer than average at 96dB sound pressure level, but reduced to acceptable levels at 86dB spl. On the intermodulation and compression tests, a significant 2.2dB of compression was measured.

The impedance curve dipped close to 5 ohms in the treble range but otherwise was quite uniform, and with its high sensitivity it should prove an easy amplifier load.

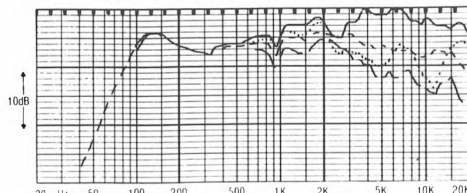
From the room response, the deficient bass was clear enough as was the 100-125Hz boom, the speaker thereafter appearing fairly tidy, in energy terms at least.

## Summary

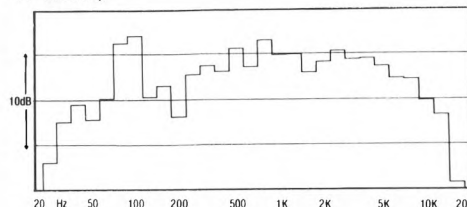
The standard set by this speaker illustrates what real audio is all about. It may be at the top of the music centre ladder but the gulf between it and the recommended £80-plus hi-fi speakers in *Choice* is considerable, and in my opinion, it would be false economy to try and save £10 or £20 if this is what you wind up with. Unfortunately no *HFC* recommendation of any kind is possible for this model.

## GENERAL DATA

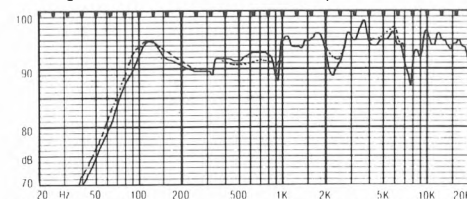
Size (height x width x depth).....56 x 27 x 23cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(10)—50W  
 Recommended placement.....shelf  
 Frequency response, within  $\pm 3$ dB at 2 metres.....see text  
 Low frequency rolloff (-6dB point) at 1 metre.....76Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....94dB/W  
 Approximate maximum sound level (pair) at 2 metres.....105dBA  
 Impedance characteristic (ease of drive).....good  
 Forward response uniformity.....poor  
 Typical price per pair, including VAT.....£80



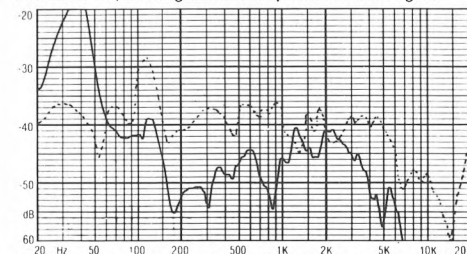
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



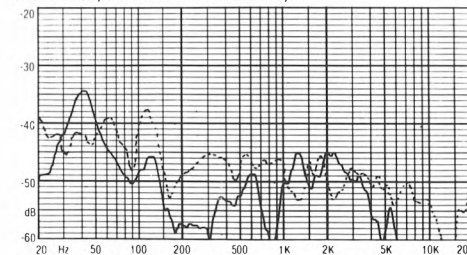
Averaged forward characteristic response in room



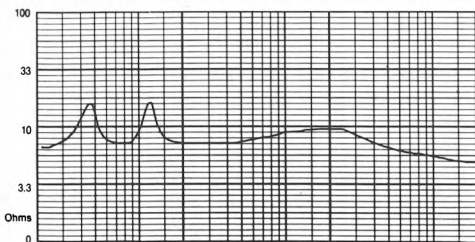
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



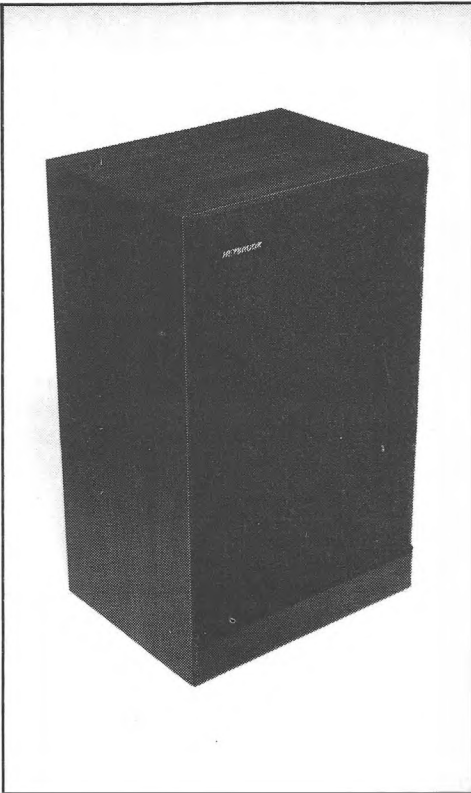
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Heybrook HB1

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



This low-cost speaker is rather better made than usual. The exterior of its rigid chipboard cabinet in vinyl 'walnut', while internally it is damped by bituminous cladding plus acoustic foam absorption. A superior reticulated foam grille is fitted and electrical connection is via binding posts/4mm sockets of good quality.

Internal volume is 22litres, and two drivers are used, both of Danish 'VIFA' origin. The 200mm doped pulp cone bass/midrange is fitted with a decent magnet and a superior frame, and the high frequencies are handled by a 25mm soft plastic dome tweeter, whose chassis is reinforced inside the cabinet, this also serving to brace the front panel. A 12dB/octave crossover of superior quality integrates the two units at 3.7kHz.

Appearances response-wise suggested a character which might suit shelf mounting against the wall, and in fact the *HB1* did work 92

quite well in this position, but for the listening tests the cleanest results were felt to come from positioning on rigid open stands.

## Sound quality

Personally I had some reservations concerning this model's sound quality, these based on the results of an earlier audition, but under blind conditions, the panel (myself included) thought highly of the *HB1*. Consistently good marks were awarded, placing it high in the field irrespective of price.

Good qualities included a highly revealing transparency which was truthful to the programme character. Stereo images showed quite good depth with a realistic acoustic and decent frontal focus; in fact it sounded almost too 'clean' in the 'open' sense, as opposed to 'shut-in' or enclosed. The bass was articulate, with fair extension if a mite too 'dry', although this helped on percussion.

On the minus side, the sound showed some boxy colorations plus mild tizz and hiss emphasis in the upper treble. The mid could also appear somewhat hard and forward. Using first-rate programme, these effects were somewhat less serious than when juxtaposed with the more distorted output of a brighter and less expensive analogue disc player. Tonally speaking, the *HB1* was balanced on the bright side.

## Lab results

Excellent pair matching was demonstrated, with a high 90dB/W sensitivity, and despite this the bass was reasonably extended to 55Hz, -6dB, on the anechoic response, as well as being free of overshoot.

In the view of the 80W maximum power handling, decently loud 104dBA sound levels were possible, while a little as a 10W input raised pretty good levels of around 95dB in a typical room.

Out at 2metres the general trends can be seen and the speaker only just scraped into the nominal  $\pm 3$ dB response limits for axial output. The upper mid was indeed forward by 2-3dB while an energy suckout occurred at 7kHz, high enough not to be felt subjectively as a loss of presence or 'air'. The treble recovered soon after, with a broad hump centred on 14kHz. Both plus and minus 15° vertical off-axis responses were run, showing the *HB1* was axis critical and should be directed straight at the listener in the vertical plane. Crossing the axes in front of the listener for 10°-15° lateral angle also improved

the tonal balance.

Measured at 96dB the distortion was moderate at 0.8% to 1.5%, with a further improvement noted on reducing the signal level to 86dB.

Occasionally the *HB1* impedance almost approached 50ohms, but it represents a simple amplifier load reactively and should prove fairly easy to drive. System resonance was noted as 65Hz.

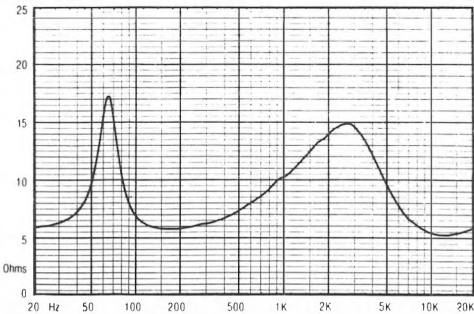
Room averaged, the bass was smooth but somewhat deficient, being a few dB down in the fundamental midrange. Consequently, the mid remained forward although the integrated treble works better than the axial responses might otherwise suggest.

**Summary**

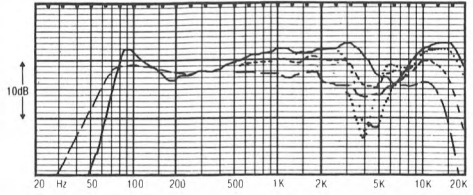
The *HB1* offers a distinctly bright character plus an above average build quality. Moderate distortion levels, high sensitivity as well as good maximum acoustic power are also all apparent, while the sound is strikingly clear with a fine transient performance. On the basis of its sound quality ratings as well as its modest price, the *HB1* attains 'Best Buy' status.

**GENERAL DATA**

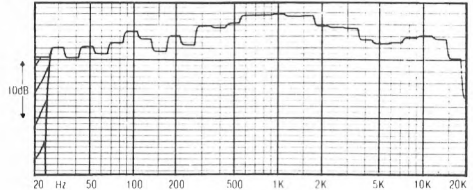
Size (height x width x depth) . . . . .	47 x 29 x 23cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres) . . . . .	(10)—80W
Recommended placement . . . . .	open stands
Frequency response, within ± 3dB, a 2 metres . . . . .	65Hz to 20kHz
Low frequency rolloff (− 6dB point) at 1 metre . . . . .	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre . . . . .	90dB/W
Approximate maximum sound level (pair) at 2 metres . . . . .	104dB
Impedance characteristic (ease of drive) . . . . .	good
Forward response uniformity . . . . .	fairly good
Typical price per pair, inc VAT . . . . .	£139



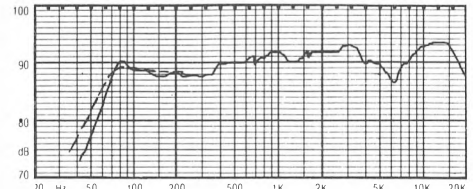
*Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.*



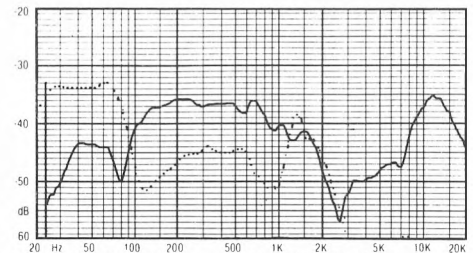
*Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).*



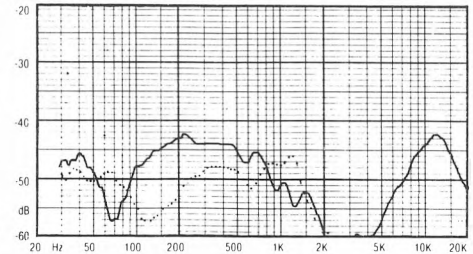
*Averaged forward characteristic response in room at listening position.*



*Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.*



*Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).*

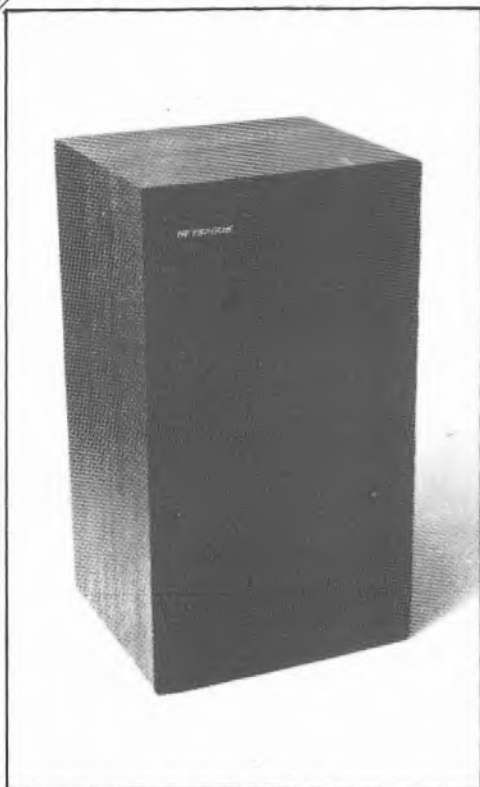


*Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).*

**Heybrook HB2**

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

RECOMMENDED



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

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



the speaker was not driven too hard, and the balance tended to openness with light sibilance, but in a smooth and acceptable manner.

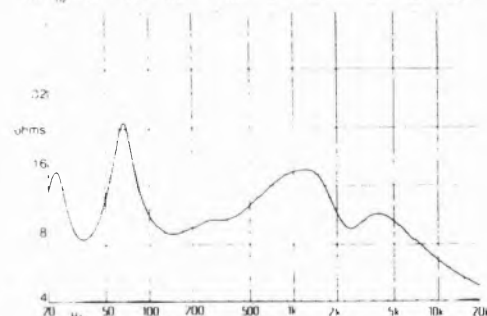
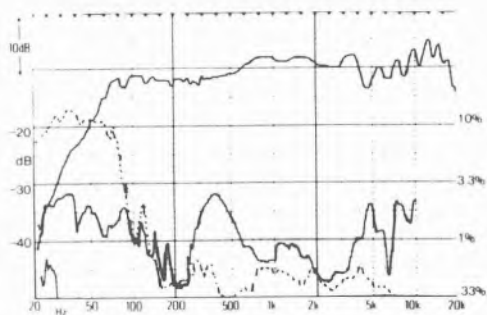
### Summary

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.

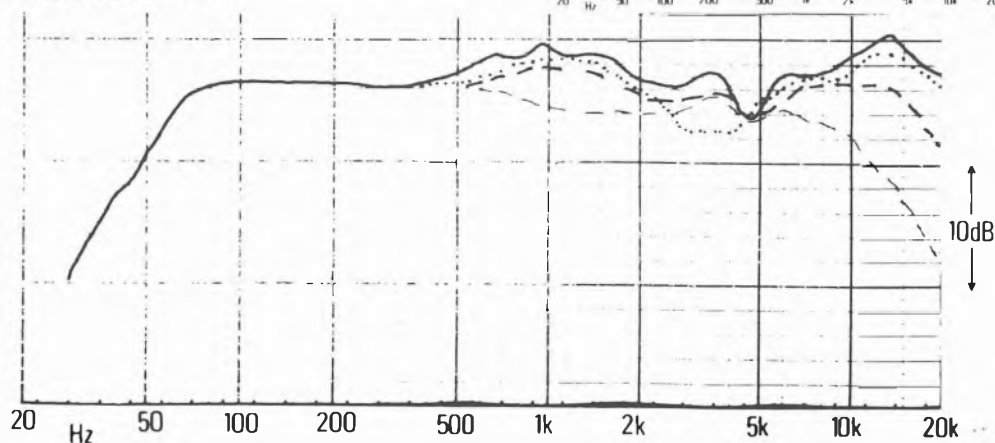
*Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB*

*Middle: Impedance (modulus)*

*Bottom: Frequency response, 2m <sup>1</sup>/<sub>2</sub>-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	£199



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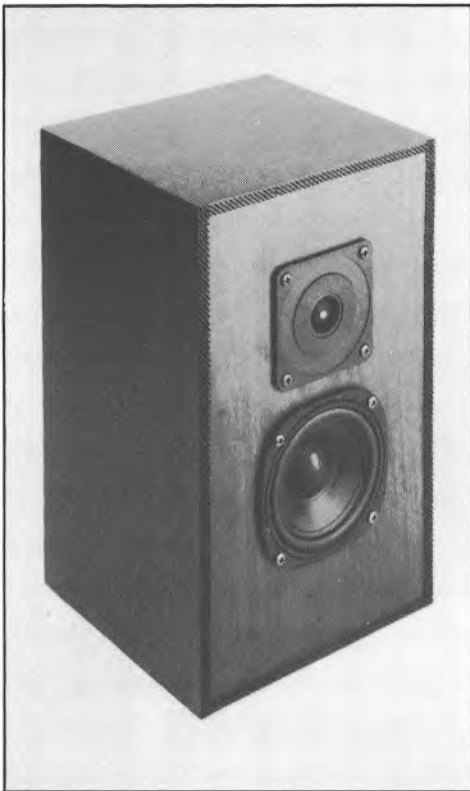
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# IAS 808

Integrated Audio Systems, 18 High Road, Swaythling, Southampton, SO2 2JH  
Tel (0703) 553473



A compact 'walnut' vinyl covered speaker with an acoustically sound foam grille, the 808 is the smallest speaker IAS make, with an internal volume of approximately 9 litres. Despite this, the interior is complex, comprising a folded closed line design, supplemented by a rear slotted port. This is quite large, tuning the system to a bass resonance at 100Hz, and thus curtailing the response below that point.

A 100mm frame SEAS driver with a doped pulp cone serves for the bass/midrange, while a Philips tweeter covers the remainder, this a modified 25mm fabric dome unit. A hole is present in the apex into which some wadding has been stuffed, presumably to control the upper breakup modes. The internal wiring is hand soldered, though the crossover is a bit frail, being built on perforated board. A pair of 4mm sockets are provided on the rear for amplifier connection, and the enclosure is

highly rigid, owing to the internal bracing introduced by the labyrinth construction.

## Sound quality

While rated rather below average, the listening tests results were not a disaster for the 808. It did sound a bit 'thin' with a lightweight tonal balance but was quite well controlled. Bass as we know it was lacking yet upper bass detail was quite well presented, although the mid was rather boxy and also had a tendency to nasality.

Panelists described a 'hazy' quality, showing as a lack of fine detail and furthermore stereo depth was rather restricted. Overall it sounded rather like a small box design, something other miniatures do manage to disguise — take for example the 3/5a or the *Solitaire*.

## Lab report

Pair matching was fine over the whole range with only minor 0.75dB deviations. The axial reference response suggested a 87dB/W average sensitivity and a lumpy characteristic. Mid and treble prominences were apparent while  $\pm 5$ dB limits were required for a 80Hz to 20kHz range. Against the 87dB reference, the  $-6$ dB rolloff was at a high 86Hz.

Out at a 2 metre microphone spacing, the forward response family showed a tidy well integrated set of traces. The mid treble plateau was clearly shown, amounting to 3dB relative to the reference 200Hz point.

At a 96dB spl level the 808 was clearly working very hard with second harmonic distortion at 3% mid band and with a peak in third at 2kHz. At 50Hz the true distortion percentage approached 30% for third harmonic, so the speaker does not like to be driven hard (ie, with more than 10W sinewave).

Some distortion improvement was noted at 86dB spl, but it was still higher than average. The intermodulation result was also poorer than usual at  $-33$ dB and the mid band compression registered a considerable 2.2dB.

The impedance curve was most uniform and almost flat at 7 ohms, over most of the range. As a load this speaker was straightforward, and with a 50W power handling, (with care!) it should be capable of around 99dB in a typical room.

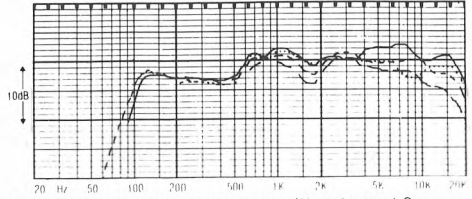
Computer averaged the room response showed the mid and treble peaks, as well as the significantly depressed mid range, while the bass falls away below 80Hz.

## Summary

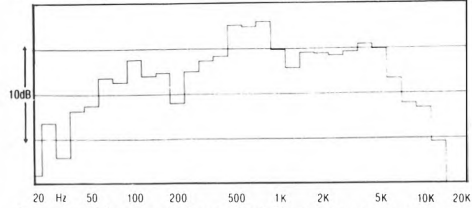
Considering its poor bass range, forward mid range and lumpy response, the 808 has not actually done too badly. However the significant level of coloration as well as restricted dynamic range do also tell against it, together with its poor bass power handling, and these characteristics together combine to rule out any recommendation here, bearing in mind a retail price approaching £200 a pair.

## GENERAL DATA

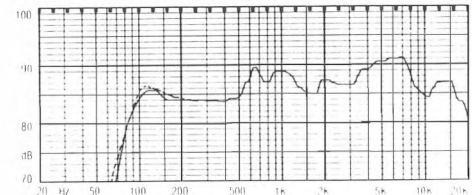
Size (height x width x depth).....33 x 20 x 22cm  
 Recommended amplifier power per channel  
 (for 96dBa per pair at 2 metres minimum).....(15)—50W  
 Recommended placement.....shelf  
 Frequency response, within  $\pm 3$ dB at 2 metres.....see text  
 Low frequency rolloff (-6dB point) at 1 metre.....86Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....87dB/W  
 Approximate maximum sound level (pair) at 2 metres.....99dBa  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good +  
 Typical price per pair, including VAT.....£199



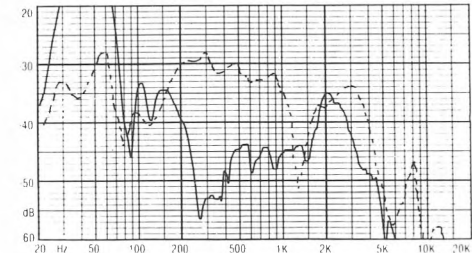
Forward characteristic response ( $1/3$  octave at 2m, dotted 15° lateral, small dash 30° lateral, long dash 45° lateral).



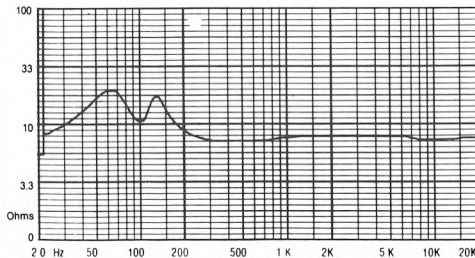
Averaged forward characteristic response in room



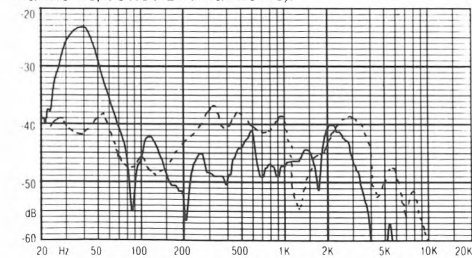
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

## JBL L46

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



This two-way JBL compact encloses a 35 litre volume and is best suited to free space stand mounting, though at a shelf could be used. The system is reflex-tuned to 35Hz by a 5cm diameter port, backed by a 13cm tube. Both the drivers are made by JBL, and comprise a 25mm hard fabric dome tweeter, with a 220mm high power reinforced pulp cone bass unit. The latter is built on a die cast chassis with a generous magnet. The rigid enclosure is built from 20mm thick chipboard, and is excellently veneered in walnut. The 20mm thick grille panel is unrebated and this will cause treble reflections. The interior is lined with bonded mineral fibre and the six element plus one resistor crossover is of excellent quality. Rear connection is via the usual JBL recessed screw lock binding posts, and for the price the workmanship is very good, particularly so bearing in mind the cost

penalties for an imported model.

### Sound quality

The L46 did well scoring a 'good' overall rating, which is a fine result for the price. The panel's comments were most interesting as they appeared to find a number of points to criticise and yet at the same time, they liked the overall result enough to score it well.

The speaker demonstrated power, impact and truthfulness in the bass though with some overhang in the extreme registers. The mid was clear and articulate but had a touch of 'edge' and hardness — fine for bass percussion but a bit wearing on voice and piano. The treble also gave good detail but could sound slightly metallic and brash. Stereo focusing was good, particularly with the grille detached, and both stereo depth and the recording acoustic were well presented. Dynamics were excellently portrayed, and it could also play very loud, handling the 400W peak input with full control. However 150W is probably a sensible maximum for normal use.

### Lab report

Pair matching was not outstanding, with  $\pm 1$ dB variations cropping up at various points in the range. Sensitivity was noted at 87dB/W which was about average, with a  $-6$ dB bass rolloff point at 48Hz showing good low frequency extension. The rolloff below this was also quite shallow. Axial response was pretty uniform with or without the grille, and  $\pm 2.5$ dB limits sufficed for 55Hz to 20kHz, a far cry from the older 'roller coaster' curves this company produced! With a 200W power capacity, decent 105dBA sound levels can be produced by a pair in a room.

Out at 2 metres the family of responses was tidy in the lateral plane but at  $15^\circ$  above, a crossover phase dip occurred at 3kHz. The suggestion is therefore to mount it so that the top of the cabinet is close to ear level, or alternatively tilt the speaker to get the same result. At 96dB a fair amount of second harmonic was produced and third rose to 1% in the midrange while holding below this level at 100Hz. At the lower 86dB sound level the distortions were improved though third remained high at 1kHz, 0.8%. On the intermodulation and compression test the former read  $-44$ dB, the latter 0.7dB, both fine results. The impedance curve suggested that this was essentially an 8 ohm model, though it

does dip to 5 ohms at 4.5kHz, so really weak amplifier models should be avoided.

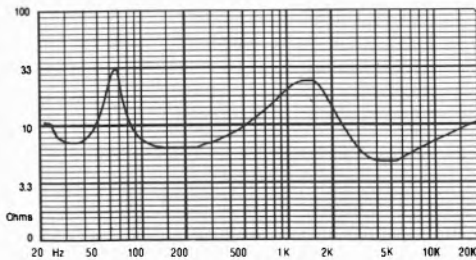
The room curve showed a well-balanced response above 60Hz, though with some presence excess at 3-4kHz — perhaps this is the edge or 'hardness' we noted on audition. The low bass was excessive but welcome nonetheless, with its extension to 25Hz.

### Summary

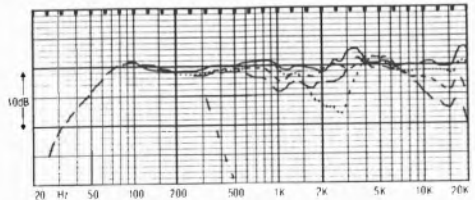
This JBL has a lot to offer for the price. It has a deep powerful bass, a sharp clear midband and good dynamics, and is also faithful to recorded acoustics suiting both rock and classical material. Despite its faults the panel liked it a lot. Its technical data is also pretty good, while build quality is excellent, and the *L46* therefore becomes the first JBL speaker to win a Best Buy rating in *HFC!*

### GENERAL DATA

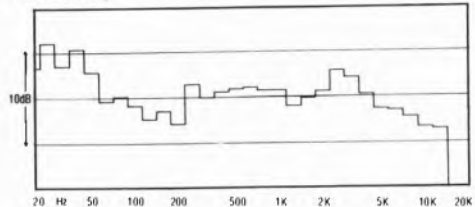
Size (height x width x depth).....	52.5 x 32 x 29cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(15)—150W
Recommended placement.....	on open stands
Frequency response, within $\pm 3$ dB at 2 metres.....	52Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	48Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	87dB/W
Approximate maximum sound level (pair) at 2 metres.....	105dBa
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	good
Typical price per pair, including VAT.....	£240



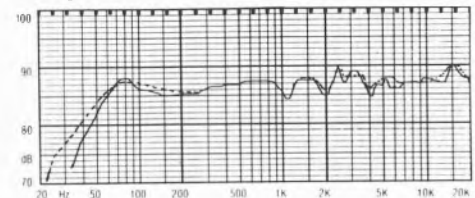
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



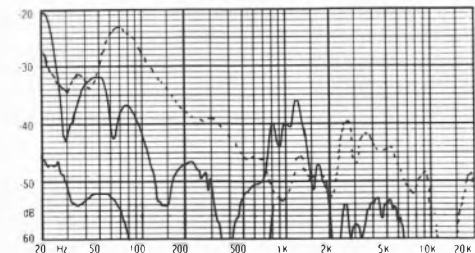
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



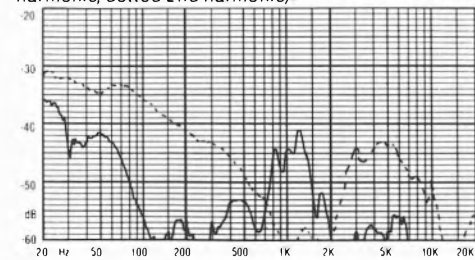
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity) Dashing corrects for chamber LF, dotting shows response without grill



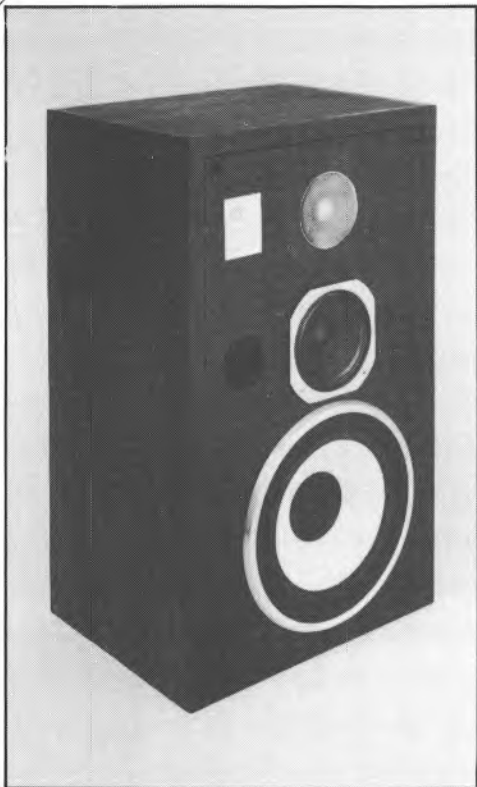
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic)

# JBL L86

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



The *L86* can be regarded as a three-way version of the *L46*, also reviewed in this issue. Since the *'46* works so well, one wonders at the need for the *'86* particularly since the cost penalty is quite severe.

Fractionally larger than the *'46* at 37 litres this speaker is tuned to a low 32Hz by a 5cm port 15cm long, which is too long in my view. Bass is handled by a 220mm reinforced pulp cone driver, with mid frequencies allocated to a light pulp cone 115mm unit and the treble to a 22mm aluminised fabric dome tweeter. The box is plain 20mm thick chipboard, finished in natural walnut veneer, with a reflective 20mm thick unrebeated grille frame. Internal construction was good, with a hard-wired, top quality crossover using special 'speed up' capacitors. Seven main elements are involved, plus five power resistors. Screw wire clamps are used for rear electrical connection and, in

contrast to previous JBL models, no controls are present on the fascia. The *L86* performed best when stand mounted, well clear of local boundaries; we used a heavy grade, 42cm high stand with integral floor spikes.

## Sound quality

While the *L86* performed well on the panel listening test, its absolute merit expressed as a numerical score was almost the same as for the *L46*, the difference being, statistically, well within the error deviation. Its obvious qualities included a detailed clear projections, good stereo focus fairly good depth and an ability to 'read' the recording acoustic. It also demonstrated a wide range, powerful output.

On the minus side, the low bass was a trifle overpowering at times though the upper bass remained tuneful and articulate. The mid could sound somewhat metallic and hard, a familiar characteristic of this series of JBL mid range units, while the treble was a touch forward and 'zippy'.

Power handling was very good, and it could produce excitingly high sound pressure levels.

## Lab report

The reference sensitivity measured 87.5dB which was about average, with the axial response meeting  $\pm 2.5$ dB limits 50Hz to 20kHz. The  $-6$ dB bass point showed good extension to 40Hz. Pair matching was fairly good with minor  $\pm 0.75$ dB variations at a few points, the dotted line suggesting that the grille did not impose too greatly on the frequency response. Out at 2 metres, the forward response family suggested some forwardness in the mid and treble, with a slightly 'lightweight' overall balance. The family of curves indicated very good lateral performance but phase loss was clear in the vertical plane, 15° above; this speaker should be used with the treble directed at the listener's head.

Impedance did not fall below 6.4 ohms, and an 8 ohm rating is thus appropriate. Drive to a 96dB spl, both second and third harmonic distortion were fairly low, and improved still further at 86dB. Low frequency distortion was particularly fine with good compression at 0.9dB; the intermodulation product was a trifle high however at  $-33$ dB.

Examining the room response, the speaker showed some mild forwardness, with a 'sharpness' at the extreme treble and the bass



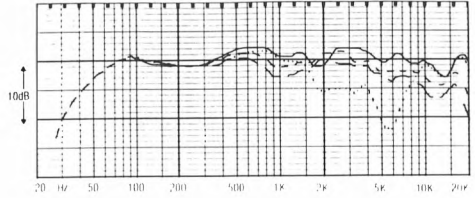
rose excessively below 50Hz, a feature also noted on audition. In theory this system could be run at a higher electromagnetic damping level to trim the bass lift and improve system efficiency.

**Summary**

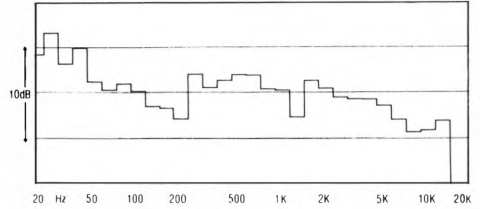
The *L86* is another fine JBL speaker but in some respects is not quite as tidy as the *L46*, while at the same time costing rather more. It offers a wide dynamic range, with low distortion, and despite the heavy level of low bass, this speaker is clearly a contender for recommendation.

**GENERAL DATA**

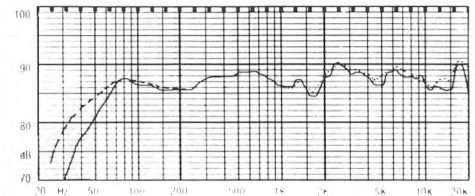
Size (height x width x depth).....54 x 33 x 27cm  
 Recommended amplifier power per channel  
 (for 96dB/A per pair at 2 metres minimum).....(15)—200W  
 Recommended placement.....on open stands  
 Frequency response, within ±3dB at 2 metres.....45Hz-20kHz  
 Low frequency rolloff ( - 6dB point) at 1 metre.....40Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....87.5dB/W  
 Approximate maximum sound level (pair) at 2 metres...106dB/A  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good  
 Typical price per pair, including VAT.....£375



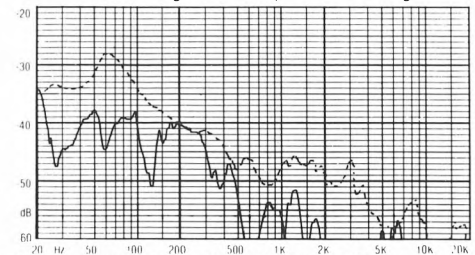
Forward characteristic response (1/3 octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral).



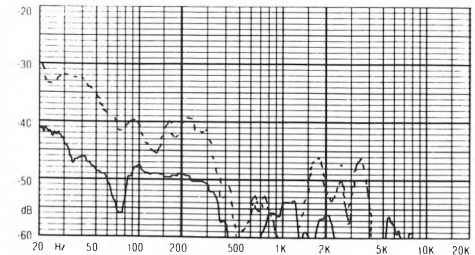
Averaged forward characteristic response in room



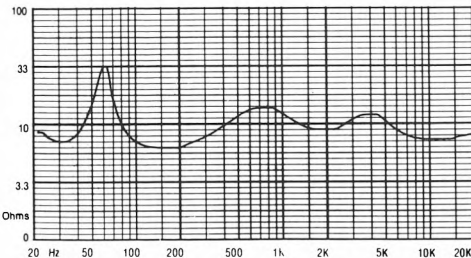
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



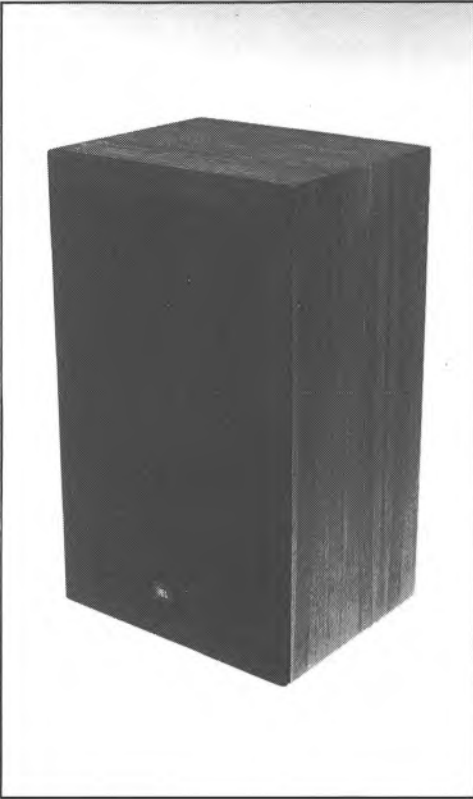
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# JBL L96

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



The L96 is a derivative of the JBL L110, reviewed in the last edition. But in contrast to the 110 with its staggered drive unit mounting and 310mm bass unit, the 96 is a true vertical-in-line system, employing a 250mm reflex-loaded bass driver.

JBL have an acknowledged ability to craft bass drivers and the standard achieved with the unit in the L96 is exemplary. The large SGF high-linearity ventilated magnet is fitted on a massive 75mm pole motor system, built on a die-cast aluminium frame. The rigid, slightly concave, doped cone has a foam surround.

Reflex-tuned to a low 26Hz the 40 litre enclosure is fitted with a rather long cranked ducted port 230mm by 75mm in diameter. JBL's usual pulp cone 100mm driver is used for the midrange, while a further developed version of their 25mm hard fabric aluminised dome unit covers the treble.

A fine-quality high-power crossover marries the output of the three units, electrical connection being made via the bare wire clamping posts. Surprisingly, though, the internal wiring was joined up by spring clip push-on terminals, rather than being hard soldered.

Superbly veneered, the enclosure is rigidly built in extra high-density chipboard but is not damped internally. The grille design also leaves something to be desired, in presenting a reflective step near to the tweeter (see graphs).

## Sound quality

Opinions on this speaker showed some variation from panelist to panelist, some finding a few problems while others thought it lively and powerful. However on balance an average score was attained, which was not too inspiring.

Some coloration was evident — a midrange sharpness and hardness plus a trace of metallic sound and a mild treble roughness and dullness; all in all an odd combination. At times it sounded a trifle 'wooden', and the low bass could appear excessive although the upper bass registers were pleasingly well differentiated with fine 'attack'.

Stereo focusing was quite good, with generally satisfactory instrumental detail as well as moderate depth effects. Overall we felt digital master programme gave better results than analogue.

## Lab results

Sensitivity was well above average at 89dB/W but our samples showed a 1dB pair imbalance in the bass and midrange, with an instance of 2dB imbalance in the treble — in practice adjustment of the level control could help matters here. The grille definitely has a deleterious effect on the response (dotted line for grille removed) and is responsible for many of the treble aberrations. The -6dB rolloff was quite low at 40Hz due to the extra-low-frequency tuning, with good extension still present to still lower frequencies.

At 2metres several factors were revealed. First, the mid was generally dominant by a couple of dB, this tendency emphasised by the upper-treble suckout and the poor mid-through-treble integration, while the treble peaked up towards the end of its range and was none too even. The lateral off-axis curves were fine but the 15° above-axis response showed a stereo loss, indicating a listening axis well onto the midrange driver. The output only just fitted the

nominal  $\pm 3\text{dB}$  limits from 50Hz to 18kHz.

Room-averaged, the mid-dominance was again demonstrated and the treble was too flat; a gentle rolloff above 6kHz is needed for a correct sound with this curve. The extreme bass also showed the excess heard on test.

Measured at 96dB, distortion was low and averaged 0.3% second harmonic with rather less third. At 86dB distortion was exemplary throughout and well ahead of the field.

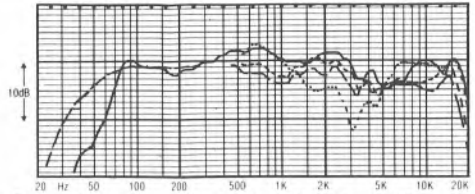
At a couple of points the impedance dipped to 5ohms, and demonstrated an average of 7ohms, a result below the 8ohm standard but still reasonably easy to drive.

**Summary**

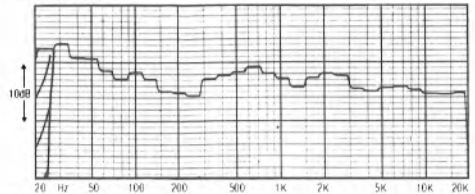
This is a speaker worthy of consideration on the basis of its reasonable scoring and the fact that some panelists favoured it quite strongly. It provides very low distortion, extended bass and a wide dynamic range plus a good transient performance especially on percussion. Stereo presentation is also above average. The mid and treble level controls might be considered to help or hinder, depending on taste. The L96 did sound better with the grille off, and fortunately looked presentable used this way. This model will certainly be some men's meat, but could prove another's poison — an idiosyncratic speaker.

**GENERAL DATA**

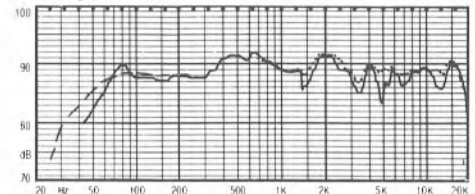
- Size (height x width x depth) ..... 60 x 36 x 30cm
- Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres) ..... (10)—200W
- Recommended placement ..... open stands
- Frequency response, within  $\pm 3\text{dB}$ , at 2 metres ..... see text
- Low frequency rolloff ( $-6\text{dB}$  point) at 1 metre ..... 40Hz
- Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 89dB/W
- Approximate maximum sound level (pair) at 2 metres ..... 107dB
- Impedance characteristic (ease of drive) ..... fairly good
- Forward response uniformity ..... fair
- Typical price per pair, inc VAT ..... £580



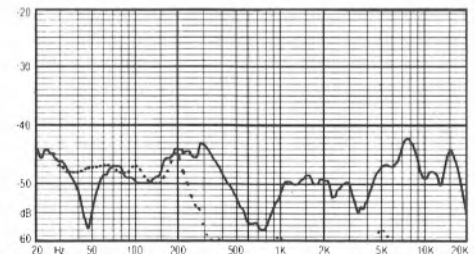
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



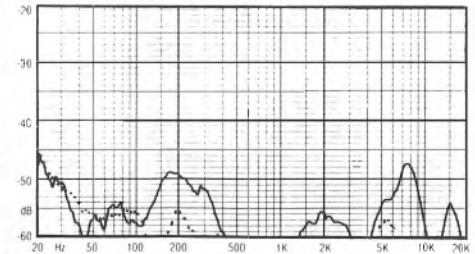
Averaged forward characteristic response in room at listening position.



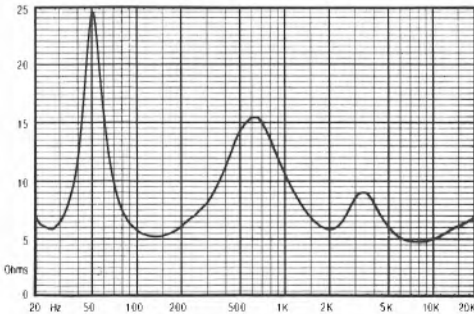
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# JBL L150A

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

RECOMMENDED



Previously reviewed and recommended, the *L150* now carries an *A* suffix denoting the substitution of a new and improved treble unit, distinguished by a protection grille, and further crossover refinements. An imposing structure just over a meter high, the vertical-in-line driver array comprises a 305mm auxiliary low frequency radiator of exceptional throw, plus a high power 305mm bass unit fitted with a rigid coated-pulp cone and built on a die-cast frame. A high linearity ceramic magnet system is employed. The traditional 100mm pulp cone mid unit is positioned above the bass driver and is followed by a 25mm aluminised dome tweeter, the latter a hardened phenolic linen structure. The crossover possesses good power handling with low loss components, and the mid and treble level controls are now marked with an 'O' 'flat' position in addition to boost or cut. (JBL used to deny the existence of a flat curve, preferring to let the customer choose it for himself in the final listening position).

The internal volume is large at 110 litres, with the massive and rigid enclosure built from high density chipboard fitted with extensive bracing and a fibreglass acoustic absorption fill. Externally the American walnut veneer was of the highest quality.

For the new review the speaker was fully auditioned and substantially re-measured. While the 2 metre and distortion curves refer to the previous version, they are still relevant, the only exception being the treble lift above 15kHz which on the new version is now replaced by a gentle rolloff.

### Lab performance

The new axial reference curve was remarkably similar to the previous samples right up to 6kHz, beyond which the slightly ragged character plus oft-criticised peak at 19kHz has been replaced by a smoother trend, plus a gentle hump at 15kHz, rolling off thereafter. The sensitivity remains high at 89dB/W, and the drive characteristic with a minimum impedance of 5.5 ohms was rated as average, and should embarrass very few amplifiers.

As the existing forward characteristic shows, the *L150A* is a very well integrated system, especially considering its size. The low frequency response was superbly extended to a -6dB point at 32 Hz, gently tapering below 200Hz to improve the room energy balance (which tends to augment the lower frequencies by a few dB or so). It is essentially well balanced as the reference response indicates, +/-3dB limits sufficing for a 33Hz to 19kHz range, even sinewave measured.

At 96dB distortion levels were very low throughout the range, typically around 0.4% and remaining well below 0.3% at 90dB. Fed 100W peak power pulses the system exhibited negligible compression at both 500Hz and 5kHz, while a mild 3.0% 3rd harmonic was recorded at the lower frequency; elsewhere the remaining measured harmonics were consistently low, which is indicative of a fine dynamic range.

With 500W peak power handling, the *150A* is capable of a half-filling 111dBA, and should satisfy all but the most insensitive disco fan. Room averaging showed an interesting interaction, with the 100Hz to 5kHz range exemplary at +/-2dB, although above 5kHz the rolloff should have been smoother and slower. Below 100Hz the strong low frequency output of this model produced an elevated response right down to 40Hz, and by implication a touch of low bass cut on an accompanying amplifier may be necessary in some situations.

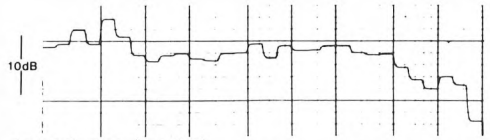
### Sound quality

The L150A continued to set a high subjective standard throughout the listening tests. On the live comparisons it showed some mild colorations, and was inferior in this respect to the smaller classic BBC designs; 'boxiness', 'nasality', slight 'sibilance' and 'hollowness' were all noted. But on the plus side the frequency balance was highly neutral, with a well-defined and crisp, clear rendition.

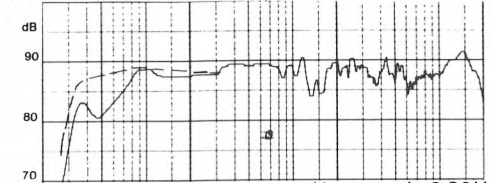
On stereo programme the speaker gave a 'big' sound, partly as a result of its physical height and its wide bandwidth. The bass was superbly clear and unusually extended, if slightly excessive, while 1000W of electric bass guitar was handled without knocking or distortion. Stereo imaging was to a good standard, with fine detail, well articulated vocals, and promising depth. Overall the effect was a trifle 'hard', which suited rock programme best, but results were impressive on all material, with plenty of information reproduced.

### Summary

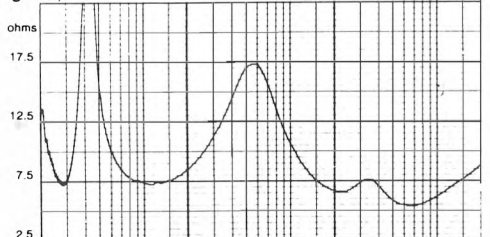
Continued refinements have helped to maintain the competitiveness of this model, and despite its high UK price it provides a sufficiently good standard of sound quality to deserve continued recommendation. Its particular merits include low distortion, a wide dynamic range and exceptional power handling, plus above average sensitivity, clear articulate sound with great bass extension, and an essentially neutral frequency balance. Finally the system is relatively easy to drive, and is superbly engineered and finished.



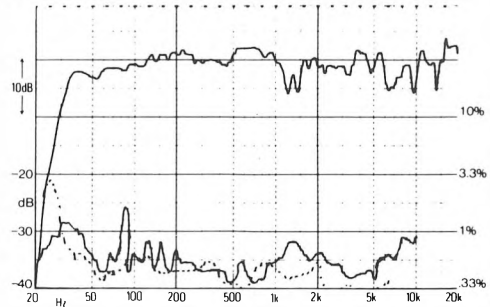
Impedance (mod Z).



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



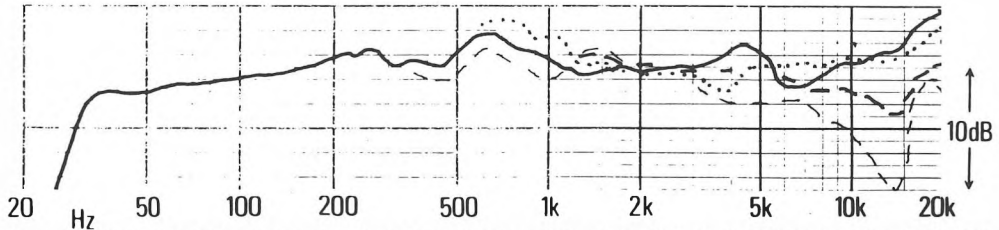
Averaged forward characteristic response in room at listening position.



Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion at 96dB.

### GENERAL DATA

Size (h x w x d) .....	105.4 x 43 x 33cm
Weight .....	36kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum) .....	(10)–500W
Recommended placement .....	on floor clear of walls
Frequency response within $\pm 3$ dB (2m) .....	35Hz to 18kHz
Low frequency rolloff ( $-6$ dB) at 1m .....	32Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	89dB/W
Approximate maximum sound level (pair at 2m) .....	111dBa
Impedance characteristic (ease of drive) .....	average
Forward response uniformity .....	very good
Typical price per pair inc VAT .....	£1000 when reviewed, now £1350



Forward characteristic response ( $1/3$ -octave @ 2m, solid axial, thick-dash  $30^\circ$  horiz, thin dash  $45^\circ$  horiz., dotted  $15^\circ$  vert.).

# JPW JP1

JPW Loudspeakers Ltd, PO Box 31, Plymouth, Devon PL1 1YH  
Tel (0752) 784284



Least expensive of a range of speakers designed and produced by a small UK company, the *JP1* is a standard-formula budget two way design. Selling for a modest £90, it is distinguished by a real wood veneer in a price category where most are vinyl coated. The cabinet is a 19 litre sealed-box enclosure, solidly constructed from 19mm chipboard, its interior lined with acoustic fibre. The 9mm thick grille panel is unrebated.

Bass is covered by a 200mm VIFA unit with a modest magnet, this fitted with a straight sided pulp cone. Treble is allotted to a second VIFA unit, this a 19mm polyamide soft dome, and a standard four element 12dB/octave crossover divides the signal electrically.

External finish is very good while the general specification suggests shelf or stand

mounting, the latter arrangement probably giving the best results in practice.

## Sound quality

The *JP1* scored below average on the tests but not too seriously so, in view of the modest price. Panel comments were mixed. Over and above a basically satisfactory sound, criticisms of a boxy and thickened effect were made, and while the bass was respectable it lacked real extension. The tonal balance was lightweight and the upper range showed some unevenness, varying in effect according to programme. Both a sharpness and a 'wirey' coloration were evident, and the upper treble was sometimes rather prominent. Stereo images were quite well focused but again, the depth effect was variable, with different programme. Sometimes it sounded OK, but on occasion, the sound was best described as more two dimensional.

## Lab report

Pair matching was very good, within  $\pm 0.3\text{dB}$  over the whole range. Reference sensitivity was high at a mean 90dB/W, and with a 100W power handling, a pair will be capable of 105dBA; even 15W amps will give quite decent sound levels. The  $-6\text{dB}$  bass rolloff came in at a typical 60Hz and despite the grille rebating, the dotted trace showed the significantly smoother response obtainable with grille removed.

Out at 2 metres, the smoothed output still showed some tendency to lumpiness, with a plateau around 1kHz and minor peaks at 15kHz. Nevertheless  $\pm 2\text{dB}$  limits sufficed for an 80Hz to 20kHz response. Driven to the 96dB sound level, requiring only a modest 4W input, the JPW distortion was about average at around 1% over most of the range. At the lower 86dB spl, third harmonic distortion reduced to the 0.3% level, while second remained much the same. Compression measured  $-1.4\text{dB}$ , poorer than average, but intermodulation was rather better, at  $-44\text{dB}$ .

From the impedance graph, the system resonance was seen at 88Hz. The impedance variation was small, averaging 7 ohms, with a small dip to 6 at 15kHz, which is pretty harmless. In view of the high sensitivity, this loudspeaker should not present any problems for any modern amplifiers.

The room-integrated response illustrated the

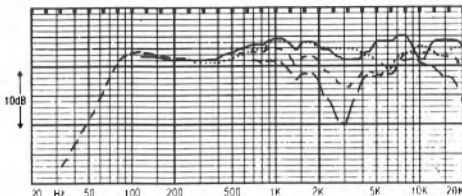
'lumpy' nature more clearly, with almost a three-humped response present with a forward midrange. The treble 'bites' a little at 5kHz and while the bass was fairly extended, it rolled away a little too soon. Realignment to 88dB plus better driver integration at crossover would help matters a lot here.

### Summary

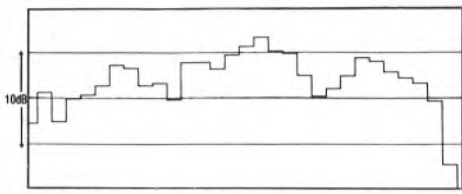
Despite the above discussion of its various character quirks, the *JP1* remains a well-crafted, well-finished speaker offering a good general performance, and the subjectiv ratings also suggest good value. It is both sensitive and easy to drive, thus qualifying for recommendation, though a personal audition is advisable, to see whether its tonal quality appeals to you.

### GENERAL DATA

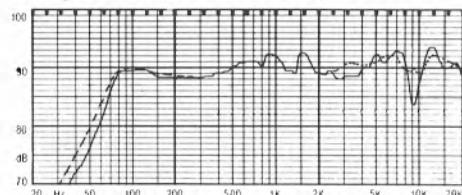
Size (height x width x depth).....44 x 26 x 26.5cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(10)–100W  
 Recommended placement.....on stands or shelf  
 Frequency response, within  $\pm 3$ dB at 2 metres.....65Hz–20kHz  
 Low frequency rolloff (–6dB point) at 1 metre......60Hz  
 Voltage sensitivity  
 (ref 2.83V or 1 watt into 8ohms at 1 metre).....90dB/W  
 Approximate maximum sound level (pair) at 2 metres.....105dBA  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good  
 Typical price per pair, including VAT.....£90



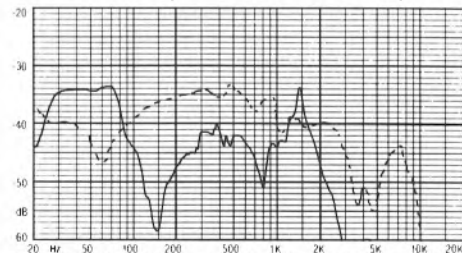
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



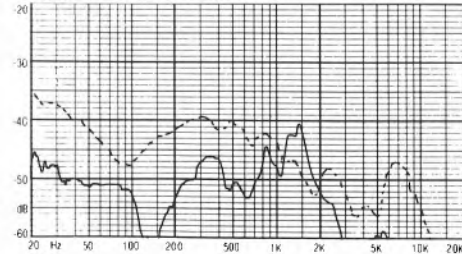
Averaged forward characteristic response in room



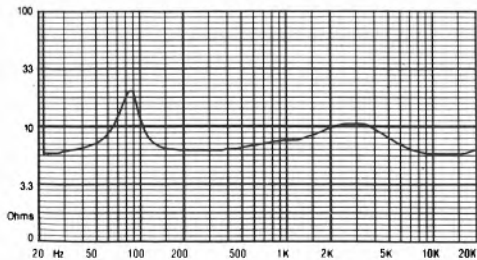
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

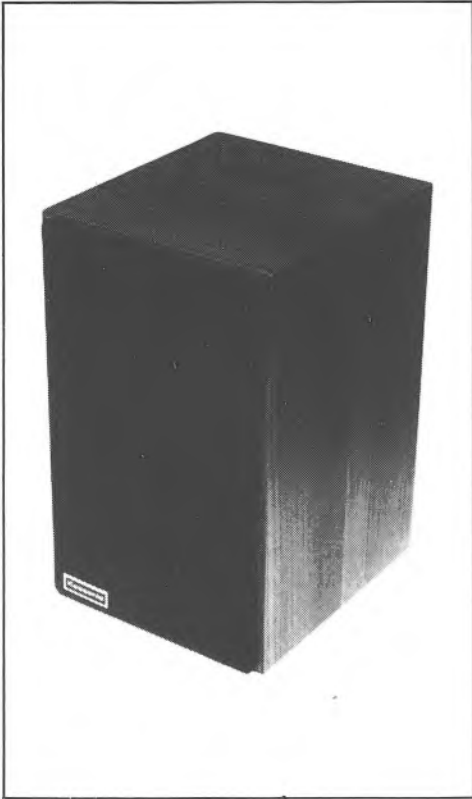


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Keesonic Kub

Keesonic  
Tel (0628) 35686

RECOMMENDED



This miniature speaker has been available for some years now and is still popular. We felt that it was time to look at a current pair again, and in the event, this proved a highly worthwhile exercise.

Apparently best suited to wall mounting, the *Kub* is rigidly constructed in chipboard and is well finished in real wood veneer on all surfaces. The internal volume is a diminutive 5litres, (*LS3/5a* size), reflex tuned to 40Hz by a rather too-small 35mm diameter port, whose duct runs to a 120mm length (not the preferred ratio). The grille is unrebated, but this does not upset the output, due to the large treble unit employed — an unlikely-looking 87mm flared paper/pulp cone tweeter. Bass and midrange are handled by an above-average long-throw 130mm pulp cone unit built on a die-cast chassis.

The crossover comprises seven elements, including two power resistors, and is of good

commercial quality, electrical connection for this speaker being via 4mm sockets on the back.

No panel damping is used or felt to be necessary but the cabinet interior is lined with acoustically absorbent plastic foam plus a volume filling of long-haired wool. Over the years the price has changed very little and the system is still available at around £82 a pair.

## Sound quality

Wall-mounted, facing ahead, that is not directed inwards (see axial and off axis curves) the *Kub* proved remarkably successful in pleasing the listening panel. It scored 'above average' which is very good for the price. Positive qualities included a fine level of clarity, transparency and detail, and it also sounded open and lively. Positioning inevitably affected the stereo presentation, but the image was still quite well focused with some depth.

Low bass was clearly missing, but the upper bass was present in good balance and could produce surprising levels on bass percussion. Upper-bass notes were felt to be sufficiently articulate and actually better than average.

On the minus side the treble had a distinctly breathy zingy quality — even a scratchy effect — which was emphasised on poor programme. Nonetheless the panel score sheets clearly showed that some listeners were fooled into thinking that the *Kub* was much larger than it really was.

## Lab results

Examined for pair matching the treble level on one speaker was 1.5dB more than the other — a greater difference than I would like but still satisfactory at the price. Average sensitivity was a little below the norm at 85dB/W, but it proved capable of withstanding considerable power inputs with a sensible 75W maximum allowing quite good sound levels of up to 99dBA from a pair. The reference response gave a -6dB rolloff at a modest 63Hz.

At 2metres, the response showed some lumpiness notably a 3-4dB treble upward shelf, also heard on the auditioning. Forward integration was quite good at angles up to 30° off-axis and began to fail more quickly in the treble at 45°. A 30° off-axis listening position gave the best overall result, typified in use by somewhat over-wide wall-mounted positioning, beaming straight ahead.

Measured at 96dB the *Kub* (not unexpectedly) produced some distortion peaking at 9%



second harmonic at 150Hz and 3% at 10kHz, with third harmonic somewhat better. Fortunately a reduction in level to 86dB resulted in a major improvement and so overall, the distortion performance here was quite satisfactory.

Room averaged, the response showed some lumpiness but a tolerably good balance. The treble should not rise as it does here towards 12kHz, and it also falls away too suddenly above this. Reasonable bass was available down to 50Hz in the room, the low frequency irregularity being typical of wall mounting.

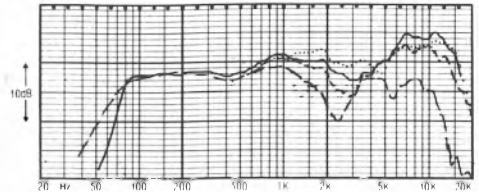
The *Kub's* impedance averaged 10ohms with a minor dip to 5.6ohms at 14kHz, thus rating as a good amplifier load.

### Summary

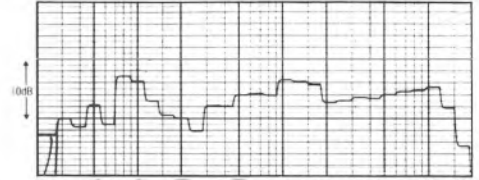
Against the latest introductions, the *Kub* faces some strong competition, but is still recommended in this issue. It packs a surprisingly clean and detailed punch, with a pleasing tonal quality, and it offers unobtrusive wall mounting. The treble is its weak area, and bright pickup cartridges should be avoided with this speaker. With a 'rounded' cartridge characteristic and a clean tuner or digital programme, this small loudspeaker can perform surprisingly well.

### GENERAL DATA

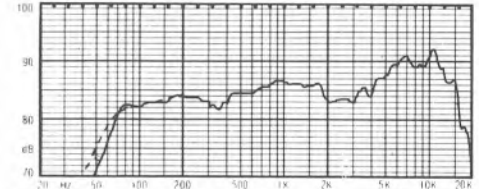
Size (height x width x depth).....	29 x 18 x 21cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(10) – 75W
Recommended placement.....	shelf
Frequency response, within $\pm 3$ dB, at 2 metres.....	80Hz to 6kHz
Low frequency roll off ( $-6$ dB point) at 1 metre.....	63Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre.....)	85dB/W
Approximate maximum sound level (pair) at 2 metres.....	99dB
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	fair
Typical price per pair, inc VAT.....	£82 when reviewed, now £89



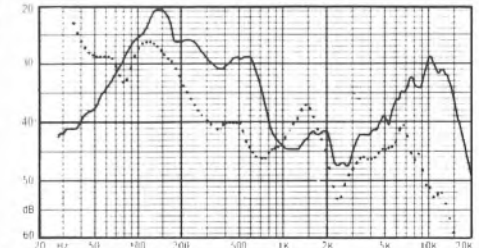
Forward characteristic response ( $1/2$  octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral).



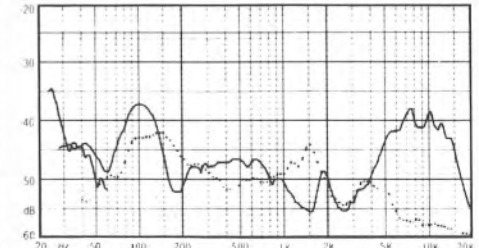
Averaged forward characteristic response in room at listening position.



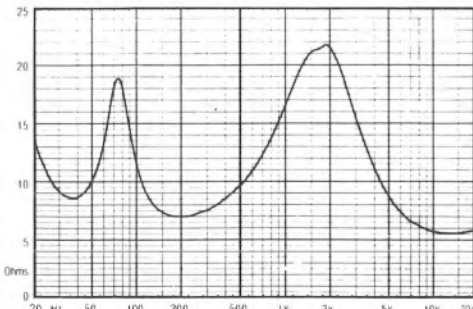
Reference sine wave response (1m on axis, 2.83V input shows sensitivity) Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading

# KEF Chorale III

KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



This miniature system is a sealed box design of just 9.5 litres internal volume. The 170mm steel-framed bass unit has a doped pulp cone with a critical flare, energised by a substantial magnet. A total of five elements are used in the good-quality crossover, this also using two attenuating resistors. Treble is handled by the KEF-Matsushita 25mm fabric dome.

Rigidly constructed in 15mm chipboard, the cabinet is finished in a restrained 'walnut' vinyl. Internally, the panels are double grooved to disperse the dominant resonant modes, and clip-on internal wiring is used. However, good quality 4mm socket/binding posts are employed for electrical connection to the system amplifier at the rear.

The grille is built using a 12mm thick unrebated panel, and is probably better left off for critical listening, a finding which indeed was confirmed by the lab results.

## Sound quality

The *Chorale* did comparatively well in the listening tests, scoring a little below average, this a fine result for its price category.

The marks were decent, but the panel was nonetheless fairly critical of certain aspects of the sound. They correctly identified it as a small box with a lack of real bass as well as a rather lightweight acoustic. Some 'boxy' and 'nasal' coloration was evident, and it was not very successful in conveying space or depth ambience in the stereo image; conversely, frontal focus was good and the speaker sounded open and clear.

Driven to high levels, the sound hardened, while the bass, none too explicit anyway, became softer, attenuated and without detail. Hard rock did not really suit it and 40-50W is probably a realistic maximum input.

## Lab report

The reference response indicated a 86.5dB sensitivity, which was just average. The -6dB bass rolloff was at 66Hz, again about average for the size. The dotted line on the reference response clearly shows the improvement to be gained by removing the grille, in particular as regards the 2kHz to 10kHz range. Grille off, it met  $\pm 2$ dB limits from 90Hz to 20kHz but with evidence of a premature rolloff at low frequencies. Pair matching was extraordinary, to within  $\pm 0.3$ dB overall!

Out at 2 metres, the speaker displayed an excellent set of off-axis responses, a model for any competent two way design. The output was highly uniform, and defied criticism, except in respect of the bass rolloff.

Working hard at a 96dB sound pressure level, the low frequency distortion averaged 2% but was pretty good at around 0.3%, mid to treble. By 86dB it had improved considerably and the speaker was quite clean when not overloaded. The 20W at 40Hz test clearly did overload it, with a 3.3dB compression, though the intermodulation product remained good at -40dB.

Impedance did not fall below 6.6 ohms, and the *Chorale* therefore offers a straightforward 8 ohm amplifier loading. System resonance was shown at 84Hz with the room averaged response confirming the shy bass, where a 200-500Hz plateau added to the 'boxiness' we noted. Above 1.6kHz, the output was well controlled, however.

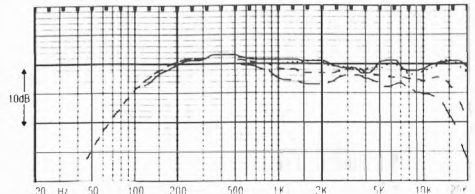
## Summary

This neat little speaker cannot quite overcome its small dimensions and yet it manages to provide a smooth uniform sound of respectable quality. It suited classical programme more than it did rock, though its clear and open character was evident on both types of material.

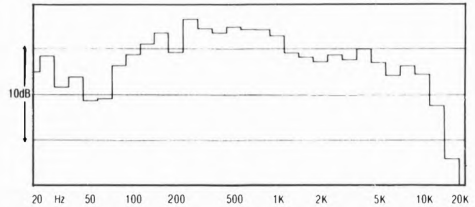
The moderate sensitivity and power handling both suggest maximum levels of 98dB, which is enough for many purposes, and this together with the modest price and good build quality, means that the *Chorale* qualifies as a Best Buy.

### GENERAL DATA

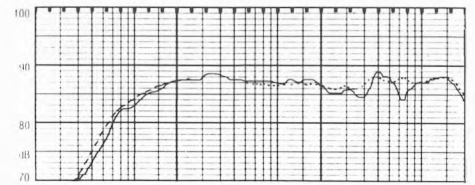
Size (height x width x depth).....	37 x 22 x 18.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(15)—50W
Recommended placement.....	on open stands or shelf
Frequency response, within $\pm 3$ dB at 2 metres.....	80Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	66Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	86.5dB/W
Approximate maximum sound level (pair) at 2 metres.....	98dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	excellent
Typical price per pair, including VAT.....	£85



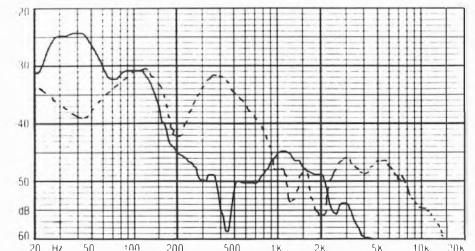
Forward characteristic response (1/2 octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral).



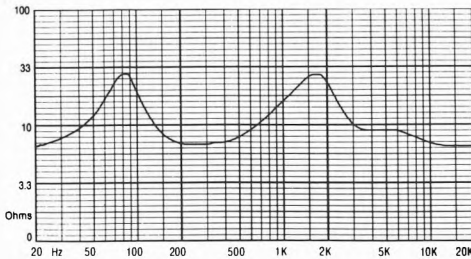
Averaged forward characteristic response in room



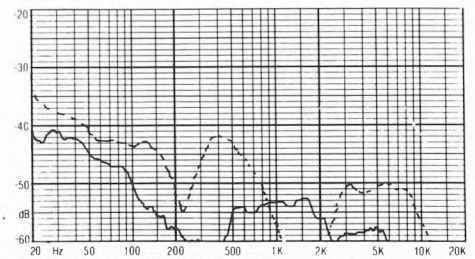
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

# KEF Coda III

KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



Just squeezed into the last issue on the basis of a late audition, the current *Coda* is here given a full review. This popular budget speaker has a 19 litre enclosure and comprises a compact two way built from plain 15mm chipboard, vinyl finished. The interior panels are vertically grooved to about  $\frac{1}{2}$  the panel thickness which helps to distribute the main resonance, reducing its 'Q' value.

The bass unit is a 210mm steel-frame driver fitted with a flared, doped pulp cone, energised by a moderate magnet. Made especially for KEF by Matsushita, the tweeter has a 25mm soft fabric dome impregnated with a damping compound, and a 12dB/octave four element crossover marries the two drivers at 3kHz. A series 450 $\mu$ F capacitor is also used to tune the bass to a third order sealed box low frequency alignment.

The grille baffle is an unrebated 12mm thick

panel, and from critical listening it is better detached, while use on open stands will also improve matters. Electrical connection is by means of 4mm socket/binding posts.

## Sound quality

The *Coda III* did well, scoring above average despite its modest price. Indeed the consistently good *Coda* results would seem to be something of an embarrassment for KEF's other product here reviewed!

First of all, it sounded smooth and well balanced, which is a good start. Fair bass extension was present and the bass was also quite detailed, if lacking in ultimate articulation. The mid was sweet enough with some boxiness and a 'paper' quality noted on occasion, with certain vocal tracks. Treble was unobtrusive, but could ring clearly on cymbals and triangle. Here the output emphasised the extreme treble, with less of the fundamental.

Stereo focus was fine with fair depth, this apparently limited by a degree of hollow and boxy coloration — by no means serious at the price. Up to 150W was handled well, with 100W representing a fair maximum power rating.

## Lab report

Pair matching was very good,  $\pm 0.5$ dB or better over the frequency range. Reference sensitivity averaged 88dB/W, which was a little above average and with a 100W maximum capacity, sound levels of 103dB were provided from a stereo pair.

Out at 2 metres the family of forward responses looked very tidy, while the axial curve was most uniform. In fact,  $\pm 1.5$ dB sufficed for a 75Hz to 20kHz frequency range (grille off). A good tonal balance was shown.

Driven to 96dB sound pressure level, the distortion results were respectable with third harmonic under good control, and were at 1% or less above 100Hz. At 86dB, the distortion levels were improved, especially third harmonic which showed only a mild peak around 1-2kHz. 1.5dB of compression was apparent at 20W – 40Hz, which was mild, while the intermodulation product was better than –40dB. There was no problem with the load characteristic; never falling below 6 ohms, the impedance essentially met an 8 ohm standard, and will not upset a modern amplifier.

The computed room response showed the fine balance of this design, really good for 40Hz

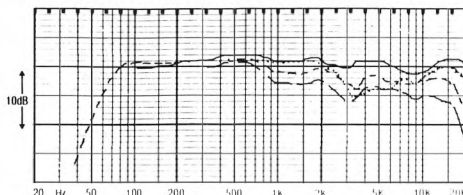
to 1.6kHz, and depressed a little in the presence range; a characteristic which was noted on audition. It was fairly tidy at higher frequencies. The bass rolled off below 40Hz and, interestingly, I believe the panel were aware of this during the auditioning.

### Summary

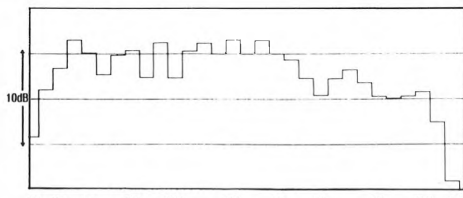
KEF have clearly maintained the *Coda's* performance standard and have continued to build a neutral well balanced speaker, which is easy on the ears and on the pocket. Distortion is moderate, loading easy and the sensitivity a little above average. It represents fine value for money and is confidently awarded Best Buy status.

### GENERAL DATA

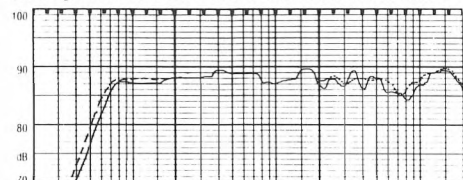
Size (height x width x depth).....	47 x 28 x 21cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(15)—150W
Recommended placement.....	open stands
Frequency response, within $\pm 3$ dB at 2 metres.....	63Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	88dB/W
Approximate maximum sound level (pair) at 2 metres.....	103dBa
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair, including VAT.....	£105



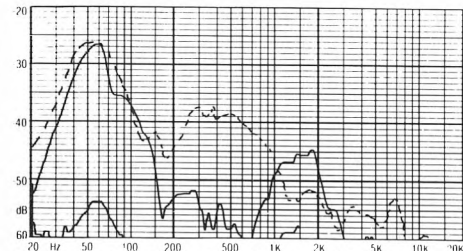
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° lateral, small dash 30° lateral, long dash 45° lateral).



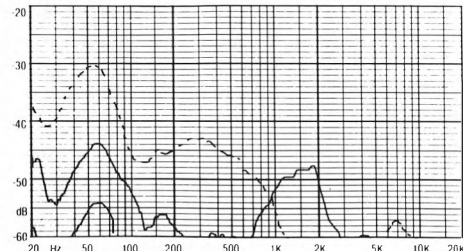
Averaged forward characteristic response in room



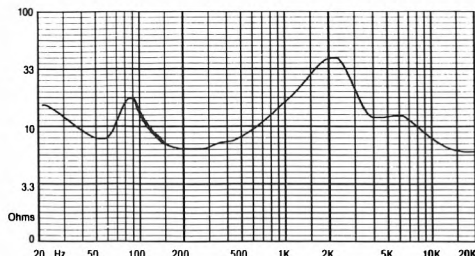
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



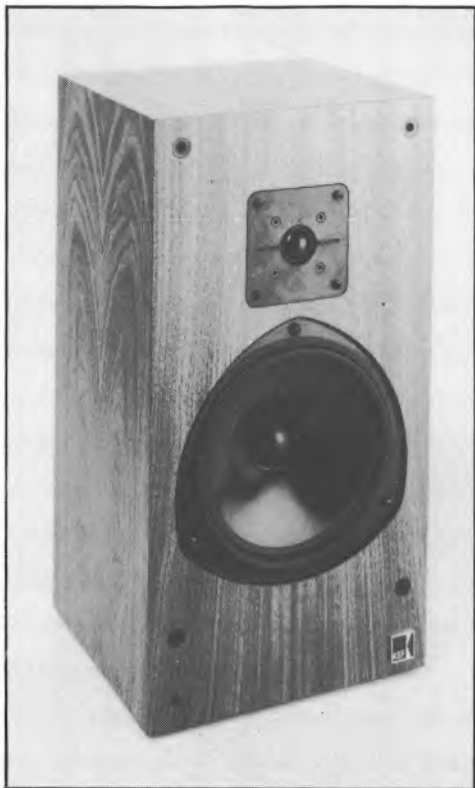
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# KEF 103.2

KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6QP  
Tel (0622) 672261



When originally reviewed some four years ago, the KEF 103 was priced at around £255, and even now sells at under £300. This compact member of KEF's 'Reference Series' was a 'Best Buy' in 1980, but the passage of time has now made the earlier review obsolete.

The R103.2 comprises a 19 litre two way compact, equipped with the S-STOP electronic overload protection system. Bass is handled by a Bextrene-coned KEF driver of 210mm frame size, the latter a pressed steel trochoid, allowing a balanced three point mounting to be used. A decoupling system is employed in the mounting, to reduce driver-induced cabinet resonances. Treble is handled by a KEF 25mm fabric dome, treated with a damping compound.

A complex 14 element crossover is employed, with high quality components, including a series tuning capacitor for the bass

alignment, which is third order sealed box. The enclosure includes treatment to reduce coloration and to some degree this speaker can be seen as occupying the same position in the KEF range as the SL6 does in Celestion's.

## Sound quality

Scoring around the average mark on the panel listening tests, the 103 displayed the hallmarks of a 'reference' model in that the tonal quality was natural and well balanced, proving even-handed on all the programme we tried. The sound was essentially 'open' and free from coloration, and it appeared quite detailed, with pretty good extension at the frequency extremes. It handled high power inputs very gracefully, and a 200W rating is not unreasonable, in view of this.

In the end, though, the speaker did prove a little frustrating, as the panelists struggled to put into words at certain aspects of the sound. It seemed to blur transient edges and mask fine detail, while the bass lacked true attack and tune-playing ability. The treble was also a touch 'lispy' and 'wispy', lacking a clear sharp ringing on the right instruments. These aspects more than anything else depressed the scoring; its reproduction appeared 'soft' though 'hardness' is not what was required to remedy the problem.

## Lab report

Reference sensitivity was much as before at a mean of 86dB/W which is a little below average. Pair matching was pretty good but not as good as previously; in the crossover region,  $\pm 3$ dB variations were noted. The grille was a good one, as it only marginally affected the axial response. Interestingly, it had a mild effect down to 500Hz. The bass extreme was fine,  $-6$ dB at 46Hz which is good for the size. The response is a touch 'rich' and was gently downtilted much like the SL6. With the 103,  $\pm 3$ dB limits sufficed for a 50Hz to 20kHz range. Out at 2 metres, a tidy set of off-axis traces were obtained. The above axis dip was mild, near the crossover point but suggests that the speaker should aim at the listener, preferably on a high stand.

Driven to 96dB sound level, the distortion was well controlled, typically 0.3% at mid and high frequencies and it was also good in the bass. Bar a little 3rd harmonic at 1kHz, distortion at the 86dB sound level was very

good throughout. The speaker also coped well on compression, with 1.3dB loss while the intermodulation product was fine at -40dB.

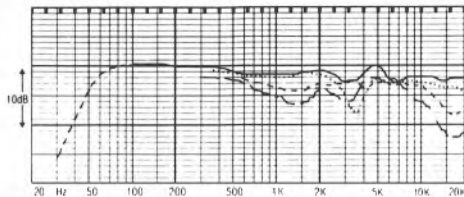
Conforming comfortably to the 8 ohms standard the 103 was considered an easy amplifier load. Sound levels of up to 104dB should be possible from a stereo pair. When room averaged the speaker's output was well extended, if slightly 'rich' at 50Hz, and showed a mild energy peak at 14kHz. However the balance was good and the mid particularly smooth.

**Summary**

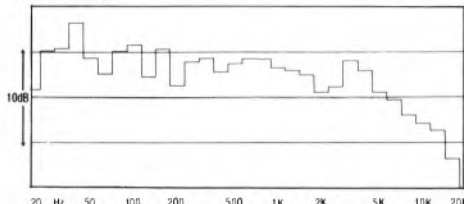
The 103 remains a competent, neutral performer possessing an extended response, low distortion and fine power handling. It works well on all types of programme, and is both well constructed and finished. Newly assessed for this issue, it lacked some of the 'see through' quality, as well as the attack and precision, of more recent speaker designs, and for the majority of the panelists, it proved rather 'bland' and 'uninvolving'. It is certainly one of the better examples in its price category, but this is not enough for recommendation.

**GENERAL DATA**

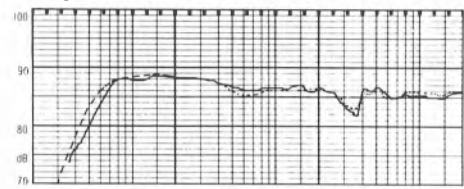
Size (height x width x depth).....	50.5 x 26.5 x 25cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(20)—200W
Recommended placement.....	open stands
Frequency response, within ±3dB at 2 metres.....	50Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	46Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	86dB/W
Approximate maximum sound level (pair) at 2 metres.....	104dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair, including VAT.....	£299



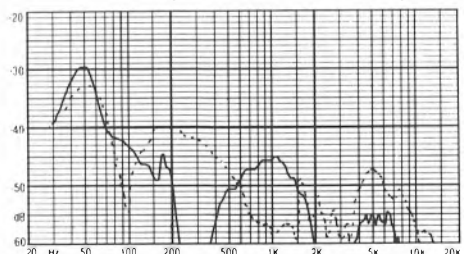
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



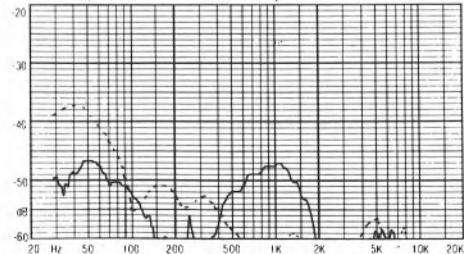
Averaged forward characteristic response in room



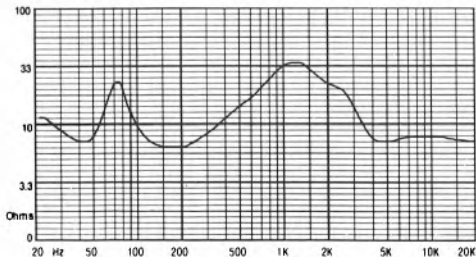
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



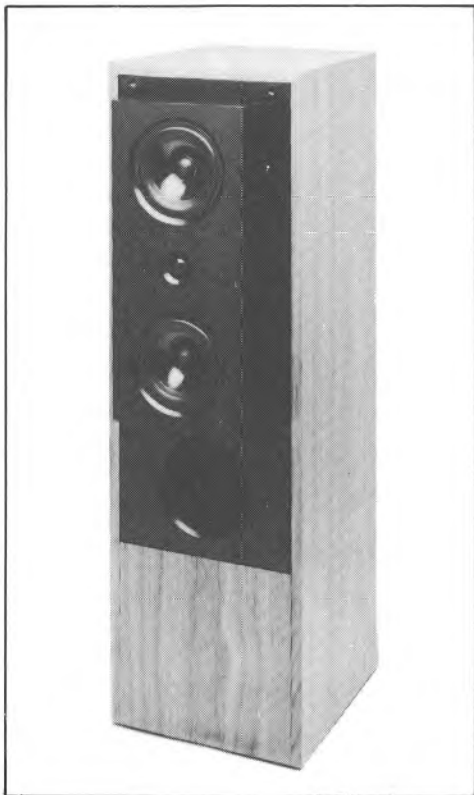
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# KEF 104.2

KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6OP  
Tel (0622) 672261



Nearly ten years ago, the original KEF 104 was a runaway success, and it was first favourably reviewed in 104 AB form by HFC in 1976. The new 104, though, is radically different to the old — even if, bearing inflation in mind, the present price of around £600 is not all that different.

A complex new speaker of very advanced design, the 104.2 uses a total of five drivers. Within the enclosure are located two 200mm pulp cone bass units, these back loaded by sealed chambers. Their frontal output feeds a damped central chamber, which is fitted with a large diameter, high velocity port, the effect being that of a second-order resonant circuit with a 12dB/octave rolloff below bass resonance. The port continues to transmit output above resonance, right up to the lower crossover frequency of 150Hz. From 150Hz to 3kHz or so, two 110mm Bextrene cone

midrange units operate in parallel, these mounted above and below the 25mm soft dome treble unit, which is ferro-fluid damped.

The enclosure is extremely rigid and well damped, with a low acoustic output and the system employs a very complex crossover with full compensation for input impedance. The assembly reflects a 4 ohm resistive load, optimally matched to modern amplifiers. Floor mounted, ideally on the piercing spikes provided, the slim Boothroyd styled cabinet is finished in natural veneer.

## Sound quality

While the design promised much, the particular exposition and balance offered by the 104 did not seem to appeal to the listening panel. Designed to play loud, it could handle up to 200W programme, beyond which it sounded painfully loud, as well as somewhat hard and aggressive.

It showed many good qualities, among them dry quick transients, very good stereo focus with fairly good depth, much fine instrumental detail and considerable clarity in the midrange. Conversely, it had a slightly odd bass quality which reduced its ability to differentiate between bass sounds, nor was the bass subjectively well extended. The treble was of generally good quality but the mid showed a significant forwardness, which compressed depth and gave a hardened, thinned quality to the tonal balance. Ultimately the panel found this wearing, despite the explicit detail and exciting 'punch' offered overall.

## Lab report

Pair matching was very good at better than  $\pm 0.75\text{dB}$  while the reference mid band sensitivity met the high specification at 92dB/W, albeit for a 4 ohm system on an 8 ohm 'watt'. The grille is best left on and is properly integrated acoustically. The main mid octave showed a 2dB lift over the lower frequency range while the -6dB point registered a modest 50Hz. Out at 2 metres the forward response family looked very tidy, while the '15° above' response indicated the the cabinet axis should be directed at the listener. Tight  $\pm 2\text{dB}$  limits sufficed for a 65Hz to 20kHz axial response, though some band to band imbalances were suggested. KEF's distortion specification was a touch optimistic in extending to 20Hz, but actually the 104 did offer low levels of distortion over the entire



range. On compression, we noted an excellent 0.11dB while the intermodulation product was negligible, since the 400Hz signature tone appeared above the crossover point.

The room-averaged curve showed agreement with the panel comments, and suggested a mild 'three humped' characteristic at 50Hz, 500Hz and 4kHz. Overall it was quite well integrated with the room, showing better bass extension than the panel noted, this perhaps due to the tonal balance of the design. The energy output certainly was on the forward side in the upper midrange.

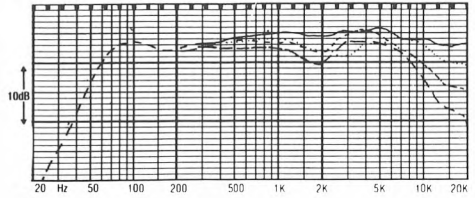
As claimed, the impedance was almost perfectly flat reflecting a uniform 4 ohm resistance, and uncritical of most amplifiers or cable type. For extended high power drive, 4 ohm rated amplifiers are a sensible choice.

**Summary**

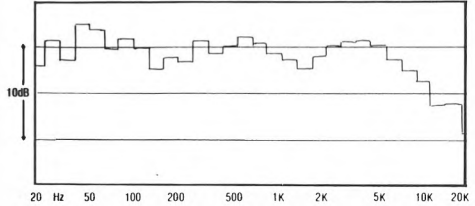
There is no question that, for us at least, the new 104 was a subjective disappointment. The scores do not justify recommendation despite the obvious and substantial design and engineering effort which has gone into the product. A 'different' KEF, the 104 is very sensitive, plays tight and loud and also offers low distortion as well as good stereo focus. If an 'upfront' immediate clarity is high on your list it could be worth trying, but if classic perspectives, good stereo depth and a neutral tonal balance are required, on a wide range of programme, then possibly it will fail to satisfy.

**GENERAL DATA**

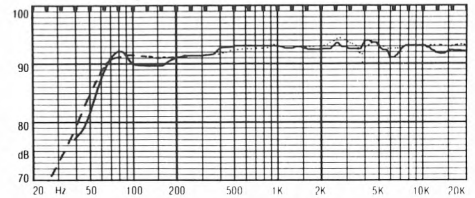
- Size (height x width x depth).....90 x 28 x 41.5cm
- Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....(10)—200W
- Recommended placement.....floor, away from side walls
- Frequency response, within ±3dB at 2 metres.....60Hz-20kHz
- Low frequency rolloff (- 6dB point) at 1 metre.....50Hz
- Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....92dB/W
- Approximate maximum sound level (pair) at 2 metres.....110dBA
- Impedance characteristic (ease of drive).....an easy 4 ohm load
- Forward response uniformity.....very good
- Typical price per pair, including VAT.....£599



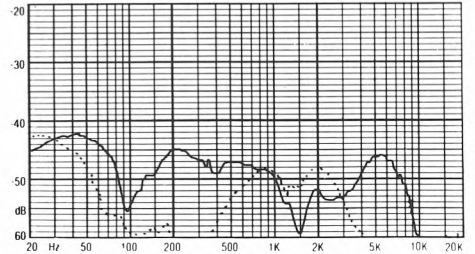
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



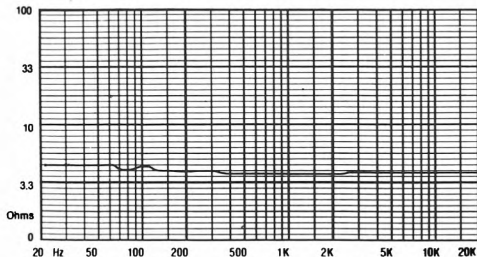
Averaged forward characteristic response in room



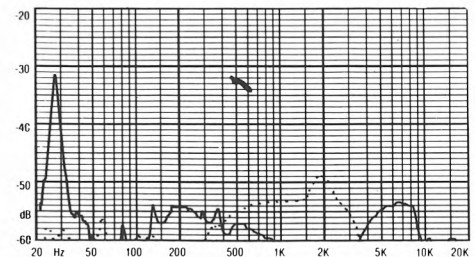
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



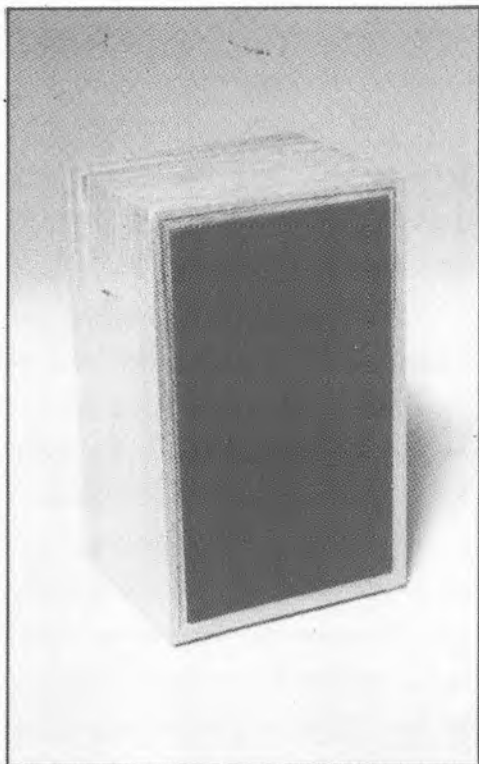
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Linn Kan

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



Originally designed using LS3/5A enclosure dimensions, the *Kan* looks superficially similar to this model, and in fact uses a Linn-modified version of the same long established B110 bass/mid driver, together with Linn's choice of tweeter, in this case a version of the Scan 19mm fabric dome unit.

Once inside the enclosure, the differences between this and the LS3/5A become more apparent. The *Kan* cabinet is made of high density chipboard containing about 5 litres of air, tuning the system to a low frequency resonance at 74Hz (rather high for a full-range system). The B110 has small damping pads on its frame, and the enclosure is also clad in bituminous panels as well as fibreboard. Extensive sealing on frames and panels ensures an airtight fit, and to avoid interference by owners (or indeed reviewers) even the front grilles are tightly glued into position. A high power six-element crossover completes the system.

With product as musical and as contentious as Linn's, it is necessary to try to come to terms with the system's philosophy, as well as the individual product. Their disc-centred approach excludes tape, broadcast or digital replay, but they justifiably argue that the analogue LP disc will remain the prime source of programme for the domestic market for some time to come, and that its reproduction should be optimised before all else. Accordingly, as the *Kan* has in the main been designed to complement the Linn record playing system, so its priorities may be expected to conflict somewhat with our objectives of natural stereo and a highly neutral tonal balance. This review therefore follows two paths: first the *Kan* was fully tested and auditioned just like any other model, including blind trials in both stand and wall mounted locations; secondly, its ability to reproduce records was subjectively assessed using some of the key elements of a Linn system (*IttoK/Asak/LP12/mat*).

## Lab performance

Nominally designed for wall location like the *Sara* and the *Isobarik*, the reference curve at 1m showed this clearly, with a step of some 5dB between the bass and the upper range, which is somewhat in excess of what is theoretically required. It was difficult to pin down the sensitivity but the curve shape suggested that a surprisingly high 87dB/W corresponded to the aural effect; this is 6dB greater than for the LS3/5A, which is equalised to flatness from 100Hz. The response was smooth but not uniform, the mid being elevated by 2-3dB from 600Hz-2.5kHz, whereas the -6dB rolloff between 70 and 90Hz (depending on location) means that low bass was entirely absent.

With an approximate wall correction shaded in (the greatest lift occurring with positioning near the side walls) the characteristic response looked very uniform, although the mid was still prominent. The 15° above response was superior to the axial curve, so the system should be mounted a little below ear level. As the off-axis curves were free field generated, they will not fully represent the equivalent response against a wall. The room averaged response brought us closer to the truth, and was plotted for both wall and stand mounting. Fine above 1.5kHz, the curves showed a potentially serious prominence 400Hz-1kHz, plus a deficient low-mid to bass region, which was unacceptably poor in the stand position. Even on the wall the 100Hz region was 8dB below the midrange, and it will be very difficult for any perceptive listener to fail to

notice such a serious balance problem. Rated as an 'average' load, the impedance dipped to 4.5 ohms, 3.6kHz, and may need some care in amplifier choice.

On distortion the *Kan* proved outstanding for its size. Just showing overload at 500Hz, 100W, the compression was satisfactory at 0.4dB, with 10.0% 2nd, 1.0% 3rd and 0.3% 5th. At 5kHz it was fine, giving 0.2dB loss with 2.6% 2nd and 0.3% 3rd. Steady state distortion was low even at 96dB, where it was mainly second harmonic. The genuine 100W power capacity meant that high sound levels of 103dBA can be achieved from a pair, and the dynamic range was certainly very good on technical grounds.

### Sound quality

Discussing the standard tests first, the system was unacceptable when stand-mounted, as the lab tests indicated. Wall-mounted (no bookcase) it showed more promise, but was still strongly criticised for its unusual balance, the midrange prominence dominating the reproduction of nearly all material. On the live comparisons it was described as 'cuppy', 'thin', 'hard', with a 'ringing' midrange and a slight lack of treble. On the plus side, it sounded 'sharp' and 'lively' on mid transients, which was not unexpected.

Results were also disappointing on the stereo sessions. Grand piano took on a 'tinkly' 'bar room' character, bass was sadly deficient, and the stereo image lacked depth, being spread wide with much less focus than usual on programmes we knew well. It did however withstand surprising amounts of power without distortion, and gave a high level of musical detail, as well as sounding very 'transparent'.

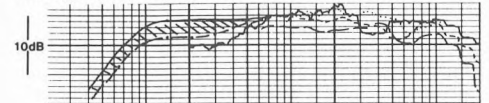
On the special tests with Linn sources the balance did improve a little, and I suspect that a listener impressed by the loudness and clarity of such a small box might well like it enough to buy. With careful choice of programme one can achieve an exciting effect, but the panel still felt that the *Kan* deviated too far from accepted standards of tonal and balance accuracy.

### Summary

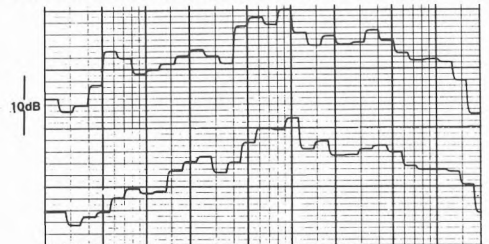
Activation of the *Kan* is now possible (for example using A&R units) and the speaker has undergone some further development since the original review was carried out. Essentially however the performance and design is unchanged, but a small, beneficial improvement has been made to the midrange which is now somewhat 'fuller' and better balanced than before. While still not recommended by *HFC*, the *Kan* is worth considering as an ultra-compact design capable of surprising clarity, loudness and dynamic range, together with reasonable bass, and if excitement matters more than absolute accuracy then this could be the speaker for you.

### GENERAL DATA

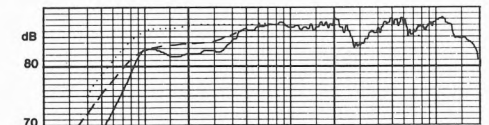
Size (h x w x d) .....	30.5 x 19 x 16.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	(15)-100W
Recommended placement .....	against clear wall, at or below listener axis
Frequency response within $\pm 3$ dB (2m) .....	130Hz to 16kHz*
Low frequency rolloff (-6dB) at 1m .....	approx 70Hz*
Voltage sensitivity - (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	88dB/W
Approximate maximum sound level (pair at 2m) .....	103dBA
Impedance characteristic (ease of drive) .....	average
Forward response uniformity .....	very good
Typical price per pair inc VAT .....	£190
*with approx wall correction	



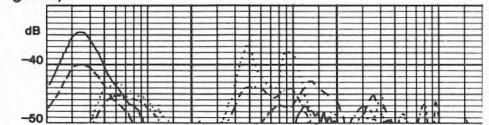
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral). Shading shows possible LF reinforcement of wall mounting.



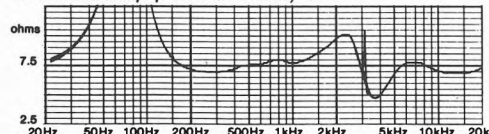
Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



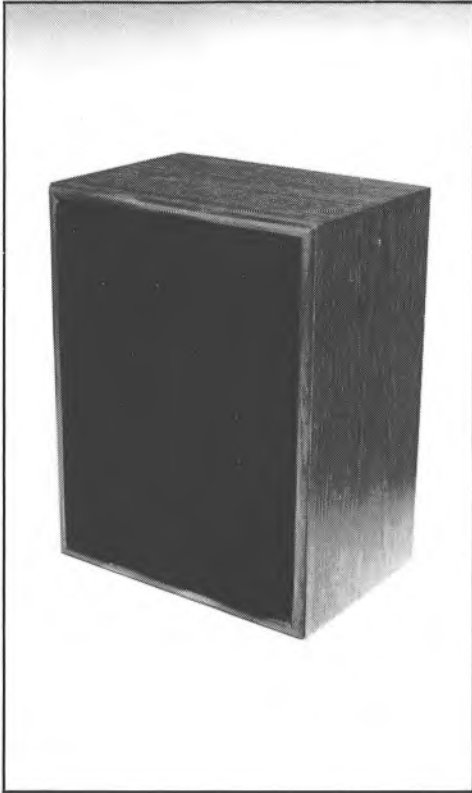
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB.



Impedance (mod Z).

# Linn Sara

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



Since its release a few years ago, the Linn *Sara* has been subject to a certain amount of internal revision and updating and is reviewed here in its latest form.

Almost 'miniature' sized and just 24cm deep, the *Sara* is a compact 20 litre sealed box speaker with two normally-mounted drivers. These comprise a modified KEF B200 200mm Bextrene coned unit working from bass to midrange, partnered by Linn's favourite tweeter, a version of the 19mm doped fabric dome Scan unit. In addition to these two units each enclosure contains a second B200 mounted in a rigid frame immediately behind the first operating electrically in parallel; in simple terms the assembly forms a higher mass, lower-system-resonance bass unit. For a given enclosure size, deeper bass and lower distortion can be expected, but at the expense the impedance, which is halved in value.

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As befits a speaker at this price level the *Sara* is excellently constructed. The enclosure is built from teak-veneered MDF which is damped, lined, braced and volume filled. A good-quality crossover comprising 16 elements, this including some resistors, is used to marry the drivers at approximately 3kHz.

This speaker is intended to be used on rigid steel-framed stands as close to the rear wall as the normal depth XLR connector plugs will allow, and the sound is generally adjusted for that position. A sensible foam grille is used.

### Sound quality

It was believed, as it turned out with good reason, that the *Sara* is at least partially optimised for analogue disc playing systems and it certainly proved worthwhile running separate auditioning sessions using a Linn based disc player.

On digital material the *Sara* achieved an 'average' score which was nothing very special in view of its price — this being double the group average. The bass sounded too heavy, particularly in the upper range, although good extension was apparent. The mid portrayed percussion and transients well, but lent a thinned quality to some sounds notably piano and voice. Treble quality was generally good, with fine detail and harmonic shaping evident. Stereo also showed an above average depth for a wall mounting model while central focus and staging were also better than we expected.

Nonetheless, the *Sara* improved noticeably when used with the Linn-based disc system, providing a more musical and realistic effect, although elements of its basic character were still apparent on occasion.

### Lab results

Measured at 1 metre the *Sara* demonstrated good pair matching showing a mean sensitivity of 87.5dB/W which was a little above average — but this result was a trifle prejudiced by the lower than average impedance. The *Sara* is essentially a 4ohm design with dips to 3.2ohms noted in several places, making the speaker quite a severe amplifier load. This does however represent a significant improvement over earlier *Saras*. Bass rolloff, -6dB, measured 42Hz which was well extended for the size.

Maximum power capacity is 100W and level of up to 103dBa were possible, with 25W representing a realistic minimum input power per channel.

At 2metres the characteristic midrange

response problem was clearly seen, some 2-3dB above the general level. Below axis it was better than above (4kHz dotted line notch corresponds to 15° above) so Linn's high stand design makes sense with this model. Overall the forward responses were quite good, though somewhat uneven.

Measured at 96dB sound level, the third harmonic distortion rose quite rapidly at the lower frequencies but was satisfactory elsewhere. Second harmonic remained at fairly low levels, peaking at 3%, 450Hz and 10kHz.

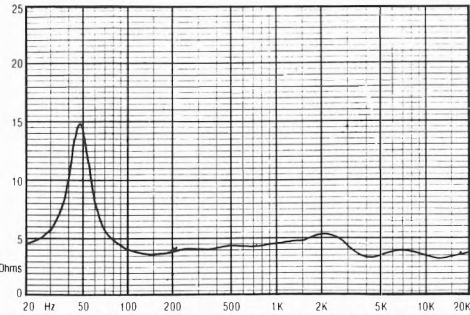
For interest's sake the computed room curve was run with open space as well near-to-wall positioning, the former giving the smoother result, although the latter was in fact better balanced especially around 100Hz.

### Summary

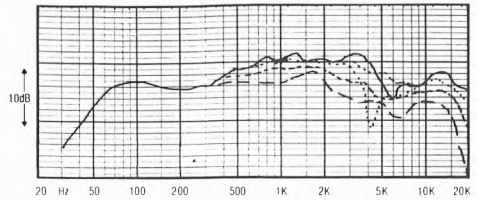
This speaker is an unusual blend of strengths and idiosyncracies. It does not present very good value, and cannot be recommended in the HFC context, particularly if predominantly digital programme is to be used. Conversely it provided a most interesting and generally 'involving' performance with vinyl disc sources, especially when these were Linn derived, and hence it cannot be dismissed out of hand. It is certainly worthy of trial but considerable care will be needed in the choice of matching amplifier source and in room location.

### GENERAL DATA

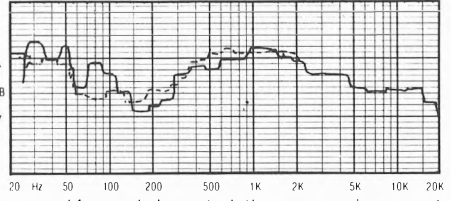
Size (height x width x depth) ..... 43 x 34 x 24cm  
 Recommended amplifier power per channel  
 (for 96dBA minimum per pair at 2 metres) ..... (25)—100W  
 Recommended placement ..... wall stands  
 Frequency response, within ± 3dB, at 2 metres ..... 60Hz to 20kHz  
 Low frequency rolloff (− 6dB point) at 1 metre ..... 42Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 87.5dB/W  
 Approximate maximum sound level (pair) at 2 metres. .... 105dBA  
 Impedance characteristic (ease of drive) ..... severe  
 Forward response uniformity ..... very good  
 Typical price per pair, inc VAT ..... £552



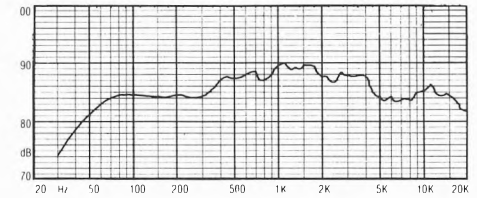
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



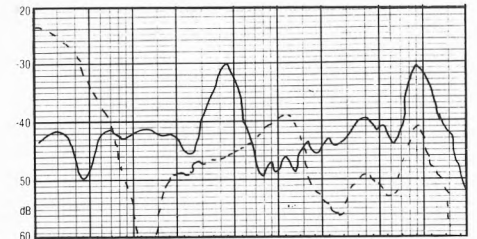
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



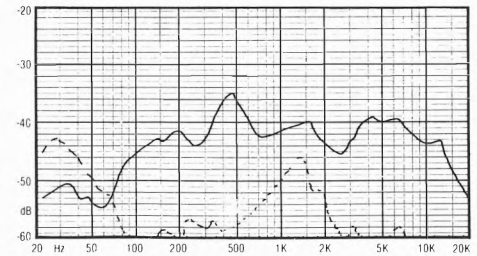
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Magneplanar MG3

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



Quite the largest and most expensive model in this survey, the *MG3* is a recent, high level introduction to the US-made Magneplanar range of open-back planar speakers. Its recent claim to distinction is the incorporation of a tweeter forming a line source almost the full height of the speaker, nearly two metres. The tweeter and the other panel elements are 1.5 metres high.

As the name 'Magneplanar' implies, the speakers are magnetically driven (not electrostatic) and have voice coil windings laid out over the entire surface area of the thin plastic film driver diaphragms.

In this three-way model, the mid is handled by a high definition film element covering approximately 30Hz to 6kHz. Below 300Hz, the bass radiator takes over, this more robust film element occupying more than 50% of the considerable radiating area. Being bi-

directional, like the panel electrostatics, it is also very sensitive and will benefit from a large room, standing well clear of the rear wall — 1.5 to 2.0 metres is a starting point.

The mid and treble units are fused separately while the crossover used very high quality components. During tests I found the system a little bright and replaced the treble fuse with a 1.8ohm 10 watt resistor, an alternative now approved by the manufacturers.

## Sound quality

Augmented (using the 1.8 ohm resistors) the *MG3* excelled on our tests. With a fine sense of scale and perspective, it also handled dynamic contrasts well, and was liked on both simple and complex material. Detail was extremely good, the treble clear and open, the mid sweet and natural, while the bass was articulate, informative and almost tactile on percussion. Low bass was pretty good if not really outstanding. Stereo focus was surprisingly good for a large panel and it seemed uncritical of either listening position or vertical axis. It gave a spacious, relaxed impression, free from the usual wooden, horny or other speaker colorations. Tonally it was considered a touch heavy in the upper bass, but remained very tuneful even here. It was consistently faithful to a wide variety of source and made even budget amplifiers sound good!

## Lab report

The *MG3*, like other large panel speakers, does not obey the inverse square law and hence the 1 metre sensitivity was not too helpful, here averaging around 85dB. At a 3 metre position it sounds more like 86dB/W, an average sensitivity. Power handling was up to 300W programme allowing levels for a stereo pair of up to 105dB, a substantial if not deafening level. Pair matching was very good, with the -6dB point estimated at 35Hz.

The axial frequency response suggested a gently falling output with rising frequency, though this did not fairly represent the perceived output at the listening distance.  $\pm 2.5$ dB sufficed for 80Hz to 18kHz, a pretty smooth result. Out at 2 metres the family of off-axis responses were surprisingly good, and while some variation appeared at each axis, a fair representation of the speaker's overall output was still output. The treble dispersion

was particularly good from the narrow ribbon tweeter.

Moderate distortion was evident at low frequencies, but above 150Hz distortion was particularly good, especially third harmonic, and it was quite exceptional at 86dB. Compression measured a very low 0.03dB, with negligible intermodulation, while the impedance was uniformly low. With 1.8 ohms added in place of the treble fuses, it did not fall below 4 ohms, and averaged a 5 ohm load, mainly of a resistive nature.

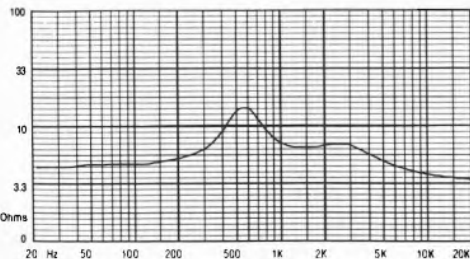
Room averaged, the *MG3* demonstrated a fine overall balance though the bass was not as uniform as some box systems, partly due to room reflection. The treble rolloff was smooth and gradual, as it should be.

### Summary

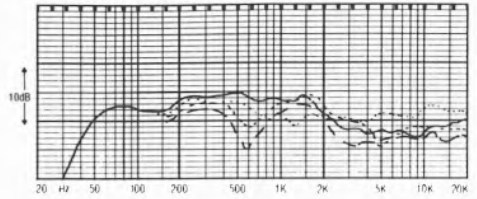
The *MG3* is a true audiophile loudspeaker, of excellent sound quality. It sets new standards for stereo performance, clarity and depth for the price, while its generous acoustic scale and dynamic range helps to convey much of the original character of the recorded performances it reproduced. A purchaser in this elevated price range should seriously investigate the *MG3*, and despite the cost, I am prepared to recommend it on sound quality grounds alone.

### GENERAL DATA

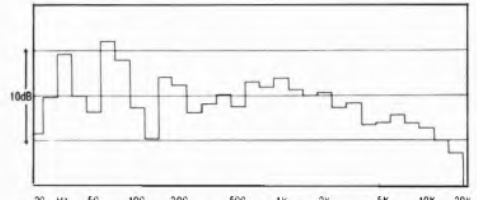
Size (height x width x depth)..... 180 x 62 x 38cm  
 Recommended amplifier power per channel  
 (for 96dB/A per pair at 2 metres minimum).....(25)—300W  
 Recommended placement.....well clear of walls  
 Frequency response, within  $\pm 3$ dB at 2 metres.....70Hz-19kHz  
 Low frequency rolloff ( - 6dB point) at 1 metre.....35Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....84-86dB/W  
 Approximate maximum sound level (pair) at 2 metres....106dB/A  
 Impedance characteristic (ease of drive).....an easy 4 ohm load  
 Forward response uniformity.....very good  
 Typical price per pair, including VAT.....£2500



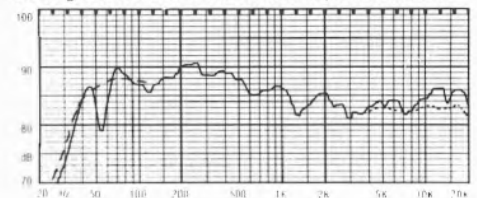
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



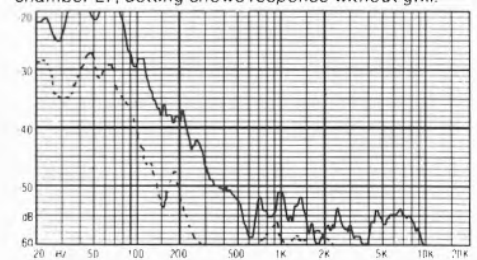
Forward characteristic response ( $\frac{1}{2}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



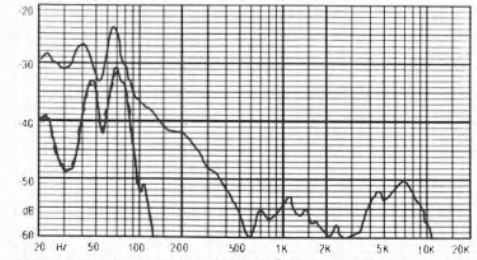
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

# Marantz LD20

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



We first covered the Marantz *LD30* in the last issue, and this has since been joined by a smaller model called the *LD20*. Its dimensions nonetheless do encompass a fair 16 litre internal volume, reflex tuned by a usefully-sized 5.4cm diameter port, 16cm long.

In this two way design, bass and midrange are handled by a 170mm steel-framed driver using a fabricated cone made from special paper. A 25mm soft fabric dome tweeter covers the treble range, while the electrical input is divided by a complex six element crossover of above average quality.

Solidly built from 20mm chipboard, the enclosure is well finished in vinyl print 'vener', with satin alloy trim for the drivers, both of which are flush mounted to minimize baffle reflections. However this good work is to some degree undermined by the 15mm thick, plain unrebrated grille, which should be left off

to get the best results Spring clip connections are fitted to the rear panel.

## Sound quality

Scoring a little below average, the *LD20* nonetheless did well considering its budget price. It delivered a well-focused stereo image, together with some of the atmosphere and acoustic of the original recordings. Depth, in the real sense, was moderate and the speaker also showed a touch of tonal balance 'lightness', together with some boxy effects, though it was not too bright in the treble — if anything it seemed a trifle depressed here. The bass was of average tunefulness and articulation, but seemed to lack extension. Several panelists indicated that more weight in the bass would be a good thing, and they were not referring here to the extreme bass.

In general it sounded clear and crisp, but at times it hinted at presence loss as well as some upper midrange muddle.

## Lab report

Pair matching in the bass-mid was fine, but much of the treble range showed a significant 2dB difference between the two speakers. The grille did affect the measured response as the ripples on the reference curve testify. Sensitivity averaged 85.5dB, which was about the group mean, but the treble range looked depressed by 2dB, leaving the midrange exposed.

The low frequency -6dB point was at 60Hz, which was about average, and with a comfortable 100W power handling, this speaker should be capable of 102dB maximum levels in a room. Out at 2 metres, the response showed clearer evidence of a presence-band loss, shown by the trend of off-axis responses around 2kHz. Limits of  $\pm 3$ dB sufficed for a 75Hz to 20kHz range. In particular the speaker axis should be directed at the listener to avoid the treble loss above axis. At 96dB sound pressure level, second harmonic approached 3% in the lower mid, but third was 10dB less, and by 86dB second harmonic had improved to a similar level both averaging 0.5%, which is not to impressive. On the compression test, a significant 2.2dB loss occurred, though the intermodulation product was fine at -43dB.

Then room curve proved revealing, showing a fair bass but shelving gently away relative to the mid band. The energy loss at 1.6kHz was clearly shown, as was the steep nature of the



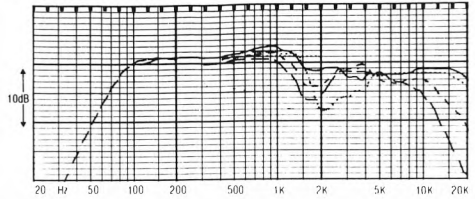
mid treble transition. The impedance dipped below the 6.4 ohm IEC minimum but not seriously so, and a 6-7 ohm rating is appropriate. This speaker should not pose any problems for an amplifier.

**Summary**

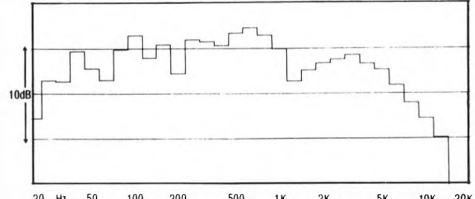
This speaker produced a pleasant relaxed sound with good stereo imaging. The bass, though 'dry', was reasonably extended, and the treble unobtrusive. It was well finished and the engineering was good — as was the overall value for money, at around £79. Best Buy status is appropriate here.

**GENERAL DATA**

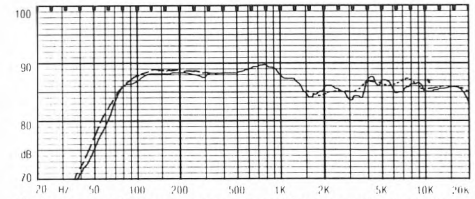
- Size (height x width x depth).....36.5 x 23 x 25.5cm
- Recommended amplifier power per channel  
(for 96dBA per pair at 2 metres minimum).....(15)—100W
- Recommended placement.....on open stands, possibly shelf
- Frequency response, within ±3dB at 2 metres.....75Hz-20kHz
- Low frequency rolloff ( -6dB point) at 1 metre.....60Hz
- Voltage sensitivity  
(ref. 2.83V or 1 watt into 8ohms at 1 metre).....87.5dB/W
- Approximate maximum sound level (pair) at 2 metres....102dBA
- Impedance characteristic (ease of drive).....good
- Forward response uniformity.....good
- Typical price per pair, including VAT.....£79



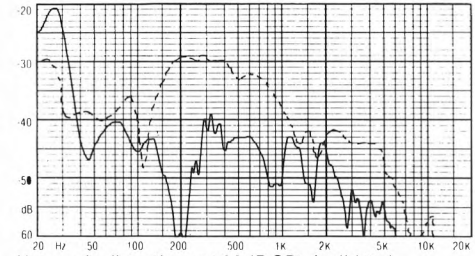
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



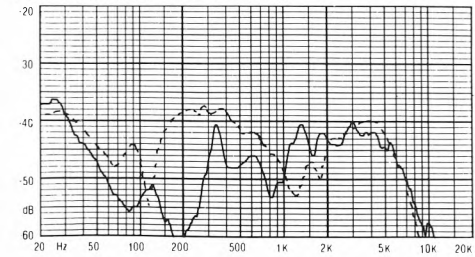
Averaged forward characteristic response in room



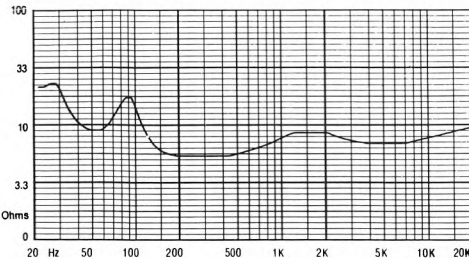
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# RECOMMENDED

## Marantz LD30

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



Inexpensive Marantz speakers have in the past often been best regarded as sensitive 'noise generators'. But with their new offerings this view may need to be revised! Designed in a classical framework, the LD30 sports an impressive list of optimum design features many of which have never appeared before in speakers from this company. The chipboard enclosure is surfaced all over in vinyl walnut and is quite strongly built, with a loose fibre blanket fill. The internal volume of 23 litres is reflex tuned by a 53mm diameter by 170mm long ducted port, possessing a larger than ideal length to breadth ratio.

Two vertically in-line drivers are used, namely a 200mm bass/midrange and a 25mm soft dome tweeter, the latter a ferro-fluid damped type. The bass unit is built on a substantial steel frame with a cone fabricated from sheet material and a generous 45mm diameter motor coil is

coupled with a decently large ceramic magnet.

Crossing over at 1.7kHz, the electrical network is quite complex (especially for Marantz) and comprises ten hard-wired components of good quality. Rear connection is by means of spring clamps.

Great attention to detail is evidenced by the instruction manual, which suggests that the grille might be removed for optimum results. The speakers should be used on open stands some 30-40cm high and spaced well clear of the walls.

### Sound quality

Scoring a little above average the LD30 has done well for its price. Major criticisms were centred around its rather rich tonal balance, with some boxiness and related coloration in the low mid as well as a mild boominess in the bass.

Conversely it sounded civilised and relaxed, offering reasonable detail, as well as pleasing transparency. Stereo images showed good depth and frontal focus, although heavy bass transients were felt to be a little 'slow', while tympani and the like were not 'sharp' enough, the speaker showing some coloration and hollowness on these sounds.

The overwhelming impression was one of a smooth relaxed sound with good bass extension particularly in view of the price, with above average stereo staging.

### Lab results

Fractionally below average, the LD30 voltage sensitivity worked out at 85.5dB/W which was sufficient to produce a pretty loud 100dBA from a pair in a typical room. A 20W to 100W maximum amplifier power range seems appropriate, on the basis of the distortion and power handling results.

Bass extension reached 47Hz, -6dB, which was good for size and price, and pair matching was fine. With the grille removed (dotted line on 1metre reference graph) a mild improvement was observed, this backed by subjective trial. Out at 2metres on the smoothed response the trends were clear. The speaker possessed a gentle downtilt of 3dB from 100Hz to 10kHz, the main explanation of its rich tonal balance. In general the forward set of responses was good, a mild dip at 15° above-axis suggesting a reasonable stand height for optimum sound quality. Limits of  $\pm 3$ dB were met over a 52Hz to 14kHz range.

Distortion was higher than average at 96dB

sound level, second harmonic reaching 8% at 150Hz, typically 1% while, Third harmonic ranged from 1% to 0.2%. An improvement was noted at 86dB sound level but the result was still poorer than average, ranging from 2% to 0.3% distortion.

Assessed by room integration, the output was as smooth and extended as the speaker sounded, which was a good result for this type of system.

Impedance dipped to 6ohms, at 150Hz, with the typical value nearer 10ohms, and the LD30 was thus quite an easy amplifier load.

### Summary

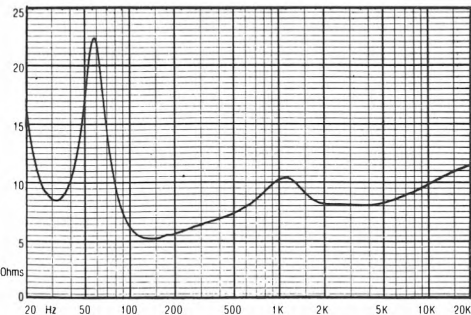
The LD30 is not an entirely neutral sounding speaker and yet it has a character which can make less expensive turntables and amplifiers sound rich and spacious with a relaxed, musical stereo. Digital programme revealed some colorations but none were too serious, and having demonstrated a good standard in most respects, the LD30 can be comfortably recommended.

### GENERAL DATA

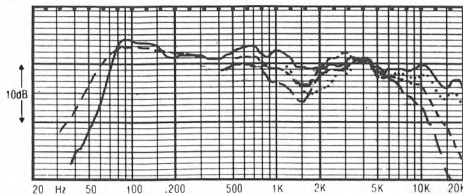
Size (height x width x depth) ..... 42 x 27 x 28cm  
 Recommended amplifier power per channel  
 (for 96dBA minimum per pair at 2 metres) ..... (20)—100W  
 Recommended placement ..... open stands  
 Frequency response, within  $\pm 3$ dB, at 2 metres ..... 52Hz to 14kHz  
 Low frequency rolloff ( $-6$ dB point) at 1 metre ..... 47Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 85.5dB/W  
 Approximate maximum sound level (pair) at 2 metres ..... 100dBA  
 Impedance characteristic (ease of drive) ..... good  
 Forward response uniformity ..... very good  
 Typical price per pair, inc VAT ..... £99

### Update

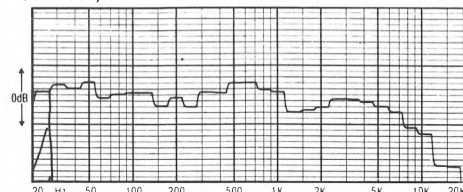
A MkII version of the LD30 is now on sale with revised tweeter and cosmetics - rosewood vinyl cabinet finished and chromed trim rings.



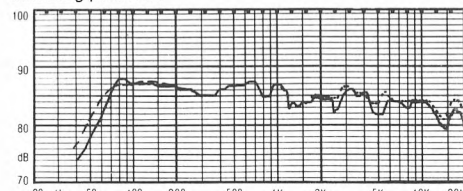
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



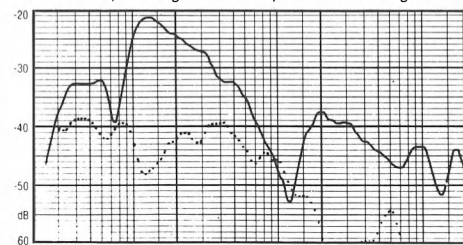
Forward characteristic response (1/8 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



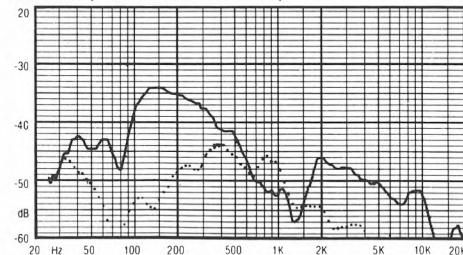
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

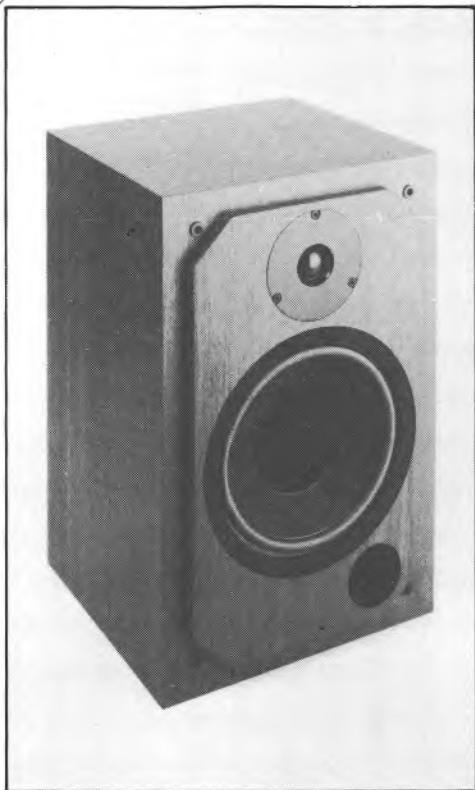


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

# Marantz LD50

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



The largest of the recent newcomers from Marantz, the *LD50* is a reflex loaded two way system, finished in a vinyl 'walnut'. The front baffle is a substantial stepped construction and the grille fits over this, with no resulting acoustic obstruction. The 210mm bass/mid unit is built on a steel frame, but fitted with a generous 50mm motor coil, energised by a large magnet. The cone is of a special paper, and is fabricated from sheet. The 19mm thick board enclosure has a substantial fibre filling for internal absorption, with its 23 litre internal volume, reflex tuned to 36Hz, this promising good bass extension.

A surprisingly complex crossover is used, with no less than four inductors, six capacitors and three power resistors. Internal wiring is effected using spring clips. Stand mounting in free space is optimum for this compact system.

## Sound quality

The *LD50* scored a convincing 'good' on the listening tests; most panelists liked it despite a noted 'richness' and 'dullness' in the tonal balance.

Its stereo presentation showed fair balance, as well as good focus, images having some sense of scale and weight, particularly on the classical programme. The bass was also quite tuneful, as well as articulate, and also showed good extension to the lower frequencies.

Overall, the standard of clarity was high and the output free from 'rough edges' or prominences in the perceived frequency response. It could play quite loud, accepting up to 200W of programme peaks.

On the debit side, some mild boxiness and muddle were noted, while a touch more sparkle could possibly have further improved the marks. It was felt to be a trifle 'laid back', although big-hearted and civilised.

## Lab report

With an average sensitivity of 86dB/W, the reference curve showed a treble band depression of 2-3dB and this was audible on audition. With the grille removed, the response deteriorated, so in this case, it should always be kept on. The -6dB bass point was 43Hz, good for the size.

Given the power handling, maximum levels of around 104dB should be possible for a pair at 1 metre. Out at 2 metres, the clear nature of the stepped response may be seen; the response is smooth, but unbalanced by the depressed treble. However,  $\pm 3$ dB limits still sufficed for a wide 50Hz to 20kHz range.

Driven to 96dB sound pressure level, third harmonic distortion proved to be well controlled, while the less aurally-offensive second harmonic did rise to 5% at 150Hz. With sound level reduced to 86dB, at 1 metre, third harmonic reduced significantly, while the second harmonic showed a still greater reduction to normal levels. High level compression measured poorer than average at 1.9dB, with the intermodulation product at -35dB.

It was in the room response that the *LD50* showed its strength. Its alignment almost perfectly matched the room, developing uniform bass down to 25Hz, while the mid was slightly peaky, emphasised by the treble depression which was otherwise very smooth.

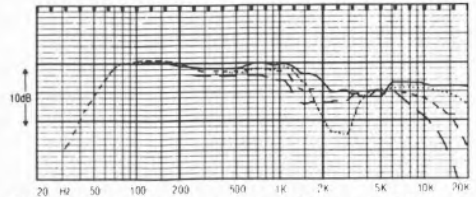
The impedance reflected a load slightly below 8 ohms nominal value, but not low enough to bother any modern amplifier.

**Summary**

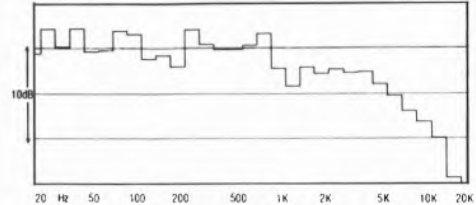
Irrespective of its particular idiosyncracies, the LD50 did well enough to merit Best Buy status. Its virtues lie in its civilised, 'laid back' quality which helps to put perspective back into much CD programme. Furthermore its bass is particularly good for the size and price, while the mid/treble range is even and detailed. This is one of those products which it is easy to live with, and it should wear well as a result.

**GENERAL DATA**

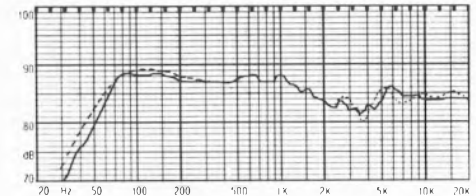
- Size (height x width x depth).....42 x 26 x 29cm
- Recommended amplifier power per channel  
(for 96dBA per pair at 2 metres minimum).....(15)—100W
- Recommended placement.....on open stands
- Frequency response, within ±3dB at 2 metres.....50Hz-20kHz
- Low frequency rolloff (-6dB point) at 1 metre.....43Hz
- Voltage sensitivity  
(ref. 2.83V or 1 watt into 8ohms at 1 metre).....86dB/W
- Approximate maximum sound level (pair) at 2 metres...101dB/A
- Impedance characteristic (ease of drive).....good
- Forward response uniformity.....very good
- Typical price per pair, including VAT.....£140



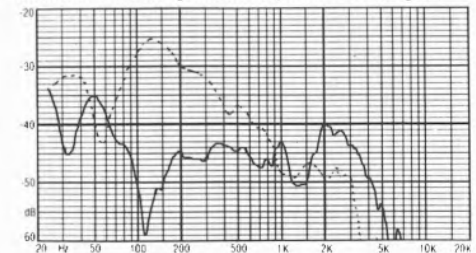
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



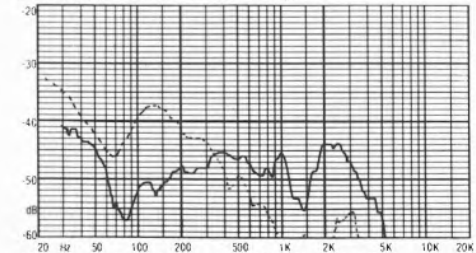
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

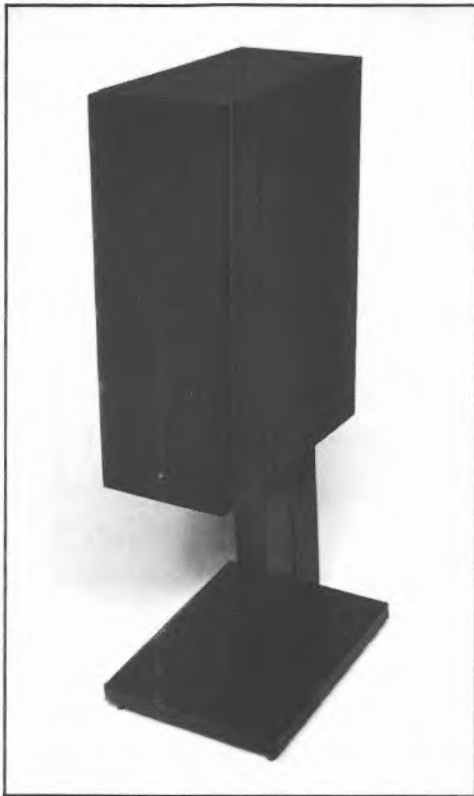


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

RECOMMENDED

# Meridian M2

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



Now well established, the M2 from Meridian is perhaps the leading UK active loudspeaker system, consisting of a slim compact enclosure mounted on a new heavyweight (and how!) rigid stand.

The box is well packed with electronics and drivers, the latter all being KEF units – two 110mm Bextrene-cone bass/mid drivers, one mounted above and one below a fairly large 38mm plastic dome tweeter. As a group this array approximates in effect to a 300 × 120mm bass unit with a concentric treble driver. The 17 litre enclosure is reflex tuned by a ducted port, which has a multi-hole aperture to improve air flow linearity as well as enclosure coloration. The box itself is superbly built in 14mm thick top-grade multi-ply and finely veneered, the back panel consisting of a metal plate which acts as a heat dissipator for the electronics. In addition to providing the electrical crossover at

2kHz, the latter realigns the bass system to a sixth order, and extended bass can be expected possibly at the expense of a rapid final rolloff as well as a possible low-frequency hangover.

DIN and phono inputs are provided at nominally 1V sensitivity and the system may be driven by a balanced output preamplifier for optimum performance — for example a Meridian 101B).

The grille components are rather close to the drivers on the narrow front panel, so measurements were taken with the grille removed and in place to assess its effects.

## Sound quality

In general the M2 sound was favoured by the panel. It portrayed dynamics well and was felt to have a clean, punchy and controlled character throughout the range. Good stereo images were developed, being well focused and showing reasonable depth. However, its slightly forward, hard and bright tonal balance was felt by some panellists to mildly flatten some stereo images.

Bass was considered well controlled with fine articulation in the upper registers and a very slight extreme low frequency hangover, the latter almost a mild 'thunderly' effect. In presentation the M2 was clear as well as detailed, with a slightly cold and clinical ambience; possibly the presence band was indeed a little too forward.

## Lab results

Considering the small size of the box, quite loud 102dBA sound levels were possible and the bass power handling was satisfactory at this level. The axial frequency response was of the 'stepped' variety, which placed the bass rolloff –6dB at 45Hz referred to the mid band. Conversely if referenced to the upper bass level, the cutoff improved to 38Hz — remarkable for the cabinet volume.

Some pair matching imbalance was apparent (solid and dashed lines above 500Hz), this amounting in places to a significant 2dB or so, and stereo focus could well have been better with a tighter match. The grille was also found to disturb the 2.5 and 8.0kHz range though it is hard to say which response was better.

At 2 metres the trend suggested upper-mid forwardness with the main range shelf-lifted above the 80-300Hz bass range. The 15° above-axis frequency response was poor, flawed by a dip at 2.2kHz, but on axis and 15° below it was perfect. Here the wisdom of Meridian's adjustable-tilt stand can be seen in bringing up

the main radiating area to the listener. The lateral off-axis curves were good except above 10kHz where the falloff was too rapid.

Room-averaged response showed a 'lumpy' bass at 30-50Hz which, however, did not subjectively prove as audible as you might expect. The mid was thin in balance terms, while the treble was sweet, though rolled off somewhat prematurely.

At 96dB distortion was fairly low, in fact surprisingly so at low frequencies. Interestingly the picture did not change at the lower 86dB level where the result was about average.

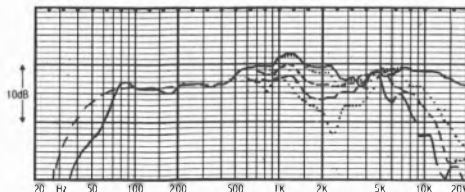
### Summary

On the basis that the amplifier section of these active speakers is worth about £400, the actual speaker contribution (about £300) is what we have to consider.

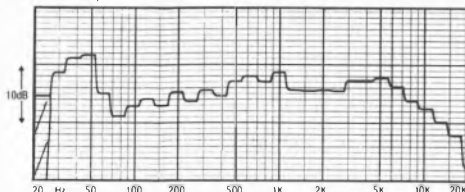
While not entirely neutral, the M2 had many likeable qualities, and gave a 'big speaker performance' from a tidy attractive package, including the sturdy integral stand. Personal audition is recommend, preferably in your own home, but with its sound quality rated in the 'good plus' category the M2 nonetheless achieves recommended status.

### GENERAL DATA

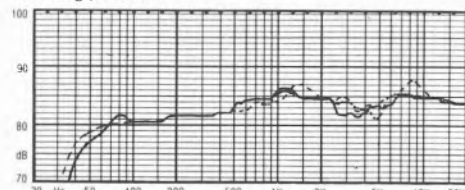
Size (height x width x depth).....50" x 18 x 38cm  
 Recommended amplifier power per channel  
 (for 96dBA minimum per pair at 2 metres).....active  
 Recommended placement .....open space, on integral stand  
 Frequency response, within  $\pm 3$ dB, at 2 metres .....60Hz to 20kHz  
 Low frequency rolloff ( $-6$ dB point) at 1 metre.....45Hz  
 Voltage sensitivity .....active, 1V for full power  
 Approximate maximum sound level (pair) at 2 metres .....102dBA  
 Impedance characteristic (ease of drive) .....active/balanced  
 Forward response uniformity .....fairly good  
 Typical price per pair, inc VAT..... including stands £899  
 \*83cm including stand



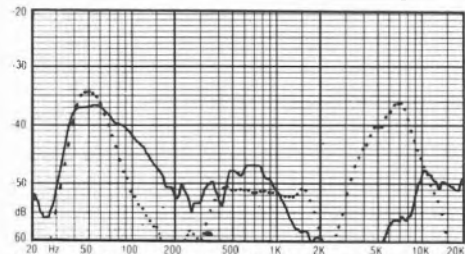
Forward characteristic response ( $1/2$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



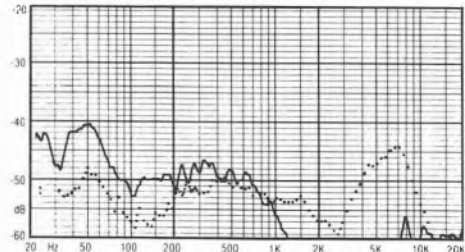
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

**BEST BUY**

# Mission 70 II

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



Now officially in *Mark II* form, the 70 is Mission's least expensive speaker, but whose performance in several areas nonetheless threatens that of several of its larger brothers in the Mission range.

A two way miniature, the 70 has a sealed box volume of 13 litres, which loads the custom 170mm pulp cone bass mid unit. Both this and the tweeter are Danish, the latter comprising a 19mm polyamide dome, ferro-fluid damped and built by Vifa. The crossover is of good quality, 12dB/octave acoustic, and uses three electrical elements.

The cabinet is nicely finished in vinyl 'black ash', with a deep grille which is integral with the enclosure. In fact the cabinet comes apart as two shells, locked together by four capped screws at the rear. A fibre wad provides for the internal absorption, while electrical connection is made by sturdy 4mm socket/binding

posts. Overall construction quality is good.

## Sound quality

While use on a shelf or bookcase is likely, this speaker actually gave a good account of itself on 42cm high stands, not too far from the rear wall. The mark was a strong 'average plus', great for the price.

There are however several criticisms, namely the sound could show some 'sibilance' and 'edge', with a mildly thin tonal balance, some boxiness and a rather dry bass.

Conversely it was favoured for its lively, 'quick' nature, revealing detail throughout the frequency range, and preserving the excitement of the performances. The bass was articulate and tuneful while the stereo focus was good, with a fair reproduction of the natural recorded acoustic around the performer.

## Lab report

The axial reference response showed a smooth, slightly uptilted character, on spec at a sensitivity of 89dB/W. The bass -6dB point was a modest 84Hz which is average for the type, with a system resonance at 97Hz. Pair matching was very good, to within  $\pm 0.5$ dB, and at 1 metre the speaker met fine  $\pm 2$ dB limits from 95Hz to 17kHz.

Out at two metres the forward response family showed an exemplary set of forward responses. The variation over the 15° vertical axis from straight in front was minimal, and the blending was very good in the lateral plane. The forward yet uniform nature of this design was clear enough.

Working hard at 96dB, the speaker nevertheless showed well controlled distortion, generally less than 1%. Down at 86dB, still a fair level, the distortions had improved to the 0.4% level, with the low frequency range rather better than average. Compression measured an average 1.9dB while the bass-mid intermodulation was fine at -42dB.

At low frequencies the impedance dipped to just under 5 ohms, and a fair rating would be 6 ohms, although most amps should have no problems.

Computer averaged in the listening room, the 70 II response was less even than expected. The mid was clearly forward, (noted on audition) while the bass was rather shy, and the upper treble was a trifle exposed.

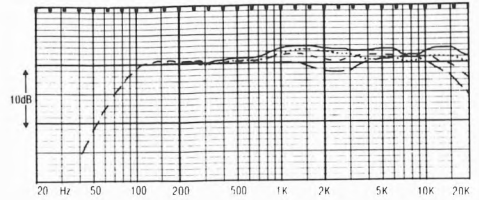


## Summary

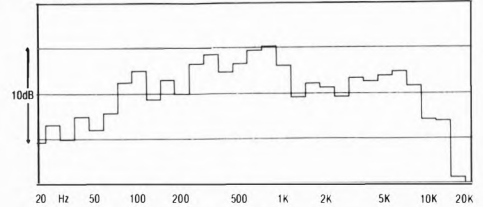
Despite the measured and auditioned tonal imbalance in the energy response, the panel liked the 70 for its lively, transparent quality, and here its subjective appeal served to outweigh its problems. The ratings suggest Best Buy status, but nonetheless, I still feel that it should be carefully auditioned before purchase.

## GENERAL DATA

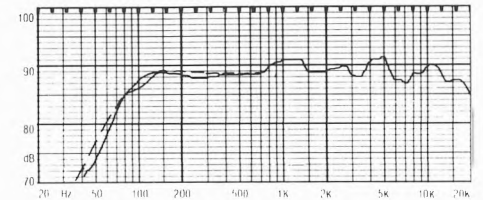
Size (height x width x depth).....35 x 21 x 21cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(10)—100W  
 Recommended placement.....on stands or shelf, near wall  
 Frequency response, within  $\pm 3$ dB at 2 metres.....85-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....68Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....89dB/W  
 Approximate maximum sound level (pair) at 2 metres....104dBA  
 Impedance characteristic (ease of drive).....good  
 Forward response uniformity.....very good  
 Typical price per pair, including VAT.....£99



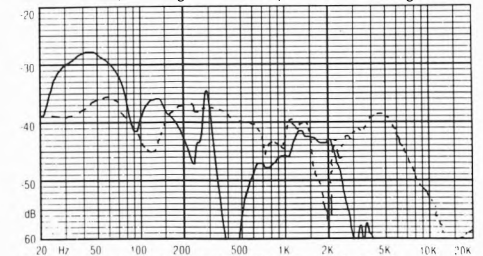
Forward characteristic response ( $1/2$  octave at 2m, dotted  $15^\circ$  vertical, small dash  $30^\circ$  lateral, long dash  $45^\circ$  lateral).



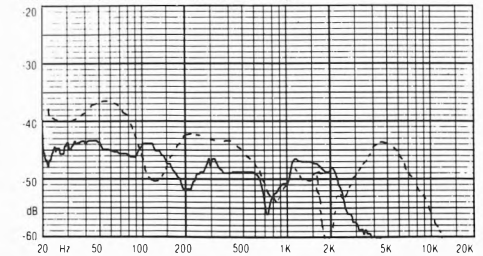
Averaged forward characteristic response in room



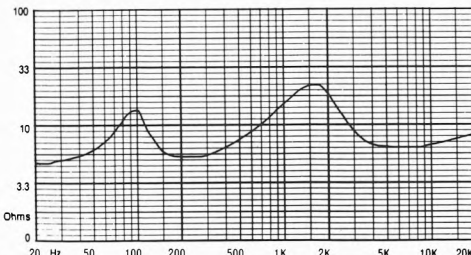
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

RECOMMENDED

# Mission 770 Freedom

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



Latest in a long line of 770 models, the 'Freedom' uses newly designed drivers. The enclosure volume remains unchanged at 35 litres, bass reflex tuned by a moulded multi-aperture port of 55mm effective diameter and 23mm deep. The custom-built polypropylene bass driver is 210mm in diameter and has a hard centre cap, with a cone flare changing to straight-sided as the perimeter is approached. A die cast frame and generous magnet are used. The treble range is covered by a version of the SEAS 25mm polyamide soft dome which is ferro-fluid damped, and the crossover is a 12dB/octave design, with four good quality elements plus one resistor. The system is hard-wired with good quality cable, and 4mm socket binding posts are fitted for rear connection.

Excellently finished in walnut veneer, the enclosure is well built, and fitted with a single large foam block for absorption, with bitumen

pads applied to control the panel resonances. 20mm thick medite is used for the front panel, and the grille has a low acoustic profile. The system is designed for use on matching low stands.

## Sound quality

We tried the low stands with the speaker backed to the wall but felt the coloration was more severe in the lower midband. Good results were however obtained using our 42cm high stands when the 770 scored average in the auditioning. Mixed reactions were obtained; this speaker appears to have a distinctive character which can appeal. It sounds highly transparent, crisp and clear, revealing much detail and the natural acoustic of recordings, and brings the performers closer to the listeners.

Bass was dry, with the midrange somewhat forward, which produced for example, a 'clangy' piano sound. Treble was just average. Tonally, it was a bit small and 'thin' sounding and when driven really hard above 200W, the sound was 'abrasive' suggestive of crossover saturation. However, at decent levels it suited rock programmes very well, with a punchy beat and as one panelist put it, 'plenty of go'.

## Lab report

The axial reference response showed a high 91dB/W sensitivity with a slightly restricted bass, reading -6dB at 55Hz. The grille has little effect, which was good, while the pair matching was also good, at within  $\pm 0.75$ dB.

Out at 2 metres the forward response family further helped to classify the output. Here  $\pm 2$ dB limits sufficed for a 70Hz to 20kHz frequency range, while the drivers seemed well integrated, with consistent off-axis responses. Both axial traces did indicate an upper mid plateau, 600Hz to 1.6kHz, and the overall balance was a touch 'forward'. Driven to 96dB sound pressure level, third harmonic distortion was excellent while second remained satisfactory — up to 1% at 35Hz and 300Hz, 3% at 100Hz. At 86dB third was even better while second harmonic evened out at a good level. A moderate 1.5dB of compression was recorded with -40dB intermodulation.

In the listening room, the computer analyser confirmed the panel results — for example, the 'dry' bass, the projected 'forward' upper and mid and the 'exposed' but not excessive treble. In absolute terms the room balance was not

too bad.

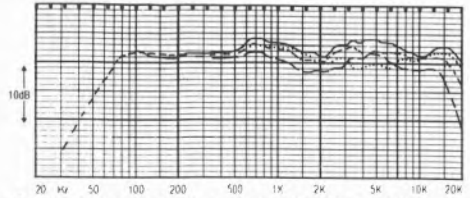
Dipping below 6 ohms in the treble range, the speaker in other respects averaged an 8 ohm impedance, and should not present any load problems to an amplifier. Its 150W power handling means that a pair of 770s will produced upwards of 107dB in a room and they will probably actually sound louder than that!

**Summary**

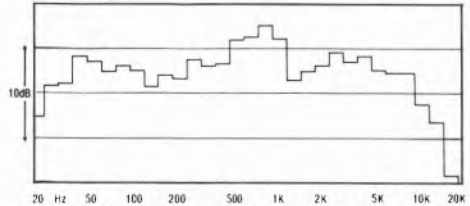
The 770 has its own virtues — dynamic impact, an up-front clarity, and an ability to be used close to the wall. Good engineering plus a fairly good panel rating also apply here. It manages a recommendation with the qualification that it should be carefully auditioned to ensure that it is the 'right one' for you and your system; classical music enthusiasts are likely to favour the 770 less than rock specialists

**GENERAL DATA**

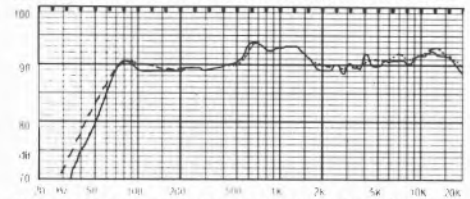
Size (height x width x depth).....	61 x 27 x 30cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(10) — 150W
Recommended placement.....	on high stands
Frequency response, within ±3dB at 2 metres.....	60Hz — 20kHz
Low frequency rolloff ( - 6dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref 2.83V or 1 watt into 8ohms at 1 metre).....	91dB/W
Approximate maximum sound level (pair) at 2 metres...	107dBA
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	very good
Typical price per pair, including VAT.....	£399



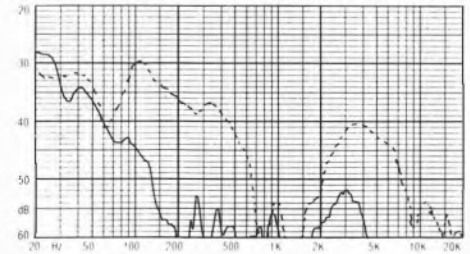
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



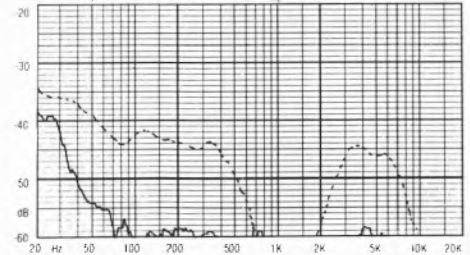
Averaged forward characteristic response in room



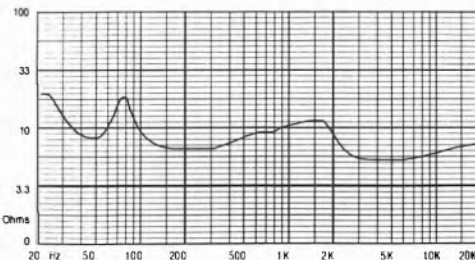
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



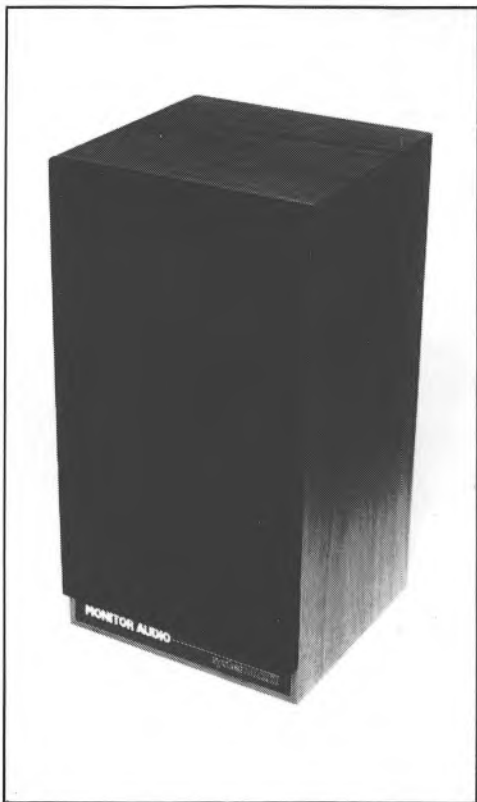
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Monitor Audio R252

Monitor Audio Ltd, 347 Cherry Hinton Road, Cambridge CB1 4DJ  
Tel (0223) 42898



The R252 is an inexpensive, two-way sealed box speaker of 17litres internal volume, employing a 200mm steel-framed pulp cone bass/midrange driver plus a 19mm soft plastic dome tweeter. It is hard-wired internally including the high-power capacity, good-quality crossover network.

During the progress of this review, the bass unit was fitted with an improved chassis which significantly altered the subjective performance, and while these effects have been accounted for on audition, the measurements relate to the unmodified unit, which was otherwise pretty similar.

Unusually for this price level, the solid enclosure is finished in real wood veneer to a high standard, the panels built of 12 and 15mm board. The grille is a low profile component, made from fully-rebated plywood.

No box panel damping is used, but the interior has been lined with acoustic foam to

suppress internal resonances, while electrical connection is by means of 4mm socket binding posts.

## Sound quality

Initially the R252 sounded rather below average on audition, appearing aggressively forward as well as brash. However with the bass/mid unit revision, a significant improvement occurred in tonal balance as well as general character, which was sufficient to move it up to an average score, this good for the price.

Some colorations did remain, notably a residual upper mid-hardness, some lower-mid boxiness and a rather dry character to the sound. Low bass was rather curtailed, though upper bass was quite detailed, and the treble was also much better than before, due to the improved balance. However the treble was still felt to be mildly rough and forward.

Stereo images were quite well focused with moderate depth and quite clear spatial effects, and the speaker also showed a good level of instrumental detail

## Lab results

Sensitivity was 89dB/W which was well above average, and in conjunction with a 10 to 75W power range, sound levels of up to 102dBA were possible. Pair matching was very good, while the bass register was very uniform and well damped, measuring 62Hz, -6dB, but rolling off quickly below this point. Note that this and other measurements here are for the unmodified speaker.

At 2metres the axial response was fairly smooth meeting  $\pm 3$ dB limits from 80Hz to 30kHz, and dispersion was excellent in the lateral, plane. However 15° above-axis a noticeable 4kHz notch appeared and we recommend using this speaker directed at ear level. In fact Monitor Audio's matching stands and designed for exactly that purpose. The forward responses were good for the type.

Room-integrated response evidenced the 'dry' nature of this speaker, with a fairly extended but shallow bass plus a slightly prominent midrange. Overall however the effect was pretty smooth.

Distortion at 96dB sound level was moderate at around 1% second and third harmonic even at low frequencies, while higher in the range third harmonic was particularly good. Further improvement was apparent at an 06dB level, with an average of 0.3% recorded here.

Bar a mild dip to 5.5ohms at 10kHz, the

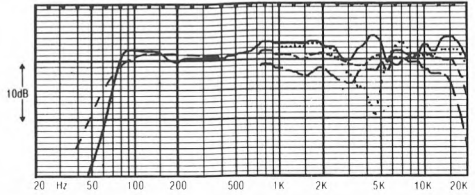
impedance was well behaved over the range, and the R252 was classed as a good amplifier load.

**Summary**

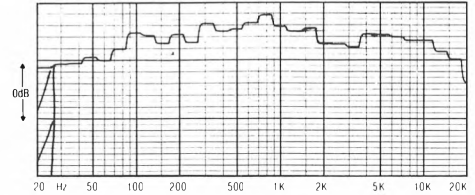
For the price, this powerful two-way design is unusually well-finished and constructed, and the version tested in the previous edition comfortably won a recommendation, with low distortion, high sensitivity and a good rating for sound quality. In view of subsequent design changes, the axial frequency response was rechecked on a current sample, and found less 'tidy' and also brighter than before, this latter a negative characteristic already noted previously. Accordingly, we arranged a full audition, and the new version did not find favour with the panel, scoring rather below average. Main criticisms were of a hard and bright quality, with insufficient output in the bass. Regrettably, we cannot continue a recommendation for the R252.

**GENERAL DATA**

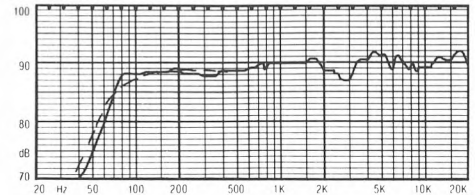
Size (height x width x depth).....	47 x 25 x 24cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—75W
Recommended placement .....	
Frequency response, within $\pm 3$ dB, at 2 metres .....	80Hz to 20kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	62Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	89dB
Approximate maximum sound level (pair) at 2 metres .....	102dBA
Impedance characteristic (ease of drive) .....	good
Forward response uniformity.....	good
Typical price per pair, inc VAT.....	wood veneer, £115 R252, vinyl finish, £99



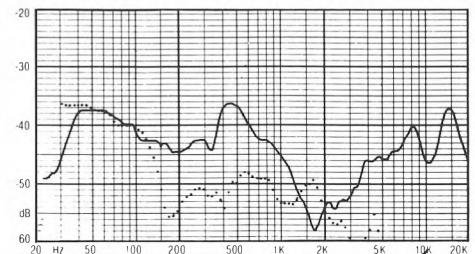
Forward characteristic response ( $\frac{1}{2}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



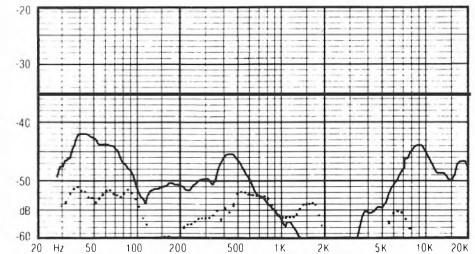
Averaged forward characteristic response in room at listening position.



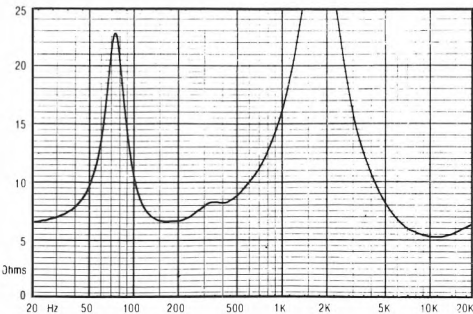
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



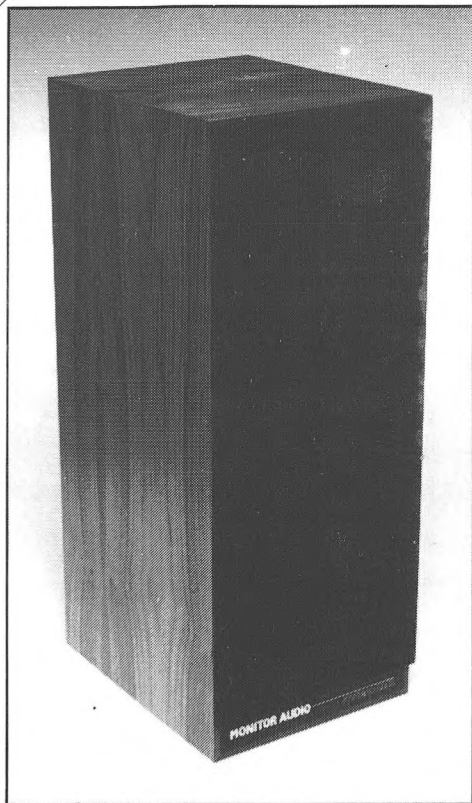
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Monitor Audio R352

Monitor Audio Ltd, 347 Cherry Hinton Road, Cambridge CB1 4DJ

Tel (0223) 42898

**BEST BUY**



This speaker is larger than usual for its price range and consists of an excellently-veneered 36litre enclosure that has been rigidly constructed from 18mm-thick heavy chipboard. Internal bracing has been used to raise the frequency and also to moderate the amplitude of the panel resonances. A fine rebated grille is also fitted. Foam absorbent blocks line the interior, and the system is bass-reflex tuned to 50Hz by a realistically-dimensioned tunnel port.

The interestingly-designed 200mm flared pulp cone bass unit uses a special magnet system which provides a better flux distribution at the pole tip, while the controlled local pole saturation should also reduce second harmonic distortion due to improved motor coil flux modulation.

A 20mm soft plastic dome tweeter (not ferro fluid damped) completes the lineup and this crosses over at around 3kHz. A high-power hard-

wired crossover is fitted showing heavy duty wiring, and 4mm socket/binding posts for rear connection. Both this model and the companion 252 come with very helpful and well written instruction manuals.

## Sound quality

The 352 scored well up the field, achieving a good overall rating which was impressive for its price category. It was liked for its well controlled, smooth and yet lively character, the bass appearing articulate but gutsy and demonstrating reasonable extension. The mid sounded clear and showed less boxiness than usual while the slightly bright treble was even and well detailed.

Stereo effects were sharply focused, with presentable depth effects where appropriate, and the speaker also proved itself capable of revealing the different ambience and acoustics present on a variety of recordings.

Rock programme was reproduced with a lively, tuneful beat and some panelists remarked that the sound 'grew on them' as the tests proceeded.

A slight muddiness and graininess was however present in the reproduction, as well as a touch of fundamental bass overhang, but none of these effects were at all serious.

## Lab results

Pair matching was good, as judged by the 1metre responses. A narrow notch was present at 5kHz but did not appear to affect the results, and overall the response was pretty flat with a well tuned bass extending to 50Hz, -6dB, which is average for the type but with a well damped and slow rolloff. Sensitivity was high at 90dB/W, providing good levels from as little as 10W and a rather loud 105dBA from the 100W per channel maximum input power. Grille effects were negligible.

At 2metres the lateral off-axis responses were fine but the speaker was clearly a mite critical in the vertical plane. Dips were recorded at and 15° above and below so accurate beaming to the listener would be important with this model.  $\pm 3$ dB limits comfortably held a 50Hz to 15kHz range.

Room averaged, the speaker's fine overall balance could be appreciated. The bass was uniform to 45Hz and well integrated while the treble showed a correct and gentle rolloff towards the extreme frequencies.

At the 96dB sound level distortion was quite low, particularly above 500Hz, and at 86dB the

results were especially good, averaging 01. % (!) over most of the range for both second and third harmonic.

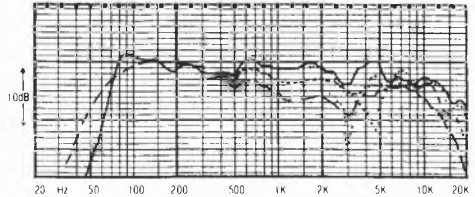
Impedance averaged 12ohms and possessed no injurious low levels at any frequency, so the 352 should be particularly easy to drive, and as such presents a 'kind' amplifier load.

**Summary**

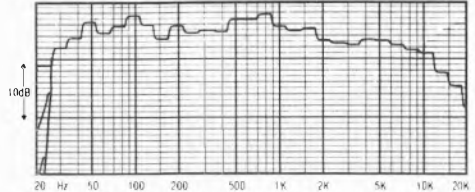
This well-finished and constructed speaker provides a sound quality and engineering performance that only a few years ago was expected of models costing twice as much. It is sensitive, low in distortion, accurate in balance and predominantly faithful to the programme fed it, and it will also provide good stereo effects. It is tonally well balanced and can provide high sound levels, being easy to drive and capable of extracting the most from any decent amplifier. All in all, the R352, one of the designer Robin Marshall's best efforts yet, comfortably scores a Best Buy rating.

**GENERAL DATA**

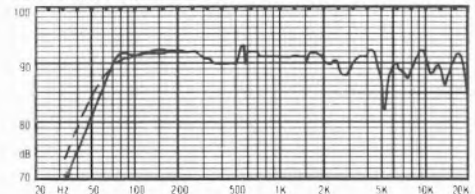
- Size (height x width x depth).....64 x 25 x 32cm
- Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....(10)—100W
- Recommended placement.....stands (Monitor Audio optional)
- Frequency response, within ± 3dB, at 2 metres .....55Hz to 15kHz
- Low frequency rolloff (-6dB point) at 1 metre.....50Hz
- Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....90dB
- Approximate maximum sound level (pair) at 2 metres.....105dBA
- Impedance characteristic (ease of drive).....very good
- Forward response uniformity.....average



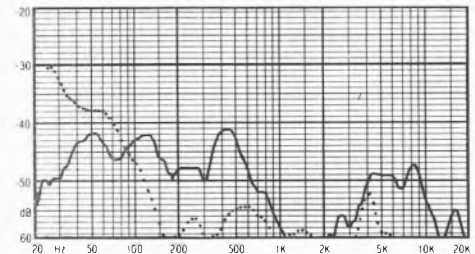
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



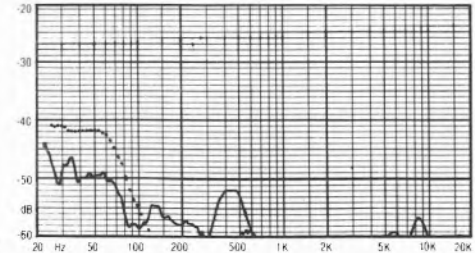
Averaged forward characteristic response in room at listening position.



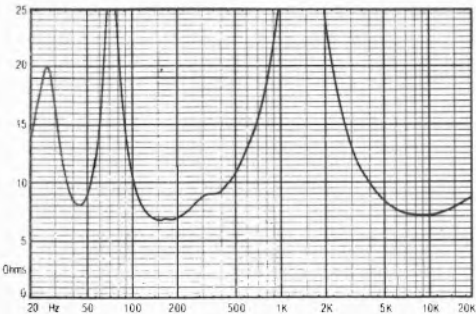
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



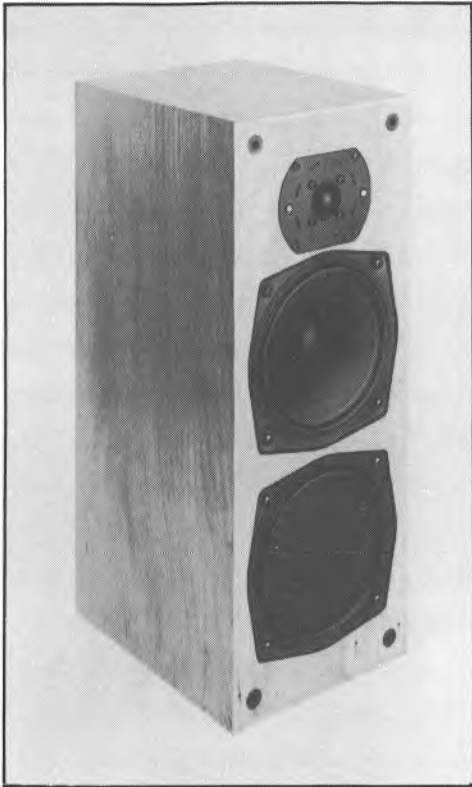
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Monitor Audio R152

Monitor Audio Ltd, 347 Cherry Hinton Road, Cambridge CB1 4DJ  
Tel (0223) 42898



The *R152* occupies a senior position in the Monitor Audio range, selling for £200 or so a pair. Finished in a top class natural veneer, this speaker was designed by Robin Marshall, and uses a special 170mm Cobex coned bass unit fitted with a large motor coil and generous magnet. The 20 litre reflex enclosure is reflex tuned at low frequencies by a long throw ABR or slave diaphragm, also built on a 170mm frame. Treble is covered by the SEAS 25mm polyamide dome while the division of the frequency range is carried out by a good quality four-element, 12dB/octave crossover, which has three additional resistors for damping and attenuation. All connections are hardwired using good cable. The slim enclosure is braced in the vertical direction and fitted with a rebated grille of shallow profile. 4mm socket/binding posts are used for electrical connection, while the enclosure

floor is fitted with threaded studs to take a matching veneered stand. Finish and workmanship were both very good.

## Sound quality

The overall score was a straight 'average' which was fair enough for the price if unexceptional. It created a mixed impression among the panel, some liking it and others turning increasingly against it. The comments suggests some 'unevenness' of tonal balance, and some specific mild colorations. String tone was a touch 'acid' while the mid seemed open and clear, but nonetheless hiding some inner boxiness. The bass was reasonably balanced and extended but lacked real attack and tunefulness.

Conversely, the *R152* did produce quite good stereo images, with good depth and quite good perspectives. It handled high powers well, even up to 300W peak, but lost definition above the 150W level.

## Lab report

With a below-average 85.5dBW sensitivity, though uncompromised by load impedance discrepancies, the *R152* had a moderate capacity to generate high sound levels, and a stereo pair should be capable of 101dB in the listening room. The midband was commendably uniform to 3kHz but the treble was unbalanced on axis. The 15kHz range was also prominent while the lower treble was rather depressed. In fact  $\pm 3$ dB limits were needed to contain a 58Hz to 20kHz response and the -6dB point was noted at 55Hz, not particularly good for the price.

Out at 2 metres the averaged response showed a similar result, with an isolated treble range and an energy 'hole' at 4.5kHz; a cross-over effect. Driven to 96dB spl, the *R152* was working hard, showing 1% third harmonic, midband, with second harmonic at 5%, 130Hz. At a reduced 86dB level, it showed an improvement but the distortion was still higher than average. However compression was moderate at 1.3dB with a low intermodulation product.

In the room, it performed more as the panel heard it; low bass was absent, but from 50Hz to 3kHz it was fine and the loss at 4kHz was not that serious in forward energy terms. The treble was nonetheless a trifle exposed. As regards impedance, the *R152* remained above 6.4 ohms at all times and therefore represents a straightforward 8 ohm amplifier loading.

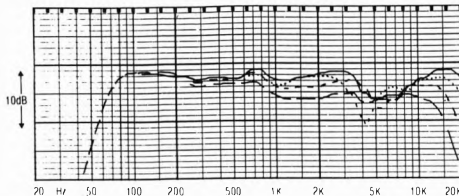


## Summary

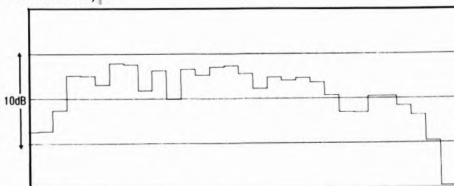
A bit off the mainstream, this attractive and well finished speaker has some appealing qualities, and did fairly well on the panel tests. Its dynamic capability is somewhat restricted however, and more definition at frequency extremes would also be an advantage. Not a strong performer, the value for money is however sufficient to qualify it for recommendation, with a bias towards classical rather than rock programme.

### GENERAL DATA

Size (height x width x depth).....51 x 20 x 28cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(15)—150W  
 Recommended placement.....on matching stands  
 Frequency response, within  $\pm 3$ dB at 2 metres.....57Hz-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....55Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....85.5dB/W  
 Approximate maximum sound level (pair) at 2 metres...101dBA  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good +  
 Typical price per pair, including VAT.....£220



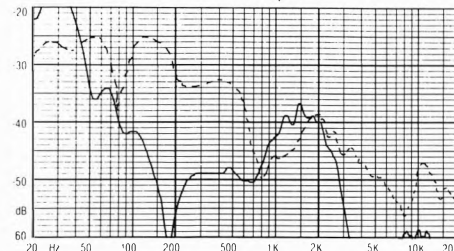
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



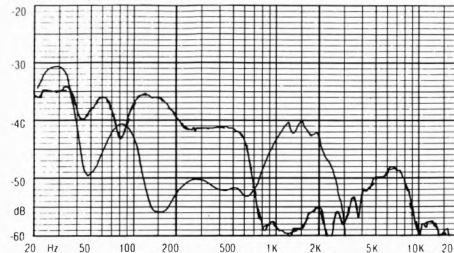
Averaged forward characteristic response in room



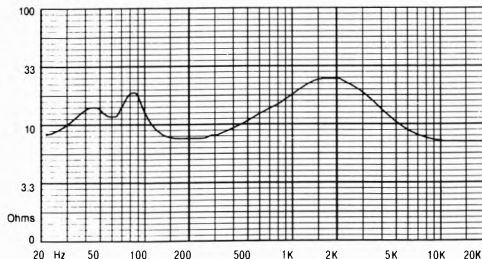
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



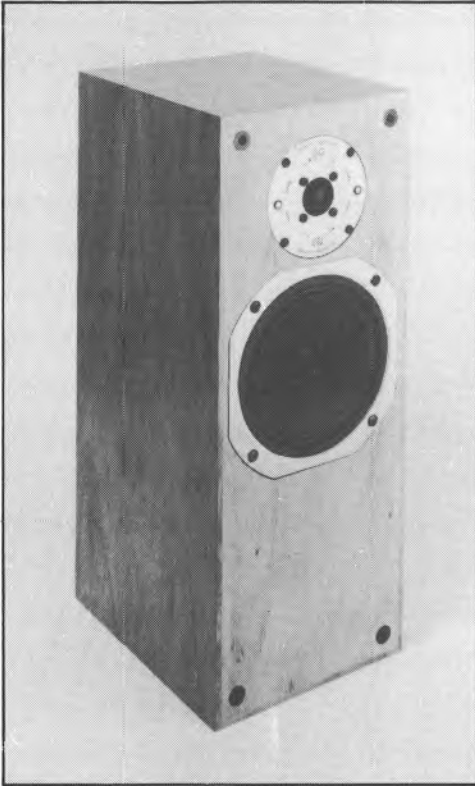
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Monitor Audio R552

Monitor Audio Ltd, 347 Cherry Hinton Road, Cambridge CB1 4DJ  
Tel (0223) 42898



Monitor's managing director was at pains to point out that the 552 speaker comes with matching stands, the whole assembly, stands included, finished in one of several high quality veneers, including the best Rosewood. In detail terms, this exterior finish could be worth as much as 25% of the final cost, and this should be borne in mind when considering this speaker; certainly the appearance can be spectacular with some veneer choices.

The 552 is a compact two way sealed box of 25 litres internal volume. Bass and midrange are handled by a Cobex-coned 175mm driver with a custom cast chassis. Treble is allocated to the usual 25mm polyamide SEAS tweeter, and the crossover operates at around 5kHz, using four main elements plus three resistors, although it is of normal commercial quality. Internal construction was good, with bracing and bitumen pad damping while the units are

hardwired with 'sound cable'. Electrical connection is by means of 4mm sockets.

## Sound quality

The panel found this speaker to be a disappointment. It scored well below average which does not begin to justify the price, despite the fine finish. The panelists were aware of a general tendency to thinness in the tonal balance, with a bright, 'obvious' treble. Bass seemed too dry and restrained, lacking extension, and overall it sounded rather 'small', failing to convey the space and atmosphere of much programme. However, in stereo terms it did focus fairly well, and the coloration level was evidently fairly low; however this was not sufficient to redeem it in the ears of the panel.

The 552 coped well when driven hard, and survived 200W peak programme despite the relatively small bass driver size. At high levels, increasing hardness became apparent in the upper midrange.

## Lab report

This speaker demonstrated an average sensitivity of 86dB/W and in conjunction with a 150W power handling, a stereo pair could provide up to 103dB in a listening room.

The axial response was quite uniform; indeed  $\pm 2.5$ dB limits were sufficient for an 85Hz to 20kHz response though the treble was a bit lumpy. The bass however rolled off early, with  $-6$ dB at 65Hz, which is rather high for a speaker in this price category. The grille was seen to have little effect on the response.

At 2 metres, the treble had smoothed out and the family of off-axis responses suggested a well integrated output from the two drivers. The 30° off axis curve was one of the best in the issue, so these speakers could be left in a neat 'straight head' position. The 'lightweight' quality was seen in the overdamped bass, rolling away from 150Hz.

For a speaker of this average sensitivity, the 96dB distortion results were very creditable, even at low frequencies. At 86dB spl, third harmonic improved markedly to a 'good' level, and while it was poorer than average on compression, measuring 2.2dB, the inter-modulation was rather better at  $-44$ dB.

Edging a fraction below 6 ohms in the treble, this speaker was otherwise easy to drive and would qualify as a straightforward 8 ohm load, uncritical of amplifier choice.

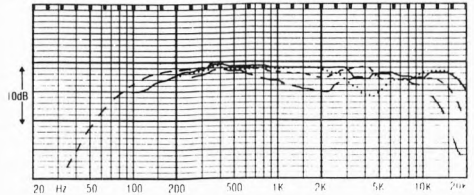
As with the similar 152, the room response proved most revealing. While some extreme bass was evident the main bass range was surprisingly deficient, leaving the midrange exposed and 'forward'. From then on, however, the output was pretty good. In design terms, I would say that the sensitivity target was too high, and that a smaller magnet, providing a realignment to 84dBW, would possibly to the trick — unhinging the bass and bring the rest into balance.

**Summary**

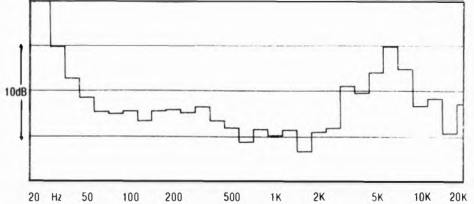
Despite considerations of excellent finish, good build quality and the inclusion of stands in the price, in HFC sound quality comes first. The panel clearly heard faults, which were also revealed in the computer averaged room response, and consequently the scores were insufficient for recommendation.

**GENERAL DATA**

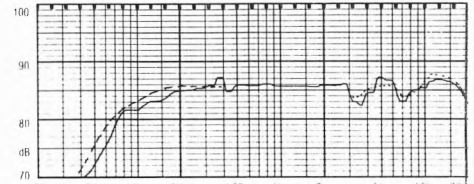
Size (height x width x depth).....	51 x 20 x 28cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(15)—150W
Recommended placement.....	on stands supplied
Frequency response, within ±3dB at 2 metres.....	80Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	65Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	86dB/W
Approximate maximum sound level (pair) at 2 metres.....	103dBA
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	good
Typical price per pair, including VAT.....	£299



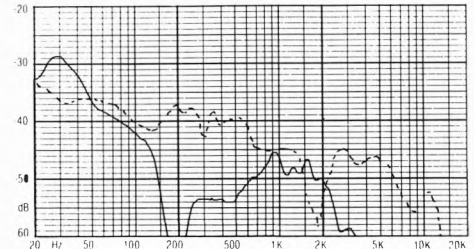
Forward characteristic response (1/3 octave at 2m, dotted 15" vertical, small dash 30" lateral, long dash 45" lateral).



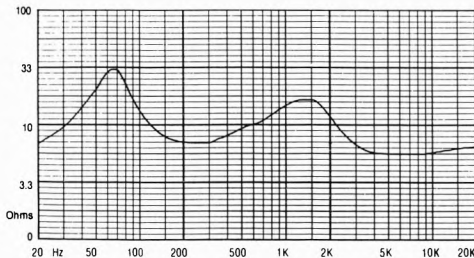
Averaged forward characteristic response in room



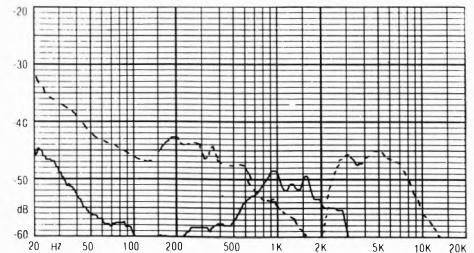
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

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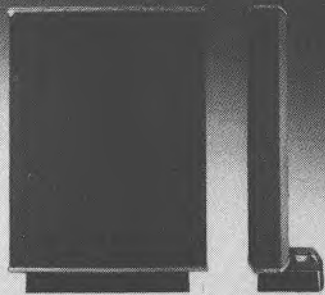
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## Mordaunt-Short MS20

Mordaunt Short Ltd, Durford Mill, Petersfield, Hants GU31 5AZ  
Tel (0730) 80721



Already acquiring a good reputation, the *MS20* could possibly be regarded as an economy version of the *Carnival* — with its vinyl-wrap cabinet, it offers a substantial cost saving. Fortunately for the consumer, things do not always turn out exactly as the manufacturer intends, and this is just one of those instances of an 'economy' model where the end result turns out to be embarrassingly good!

A slim, two-way 14litre box enclosure, the *MS20* is well finished in a convincing black ash vinyl with an unrebated grille, which as the tests show is best discarded.

Bass is provided by the wide-range Mordaunt Short doped pulp-cone 200mm driver, complemented by a diminutive plastic-dome Audax tweeter, the latter ferro-fluid cooled.

Working at around 3.5kHz, the crossover uses five medium power components and rear connection is by means of plain 4mm sockets. The

enclosure is made of 15mm rigid chipboard, with a volume filling of polyester wadding. While it probably will work best on open stands, the *MS20* will also survive shelf mounting if such a location is deemed essential.

### Sound quality

Rated at the upper end of the 'good' category, the *MS20* sound is quite exceptional at the price. When re-entered several times in the 'blind' listening tests, as one of the 'repeat' references, its performance was judged consistently good.

Bass, although of moderate depth was felt to be well balanced, tight and tuneful, while the midrange was relatively uncolored, detailed and possessed of good transient definition. The treble was slightly recessed, but pleasantly so, with only mild fizziness and sibilance in evidence. The lower-mid did however show some moderate boxiness.

The overall effect was tidy and civilised with good control over the whole frequency range. Stereo images were well focused and revealing of recording acoustics, possessing fine depth and fairly good transparency was also evident, these results fine at the price.

### Lab results

Marginally above-average, the sensitivity measured 87dB/W and with a 15 to 75W amp power range, up to 102dBA could be obtained from a pair. The bass rolloff was typical at 55Hz, -6dB, while pair matching was fine. As can be seen from the dotted response on the one metre measurement, the output was rather smoother with the grille detached, this also confirmed by the listening tests.

At 2metres a mild mid plateau was evident but otherwise the output was quite uniform on all measured axes. At 15° above-axis a mild dip was evident, suggesting that the speaker should not be positioned below the listener's head level. Conversely the 30° off-axis lateral position looked to provide a fine result, and, so the speakers do not need to directly face the listener in the lateral plane.

At 96dB distortions were about average, at typically 2% second harmonic and 0.8% third, with a worthwhile improvement at 86dB spl. The tweeter showed a distinct distortion peak at 20kHz, but this was not considered too important.

With the impedance close to the 8ohm standard, the *MS20* was classed as a very good amplifier load, and so can make the most of its

available sensitivity.

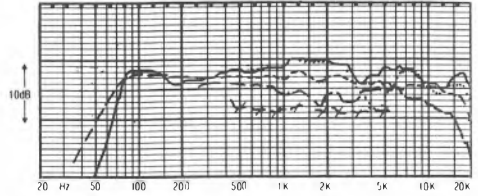
The integrated room response was most revealing, showing the midrange forwardness, plus a surprisingly extended, slightly 'shy' bass as well as a treble which uniformly decayed with the right curvature.

### Summary

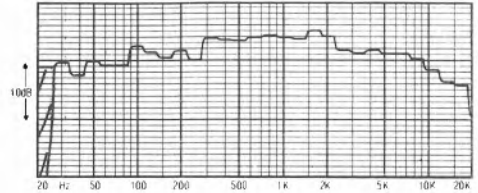
This speaker produced a remarkably good performance for the price. Slightly upper-mid forward, in all other respects it offers a finely-balanced array of subjective and objective qualities, which made Best Buy classification mandatory. Subsequent experiments with the MS20 have shown that if well positioned it can do justice to very costly ancilliary equipment. Re-auditioned for this issue, comments from the panel were much as before and the 'Best Buy' rating still well justified.

### GENERAL DATA

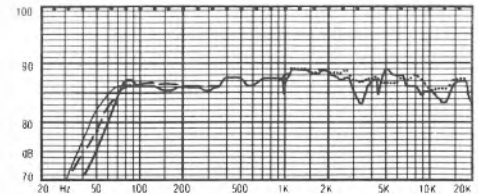
Size (height x width x depth).....	42 x 25 x 20cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(15)—75W
Recommended placement .....	open stands or shelf
Frequency response, within $\pm 3$ dB, at 2 metres .....	65Hz to 20kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	87dB
Approximate maximum sound level (pair) at 2 metres.....	102dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, inc VAT .....	£98



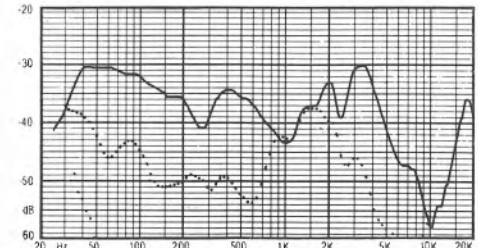
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted  $15^\circ$  vertical, small dash  $30^\circ$  lateral, long dash  $45^\circ$  lateral).



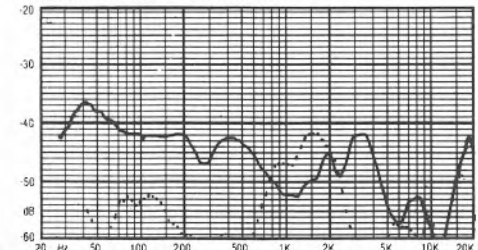
Averaged forward characteristic response in room at listening position.



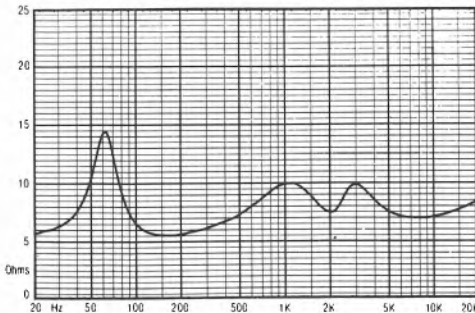
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



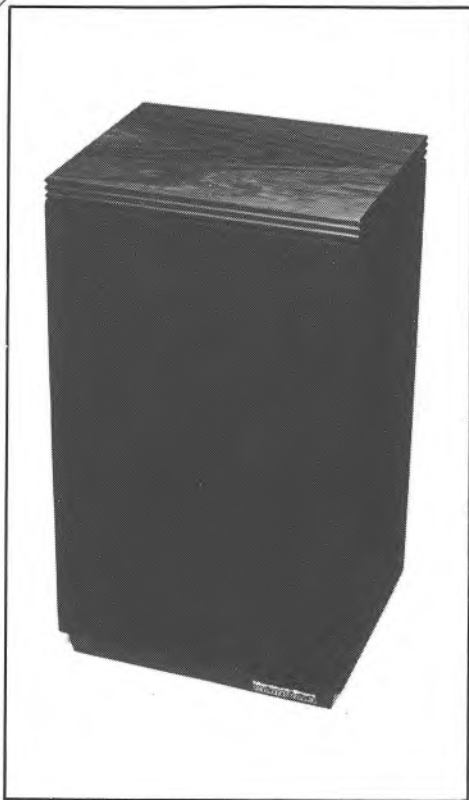
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Mordaunt-Short Carnival 3

Mordaunt Short Ltd, Durford Mill, Petersfield, Hants GU31 5AZ  
Tel (0730) 80721



Such are the vagaries of speaker design, that the *Carnival* did not do as well on test as its close but cheaper relative the *MS20*, even though it offers an apparently better technical performance.

Fitted with real wood end caps, the main body of the speaker is wrapped in good quality cloth. A two-way sealed-box, the *Carnival* uses the same drivers as the *MS20* — bass and midrange are covered by a 200mm doped cone unit, the MS D208BB, and the treble is allocated to the 20mm conedome Audax tweeter. The latter is inexpensive but can sound surprisingly good if skillfully handled by the system designer.

A good-quality crossover is used to marry the units, with 4mm sockets for electrical connection, plus a small fuse to protect the high frequency unit.

Matching slim pillar stands with four-spoke 150

bases are available as an optional extra. The system carries a five year warranty.

## Sound quality

The *Carnival* was rated as 'above average' by the listening panel, which is good for the price and indicative of recommendation. The sound appeared open and lively with good clarity, able to reveal more than just a hint of the different recorded acoustics. Stereo quality was quite good with some depth effects.

Colorations included mild mid 'boxiness' plus some nasality, and a sibilant, rather 'obvious' treble register. It was definitely a little too bright and open, and in consequence did not present a well balanced tone. As regards its bass, it was quite tight and articulate if lacking in final extension.

## Lab results

The *Carnival's* sensitivity measured 87.5dB/W, a little above average, and with its 100W maximum power handling capacity it could provide up to 103dBA for a pair in a typical room.

Closely toleranced, pair matching was almost perfect, while bass rolloff measured 54Hz, -6dB, and was quite uniform. Overall the frequency response at 1metre was slightly uptilted but it was remarkably smooth. At 2metres the upwards tilt effect with frequency was a little more obvious but the speaker nonetheless illustrated a very good set of forward responses of good uniformity.

Measured at a 96dB sound pressure level, the distortion was unexceptional averaging 2% second and with third harmonic rather better at 0.3%. Some improvement in both harmonics was evident at 86dB, at which distortion now measured around average or marginally poorer.

Room integrated by the computer analyser, the result was rather good, showing a very well-integrated lower frequency range plus a smooth mid but a marginally humped treble. Correct subjective balance remains a very subtle aspect of speaker 'voicing.'

The impedance curve showed a simple, easy-to-drive characteristics, and the *Carnival* thus rated as a very good amplifier load.

## Summary

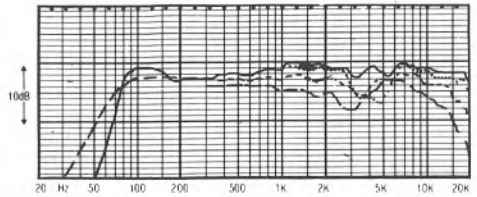
The *Carnival* is a good all rounder possessed of many qualities, including a very even response, and it deserves to be taken seriously. Its main weakness appears to be one of tonal lightness, with its mildly sibilant and excessive



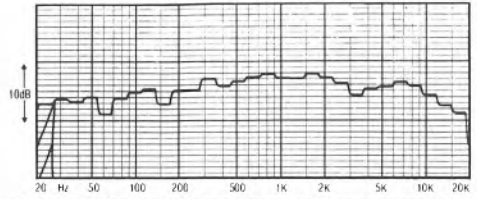
treble register, and how this affects the end result may well depend on the programme source — a 'duller' sounding moving magnet cartridge could also be beneficial here. However despite our reservations, the speaker has nonetheless done well enough to merit recommendation.

**GENERAL DATA**

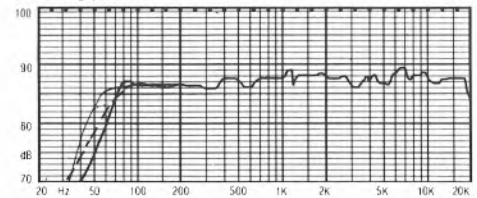
Size (height x width x depth).....42 x 25 x 20cm  
 Recommended amplifier power per channel  
 (for 96dB BA minimum per pair at 2 metres).....(20)—100W  
 Recommended placement.....open stands  
 Frequency response, within ± 3dB, at 2 metres .....65Hz to 20kHz  
 Low frequency rolloff (— 6dB point) at 1 metre.....54Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....87.5dB  
 Approximate maximum sound level (pair) at 2 metres.....103dB  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....very good  
 Typical price per pair, inc VAT.....£ 138



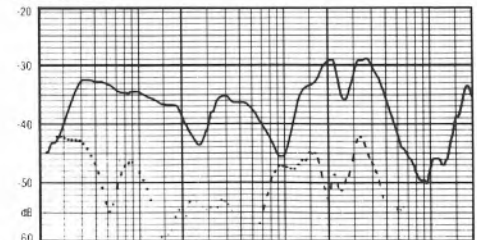
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



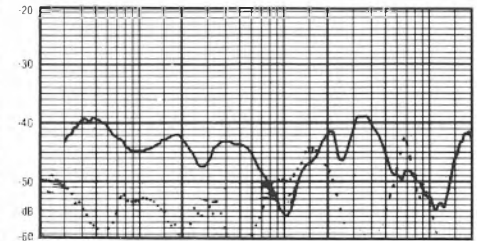
Averaged forward characteristic response in room at listening position.



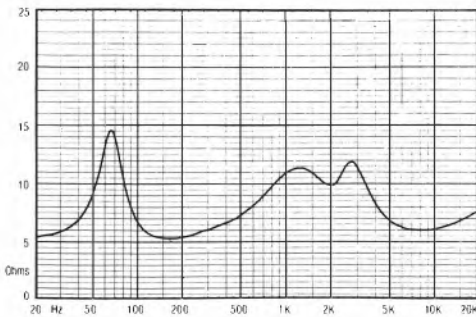
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber 1F



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

**BEST BUY**

## Mordaunt-Short MS40

Mordaunt Short Ltd, Durford Mill, Petersfield, Hants GU31 5AZ  
Tel (0730) 80721



Mordaunt Short designer Mike Deadman took a crucial step some years ago when the MS 200mm bass/mid unit was developed. This pulp cone, with its critical flare, applied damping and sensible sensitivity, has since proved to be the foundation of a whole range of designs, which are still continuing to emerge. The latest is the *MS40*, a middle-category compact of some 22 litres internal volume, reflex loaded at low frequencies. The port, which is 35mm in diameter by 18cm deep, is highly damped, yet serves to tune the low frequency range and load the bass unit in the main power range. In this two-way system, the treble is handled by a 25mm dome/cone tweeter, with integral phase plate.

The chipboard cabinet is strongly constructed with deep, well-glued corners and circumferential bracing. Mainly in 15mm grade, the front and back panels are MDF and the

cabinet has fittings on the underside to take a matching stand. Electrical connection is by 4mm sockets. A good quality crossover is fitted, with six elements plus two special protection devices, the latter thermally operated and changing from very low to high resistance under overload, thereby protecting the drivers. Their influence, if any, on sound quality is not known at present, but we can state that no untoward effects were noted.

### Sound quality

Scoring a straight 'good', which was a fine result for the price, the *MS40* proved to be a well designed model. Panelists found little to criticise on grounds of coloration or balance, and it proved consistent over a wide range of material. The bass was quite well extended if a mite 'softened', while the mid was even and clear with an open quality. Both mid and treble showed good detail, and the treble was generally rated above average.

Stereo images were well focused, and a fair representation of image depth was obtained, including a sense of the recorded acoustic.

Coloration included a hint of boxiness allied to some 'cone' sound — evident, for example, on male voice, but not felt to be serious. It sounded very well controlled, too much so for one panelist who felt a little more life and attack were required; he considered it a touch bland.

### Lab report

Pair matching was good, meeting 0.5dB limits except at 400-500Hz where a minor 1.3dB difference was noted. The grille did have some effect and was considered better detached (dotted line on the reference response). Sensitivity was about average at 86.5dB/W, while the bass cut-off was typical at 50Hz. With its excellent power handling of up to 200W programme, the *MS40* will be capable of up to 105dB in a typical room in stereo. The response showed a mild mid forwardness but met  $\pm 2.5$ dB limits from 60Hz to 20kHz nonetheless.

Out at 2 metres, the forward response family showed very good control with fine lateral off-axis results. The mild dip in the vertical plane at 15° suggested the speaker should face the listener, preferably on a good stand, 30-50cm high. Driven to 96dB, the distortion harmonics were well controlled particularly at low frequencies, and it improved generally at 86dB,

where third harmonic was low except at 2kHz, where it remained close to 1% — a little on the high side. The compression test was handled well, with -1.1dB loss and a -40dB intermodulation.

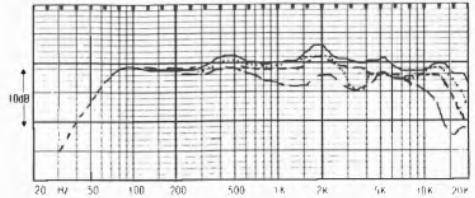
The reflex tuning did not show on the impedance curve since it was so highly damped, while the characteristic demonstrated a straightforward 8 ohm amplifier load. The room averaged response held no surprises with the speaker maintaining a fair output to 30Hz, and reasonably balanced to the smooth midrange. The interchange to the treble looked well controlled while the treble rolloff was almost as it should be.

**Summary**

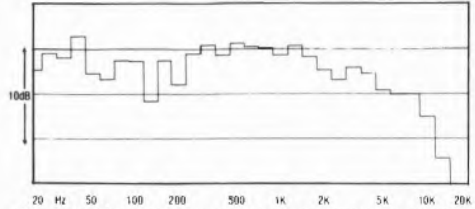
The MS40 is yet another well balanced and civilised Mordaunt Short system. Its fine control and open, even-handed sound attracted good marks from the panel and it should fit unobtrusively in a number of good audio systems. Both rock and classical were handled well and the MS40 wins Best Buy rating.

**GENERAL DATA**

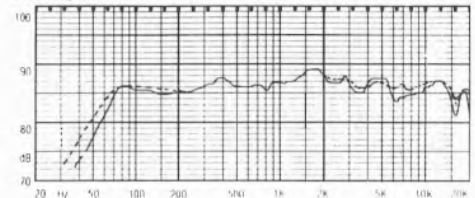
- Size (height x width x depth).....52 x 25.5 x 24cm
- Recommended amplifier power per channel (for 96dB/A per pair at 2 metres minimum).....(15)—200W
- Recommended placement.....on open stands
- Frequency response, within ±3dB at 2 metres.....55Hz-20kHz
- Low frequency rolloff (-6dB point) at 1 metre.....50Hz
- Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....86.5 dB/W
- Approximate maximum sound level (pair) at 2 metres....105dB/A
- Impedance characteristic (ease of drive).....very good
- Forward response uniformity.....very good
- Typical price per pair, including VAT.....£170



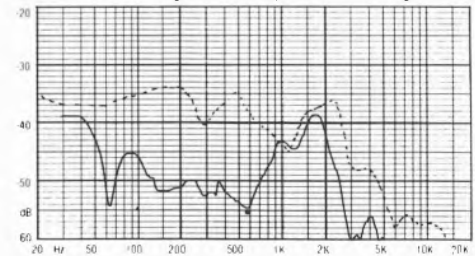
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



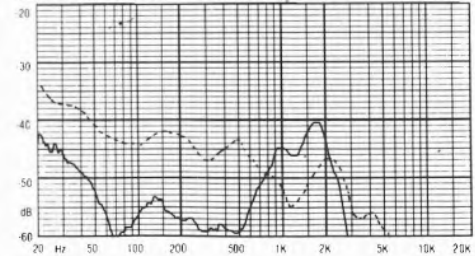
Averaged forward characteristic response in room



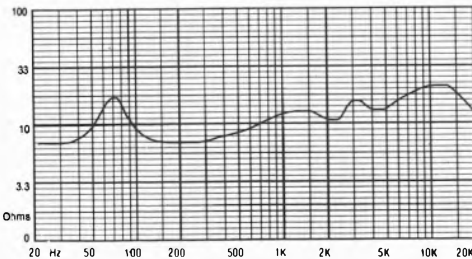
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

RECOMMENDED

## Quad ESL-63

The Acoustical Manufacturing Co Ltd, St Peters Road, Huntingdon PE18 7DB  
Tel (0480) 52561



This new design was very long awaited, and we received our samples just in time for inclusion in the 1981 issue. The original *Electrostatic* was reviewed some years back by a different author in *Choice*, and certain of the problem areas which emerged, namely directivity, bandwidth sensitivity, power handling and amplifier loading have all found partial solutions in the new model, albeit at a high price.

A single large-area damped plastic rilm diaphragm has been electrostatically energised to operate as a phased array of eight concentric elements, and the emerging wavefront is an approximate simulation of the radiation from a theoretical point source 30cm behind the centre of the panel. A high voltage delay line feeding the multiple elements incorporates compensation for the clamped boundary of the diaphragm, and also equalisation for the axial frequency response. The size and apportionment of frequency range and delay to the elements allows control of directivity, which is adjusted to give a smooth and uniform decay at increasing off-axis angles. But it should still be borne in mind that the directivity of the 63 is poor by comparison with the best moving-coil designs, and that the speaker remains rather critical of listening angle.

The latter characteristic presented a problem on tests, since in the modest confines of my listening room only two of the six Quad panelists could be in the optimum zone, and when used as suggested on the floor at our typical 3-3.5m listening distance, the main axial treble response was directed nearer to their chests than their ears. Accordingly, the speakers were elevated by

about 20cm on open stands and marginally tilted backwards. As with the Acoustat, further auditioning was also conducted with solo listeners to augment the panel subjective data.

The Quad 63 is a bipolar design which generates regions of acoustic power fore and aft, but is suppressed in the sideways directions. In consequence a rather different drive of room reverberation results compared with small box speakers which are considerably more omnidirectional. Thus even if the Quad did provide an identical axial frequency response to a low coloration moving-coil model, it would not sound the same due to the significantly different room reverberation tonal balance.

### Lab performance

The sensitivity reading was not comparable with a normal speaker due to the doublet directivity, and furthermore, the 1m reference response was theoretically too close, risking proximity and integration errors. Approximation or not, the reading was below average at 84dB/W, the reference response meeting  $\pm 2$ dB limits between 50Hz and 9kHz, outside of which some irregularities were charted which could not be wholly blamed on proximity, as a 2m and 3m check verified.

Averaged in  $\frac{1}{3}$ -octave bands at 2m, the speaker demonstrated a superbly even mid and low range response, with some mild 'lumpiness' above 5kHz. The response sensitivity to axis was shown by the special dotted curve, just  $7.5^\circ$  off axis vertically, which reveals more than a 5dB loss above 12kHz. The output decayed much more than average off-axis, but the decay pattern was exceptional in terms of consistency and evenness (see Acoustat.) In practice the bass rolloff point was indeterminate, depending on the listening room boundaries and in particular the distance to the rear wall (with zero bass when placed against the latter). In open air or in large rooms 34Hz  $-6$ dB is possible, but at a modest acoustic level.

While not as kind a load as Quad suggest, the speaker should not cause most amplifiers too much trouble, but when the speaker is heavily overloaded it protects by a short-circuit 'crowbar' which may damage some amplifiers and dips to 3.5 ohms were recorded at 50Hz and 10kHz. Above 60Hz, even at a full 96dB, the distortion performance was superlative, though the curve does not illustrate the 63's inability to accept inputs over 30W or so below this frequency without diaphragm rattling. Above 100Hz the distortion was 10-100 times better than usual but due to the speaker's protection circuit compression occurred at a 100W peak input;

however at 50W, just 3dB less, the pulse reproduction was simply too perfect to register measurements.

Due to the unusual directivity the room response is probably of marginal value, and certainly cannot be directly compared with the results for normal box systems. It is however included just for the record, but did not correlate well with the subjective data. The midrange at least is notably smooth, but the 60Hz prominence is more exaggerated than usual.

### Sound quality

At risk of appearing to make excuses for the 63, the subjective data did partly reflect its directionality, and side positioned listeners were not well served. Prolonged solo sounds suggested that to some extent the sound was something of an acquired taste, and that if its particular qualities appealed, these could assume such overriding importance than no other model would suffice. On first hearing however it can sound somewhat 'dead' and 'clothly' due in part to the loss of reverberant energy in the upper frequencies when compared to a conventional speaker. A trace of a 'whistly' quality in the extreme treble was audible to a few keen-eared listeners, while the sweetness and integration of the mid/treble band at first lends a dim impression until experience shows that the necessary treble detail still exists but in an unusually natural form.

Listeners accustomed to a dynamic and punchy bass of good power handling, particularly on rock-oriented programme, found the 63 disappointing since it could not play very loud, and the bass power though a little more extended than a 3/5A, was little greater. Without the 'liveness' and 'excitement' of some of the better box systems, it at first appears to lack detail and transparency. But prolonged listening showed that this was due to the misleading frequency balance, and that on axis superb image depth as well as detail were apparent. Respectable scores were nevertheless achieved throughout the sessions.

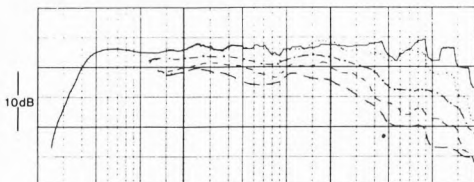
### Summary

Since our original review minor improvements have been made to this speaker, notably considerably revised protection circuitry, allowing louder and better reproduction of bass transients. While not a powerhouse, it does at least now do respectable justice to the bass on rock material, particularly if this is digitally derived and hence free of overhang or subsonic excitation. Fully re-auditioned for this edition, it achieved very respectable scores especially on digital masters.

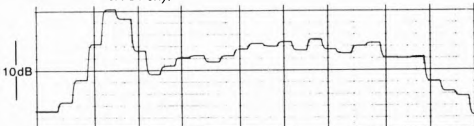
The Quad has uniquely musical qualities through the vital mid registers, and deserves auditioning on high quality material if its blend of strengths and weaknesses are to be fairly assessed by the intending purchaser. The results continue to justify a *Choice* recommendation despite the elevated price.

### GENERAL DATA

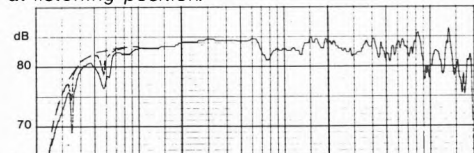
Size (h x w x d) .....	93 x 66 x 27cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	(25)-100W
Recommended placement .....	on open stand, well clear of rear wall
Frequency response within $\pm 3$ dB (2m) .....	40Hz to 18kHz
Low frequency rolloff (-6dB) at 1m .....	34Hz
Voltage sensitivity (ref 2.83V, ie 1 watt in 8 ohms) at 1m .....	84dB/W
Approximate maximum sound level (pair at 2m) .....	99dBA
Impedance characteristic (ease of drive) .....	fairly difficult
Forward response uniformity .....	good*
Typical price per pair inc VAT .....	£1000 when reviewed, now £1200
*see text	



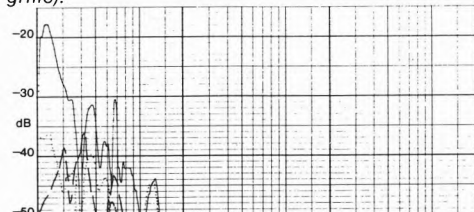
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



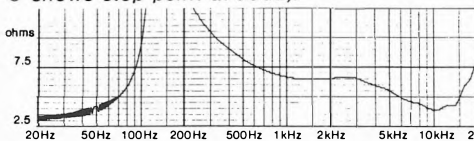
Averaged forward characteristic response in room at listening position.



Reference sineWave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



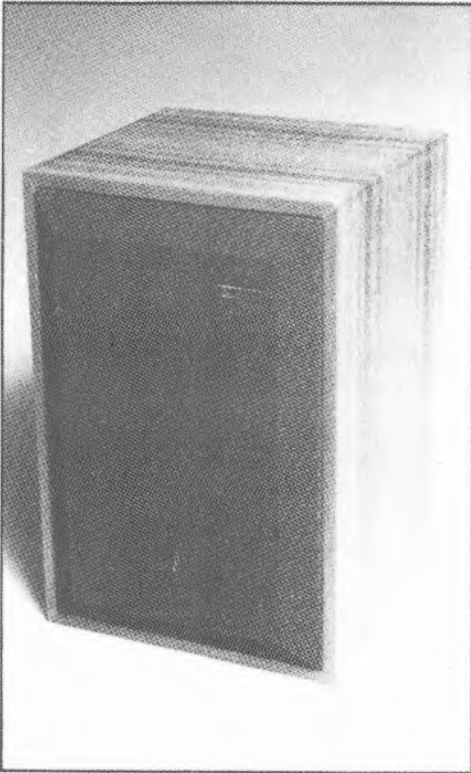
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, o shows stop point at 96dB).



Impedance (mod Z).

# Richard Allan RA8

Richard Allan Radio Ltd., Bradford Road, Gomersal, Cleckheaton, W. Yorks. Tel (0274) 872442



We were particularly looking forward to evaluating this compact and inexpensive speaker since the brochure mentioned its use by the BBC. Well finished in real teak veneer, using an acoustically superior foam grille in matching contour and colour, the RA8 is a sealed-box enclosure of 14 litres internal volume (Richard Allan's slightly misleading figure of 28 litres refers to the external dimensions). A 50W maximum power handling capacity is claimed, and a response from 90Hz to 20kHz  $\pm 3.0$ dB.

A 200mm bextrene-cone bass/mid unit is partnered by a plastic dome 19mm tweeter, which uses a diaphragm rather similar to that fitted to the original T27. The system resonance occurs at 70Hz, which is a little on the high side if good bass extension is to be obtained. Interestingly, in appearance the 200mm unit closely resembles the original BBC driver used by Rogers in their first commercial BBC monitor, the LS3/6A, and Richard Allan did in fact carry out

some of the production work on the original drivers in the late '60s and early '70s. The magnet is smaller on the R/A unit, with changes to the voice coil as well as surround termination.

Filled with polyester fibre, the 17mm chip-board cabinet has no panel damping. The crossover point is nominally at 3kHz, and five elements of average quality are used to divide the frequency range between the two drivers.

## Lab performance

Measured at 1m, one sample met  $\pm 4.5$ dB limits from 45Hz to 20kHz, with the loss of energy from 2–5kHz precluding tighter limits. The second sample showed a good match except at 4kHz, where a narrow notch was charted. Very good up to 2kHz, the response below 150Hz was marred by a lift of 2–3dB in the bass, while the narrowness of the 4dB notch suggests phase problems in the design, a suspicion confirmed during the 2m testing.

Plotted in the usual  $+15^\circ$  vertical direction 'A', a different notch appeared at 2.7kHz, some 10dB deep. Moving to  $15^\circ$  below axis, the 1 to 2kHz range output would seem to increase significantly and show rather better integration, so by implication this speaker's best integrated response would seem to be directed at the floor. It should either be used inverted, or alternatively mounted fairly high up as used in our tests. Vertical anomalies excepted, the remainder of the response was well ordered if rather 'lumpy' at 2 metres.

Sensitivity was slightly below average at 85dB/W, allowing a maximum level of 98dBA per pair and providing a modest bass extension to 50Hz  $-6$ dB. The system was easy to drive with a minimum impedance of better than 6.4 ohms.

At 3dB above its nominal power limit (ie 100W) the RA8 was in electrical overload at 500Hz, 3rd harmonic distortion reaching 16.0% with 4.0% of 2nd; 5kHz was handled rather better with 3.0% 2nd and 1.0% 3rd. The speaker was none too clean at low frequencies, where the results were dominated by 2nd harmonic products at both 96 and 90dB sound levels. By 100Hz 3rd had reached a poor 30%, 96dB and was still 15% at a modest 90dB, corresponding to only 3.5W sinewave input.

Although promising in the 100Hz–2kHz range, room averaging on the RA8s showed a prominent bass as well as a loss of energy from 2–4kHz, and also a relatively elevated treble range.

## Sound quality

The *RAB* performed moderately well on the live sound comparisons, though the bass was judged below average due to the limited power, some distortion, and a lack of power fundamentals. The treble was 'exposed', showing sibilance on speech, while the mid had a 'closed-in' 'boxy' quality, with some 'boomy', 'nasal' and 'hollow' effects. In its favour, the mid was smooth and free from 'hardness' or 'harshness'.

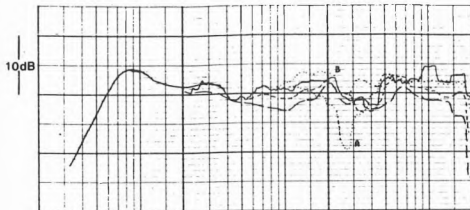
Below par on the commercial stereo sessions, the treble register emphasised hiss and occasionally added a tizzy quality. Detail was lacking and the stereo imaging suffered from a lack of impact and 'immediacy'. Even on stands the bass showed a 'one-note' undamped tendency, and could not 'play tunes' respectably. Once again it was the midband alone which was promisingly smooth.

## Summary

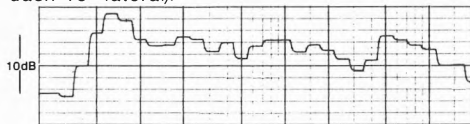
While this speaker is inexpensive and offers quite a lot of engineering and finish for the money, it is lacking in openness and immediacy resulting from poor phase control and a lack of presence, which in turn probably derives from the crossover design. If this area could be reshaped then R/A might have a worthwhile model on their hands, but as it stands, and taking into account the below average distortion as well as limited power handling capacity, it cannot be recommended.

## GENERAL DATA

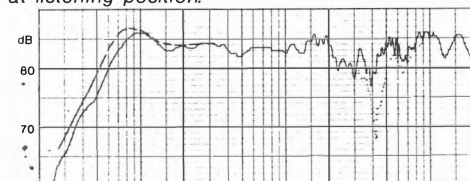
Size (h x w x d) .....	39.3 x 26.5 x 27cm
Weight .....	6.8kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) .....	(25)–50W.
Recommended placement .....	open shelf or stand
Frequency response within $\pm 3$ dB (2m) .....	55Hz to 20kHz
Low frequency rolloff (–6dB) at 1m .....	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m .....	85dB/W
Approximate maximum sound level (pair at 2m) .....	98dBA
Impedance characteristic (ease of drive) .....	very good
Forward response uniformity .....	fairly good
Typical price per pair inc VAT .....	£125



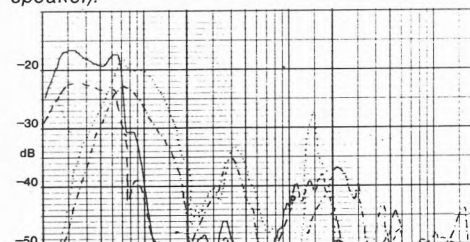
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



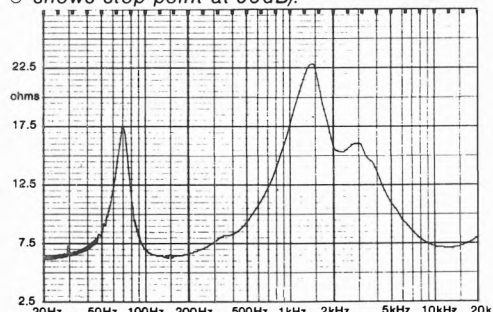
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response of other speaker).



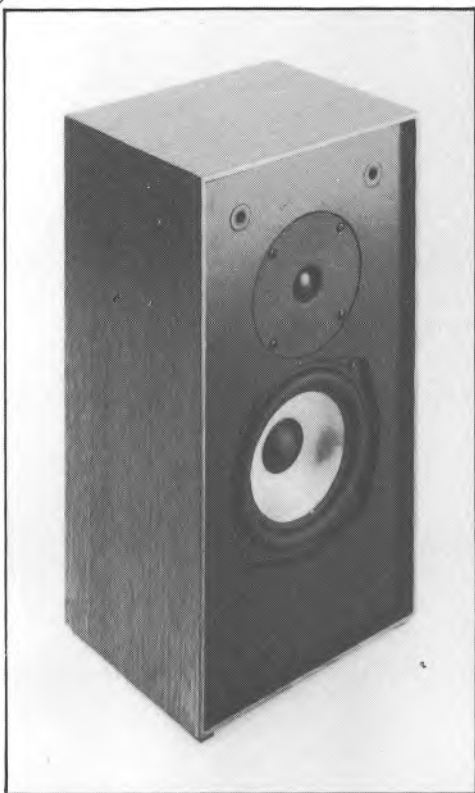
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

# Rogers LS1

Swisstone Electronics Ltd, 310 Commonside East, Mitcham, Surrey  
Tel 01-640 2172



not to cause an acoustic problem.

## Sound quality

Scoring significantly above average, which was good for the price, the *LS1* has done well for a miniature system. It sounded fairly well balanced with good levels of detail and clarity plus notably articulate voice. The bass was fair, while the treble did not draw attention to itself, always a good sign. Some boxiness and 'plumminess' were however apparent, giving a rather full cello sound, for example, but overall it was quite even-handed on both rock and classical material. Depth was quite well represented, and the speaker also had the ability to produce a good stereo focus, especially on high stands placed well out into the room. With these smaller boxes, the stereo quality is otherwise rather susceptible to interference from nearby walls.

While the bass sounded 'puffy' and soft when played loud, the speaker demonstrated a remarkable power handling and survived 300W of peak programme, remaining in fair control here.

## Lab report

Sensitivity was a little below average at 85.5dB/W while the -6dB bass point was high, although typical for the size, at 65Hz. Pair matching held to within  $\pm 0.7$ dB and the axial frequency response looked pretty uniform. Some of the treble irregularities were clearly introduced by the grille and were a function of the distinctive front panel, as well as cabinet styling. Without the grille in position it met  $\pm 2.5$ dB limits from 85Hz to 20kHz. Given the good power handling, sound levels of 104dB should be possible from a stereo pair.

Out at 2 metres, the averaging smoothed things out well and the intrinsic response was seen to be very uniform and well controlled over the forward axes, showing a mildly depressed treble register with a very mild midrange plateau. Driven to 96dB the second harmonic content was high at 8%, 20kHz but was reasonable elsewhere. Considerably reduced at 86dB, the distortion performance here was better than average. Compression was significant at 2.3dB, but interestingly the intermodulation product was very good at -46dB. The minimum impedance did not fall below 6.4 ohms and the loading was typically 10 ohms; this is an easy amplifier load.

The room response confirmed the uneven

A high quality miniature from Rogers, the *LS1* has a modest 8 litre internal volume, bass-reflex tuned. The rather small port, 28mm in diameter by 100mm deep, is fitted to the rear panel. The well built Medite enclosure is finished in natural veneer, and the 120mm bass/midrange unit is fitted on rubber decoupling mountings to reduce cabinet excitation. This unit is a long-throw type driver with a polypropylene cone, built on a steel chassis and fitted with a generous magnet. The treble is handled by a SEAS 19mm polyamide dome, and crossover between the units is accomplished by a very high quality 8 element network.

While no panel damping is used, the interior is lined with acoustic foam for internal absorption of standing waves, with electrical connection via 4mm sockets. Unrebated, the 6mm deep grille panel is probably thin enough



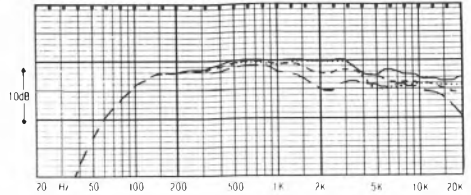
bass, with a touch of mid register richness plus the open well integrated treble, the latter notably depressed. The rolloff above 10kHz was as it should be, without sharp steps or 'corners'.

### Summary

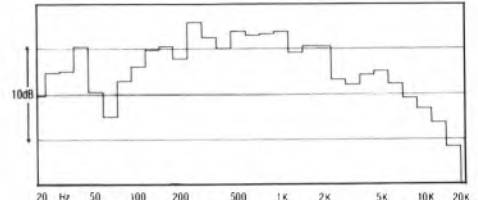
It is quite an achievement for a miniature to do this well in such a competitive market area. The *LS1* is a pleasant loudspeaker of fine finish and very good build quality; all factors are well balanced, and the model qualifies for *HFC* recommendation.

### GENERAL DATA

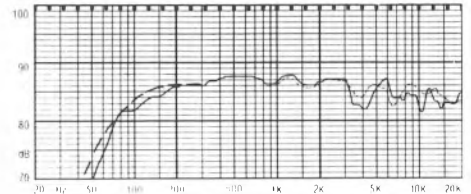
Size (height x width x depth).....35.5 x 19 x 16cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(15)–200W  
 Recommended placement.....on open stands  
 Frequency response, within  $\pm 3$ dB at 2 metres.....80Hz–20kHz  
 Low frequency rolloff (–6dB point) at 1 metre.....65Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....85.5dB/W  
 Approximate maximum sound level (pair) at 2 metres...103dBA  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....very good  
 Typical price per pair, including VAT.....£150



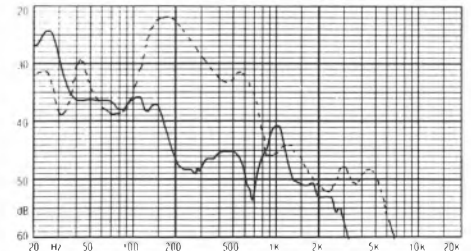
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



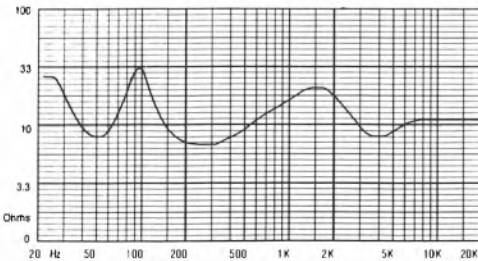
Averaged forward characteristic response in room



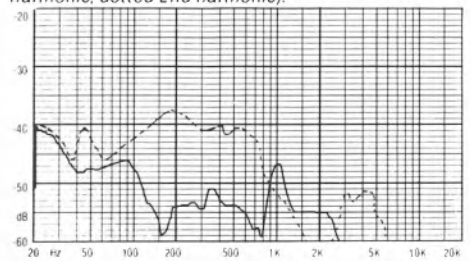
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

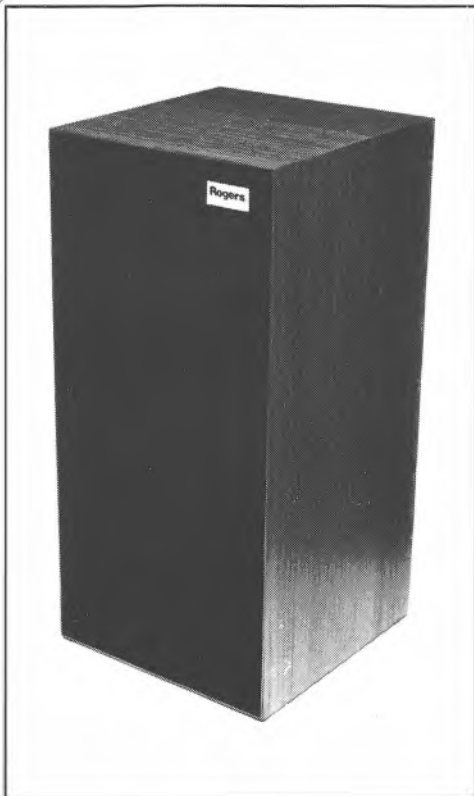


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Rogers LS7

Swisstone Electronics Ltd, 310 Commonside East, Mitcham, Surrey  
Tel 01-640 2172

**BEST BUY**



Rogers' LS7 is a fairly compact stand-mounted system, with an internal volume of 30litres. The design has been refined since it was first introduced, and the pair reviewed here are representative of current production.

Tuned to give a damped quasi-Butterworth alignment, the large reflex ducted port is 65mm in diameter, its exit flared to reduce distortion. The excellently finished enclosure is constructed of 12mm bituminous damped MDF with a reinforced 19mm-thick MDF front baffle. None of the panels are removable, internal access gained via the bass unit aperture.

The bass/midrange unit has a nominal diameter of 200mm, and uses a generous magnet, a high-power voice coil and a patented polypropylene cone possessing the classic BBC profile. A selected version of the Celestion HF1000 soft-dome 25mm tweeter covers the remaining frequency range, the excellent-

quality 13 element 3kHz crossover.

External connection is by means of 4mm socket/binding posts and the internal wiring is to a high standard, the LS7 typifying Rogers traditionally fine workmanship.

One component which I do feel needs revision, though, is the grille. Strong enough to resist warping by its now rather dated Tygan cloth, the assembly is acoustically unfavourable — a foam replacement would help here.

## Sound quality

The panel were highly impressed by the LS7. It was felt to be tonally accurate and well balanced, with an extended and uniform frequency response. Good instrumental detail was preserved throughout the frequency range, while coloration was held to a consistently low level.

Stereo images were spacious, focused and full of the intended recorded-acoustic detail. Images also demonstrated impressive depth, with an almost crystalline transparency.

The LS7 provided good extension in the bass, and while they seemed slightly 'leadened' footed here, powerful and clean articulation were in evidence. The sound was consistently clean and free of boxy effects.

Very mild criticisms were recorded concerning a slight edge and sibilant treble, with a mild vocal chestiness but neither was of much consequence. The speaker gave fine results on analogue sections but clearly excelled on the digital programme.

## Lab results

The LS7 showed fine pair matching when measured at 1metre, the axial response disfigured by a notch at 7kHz. Removal of the grille gave the more elegant dotted response illustrated. The well-damped bass response was uniform and well balanced in character, extending to 48Hz, -6dB, which was fine for the size of enclosure. Sensitivity was above average at 88dB/W, and an impressive 200W power capacity was established. Maximum sound levels of 106dBA were possible from a stereo pair, while as little as 10W would give interesting results. The sensitivity was not compromised by the impedance, which showed only a minor dip at 8kHz, with a mean value of 10ohms, thus making the LS7 a very good amplifier load.

Out at 2metres a fine set of off-axis responses were demonstrated. At 15° above a mild 4kHz dip occurred (still affected by the grille) so the speaker should be directed or elevated sufficiently to face the listener.

Panelists felt the balance to be slightly 'rich', this confirmed by the 2metre trend.

When room-averaged, very good correlation with the subjective findings was established. The bass was only marginally 'rich' and showed a well-integrated response extension in the room. The mid was quite uniform and married correctly with the treble register which smoothly decayed above 8kHz.

Measured at 96dB, low frequency distortion held to below 3% second harmonic and 1% third, and was very fine above 300Hz, which is the more critical range in this respect. At 86dB distortion improved greatly with the midband readings excellently low, measuring less than 0.1% over a couple of octaves!

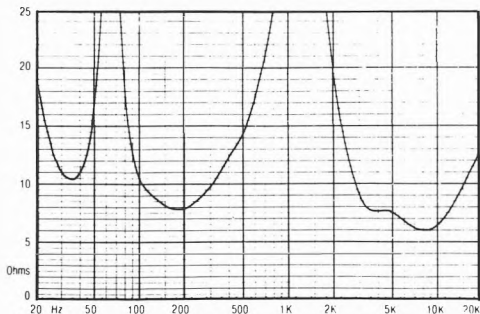
### Summary

Clearly 'digital ready' the LS7 in its latest form provides a remarkably well-balanced subjective and objective performance. All aspects of sound quality such as extension, balance, stereo clarity and coloration were very good, while technically speaking it was easy to drive, low in distortion, sensitive, and consistent as regards frequency balance.

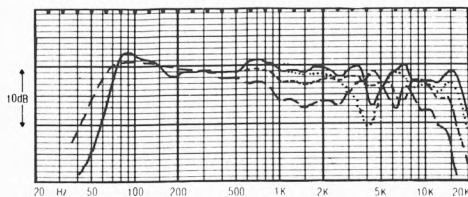
A current sample was checked and found to give a smoother grill-on response and slightly more sensitivity. Listening tests strongly confirmed the Best Buy rating for this beautifully-made and well-balanced performer.

### GENERAL DATA

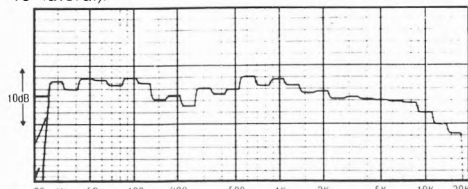
Size (height x width x depth).....	56 x 27 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—200W
Recommended placement.....	open stands
Frequency response, within $\pm 3$ dB, at 2 metres.....	55Hz to 18kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	48Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	88dB
Approximate maximum sound level (pair) at 2 metres.....	106dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair, inc VAT.....	£285



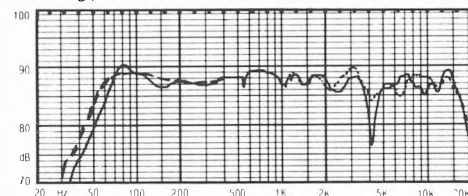
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



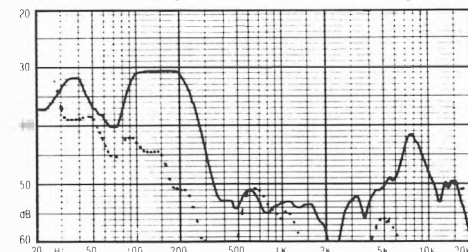
Forward characteristic response ( $1/2$  octave at 2m, dotted 15 vertical, small dash 30 lateral, long dash 45 lateral).



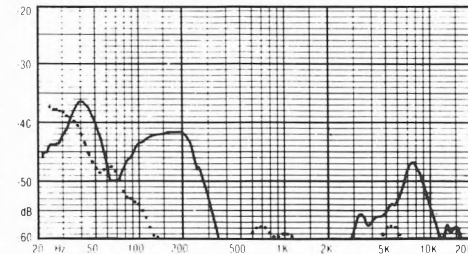
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

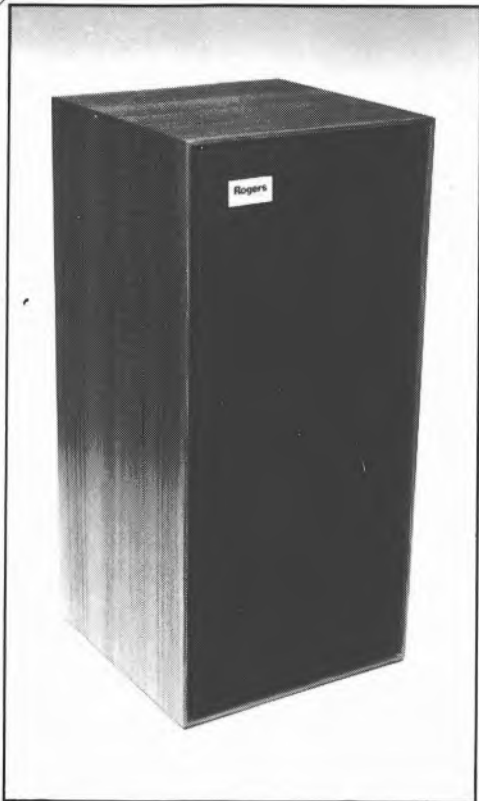


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

RECOMMENDED

# Rogers Studio One II

Swisstone Electronics Ltd, 310 Commonsidge East, Mitcham, Surrey  
Tel 01-640 2172



Well-received in previous issues, the Rogers *Studio One* has now been extensively revised by the manufacturers, with improvements to the bass cone, sensitivity, bass alignment and cabinetry.

A 'classic' Bextrene-cone design, the *Studio One* is a medium-sized bass-reflex model of comparatively high power capacity. Its 44litre enclosure is built of MDF panels, fully veneered and clad internally with bituminous damping pads. It is tuned to a partially-damped 'quasi' bass alignment using a large-diameter ducted port with a large volume velocity, which uses a chamfered front exit to further reduce distortion.

The main driver is a 200mm bass/mid unit, built on a cast-alloy chassis and employing a generous magnet plus high temperature capability Kapton motor coil former. The primary tweeter is a version of the long-lived Celestion

HF1300, while the final half-octave is filled in by a KEF T27, a 19mm plastic dome.

A top quality crossover integrates the drivers, and the XLR rear connector is now joined by a pair of 4mm socket/binding posts.

Overall, finish and engineering are to a very high standard.

## Sound quality

The previous *Studio* did well in our tests, and was mainly criticised for a significant bass overhang. The new version did show much better control in the bass although it still suffered from a trace of bass excess, this admittedly more noticeable on digital as opposed to analogue sourced programme.

Measured against the higher standards of this new issue, the *Studio One* did not fare as well as its predecessor, but nonetheless it achieved an above-average rating which was sufficient for a recommendation.

Overall the performance was quite good, with well focused stereo images, fairly good depth and a pleasing level of clarity as well as detail. Tonally, it appeared accurately balanced, with an even, wide response.

We noted some confusion on heavy bass percussion, while there was some mild 'boxiness' and 'hollowness', plus a mild brashness, with less than perfectly sweet rendition in the treble registers.

## Lab results

As before, pair matching was excellent with a very smooth frequency response over most of the range. A slight bass excess was present at 80Hz, while the dotted curve on the one metre response showed the effect, which was slight, of removing the grille.

This latest version of the design showed a 2.5dB improvement in sensitivity, which was now about average at 86.5dB/W. Power capacity ranged from 20 to 200W and sound levels of up to 104dBA are expected to be available from a pair in a typically sized room. Good bass extension was shown by the rolloff to 36Hz, -6dB.

Out at 2metres a very uniform response was demonstrated, with good off-axis results, these closely matching the axial curve. In balance terms this speaker now looks a little rich.

Room-averaged, the *Studio* definitely produced bass of fine extension, if somewhat excessive. The mid was slightly forward but the remaining response was nicely controlled.

Measured at 96dB, distortion above 500Hz

was very good, measuring under 0.3% second and with negligible amounts of third harmonic. Below this frequency, an average of 2% distortion was noted, and a general improvement resulted with a reduction to the 86dB SPL, typically measuring 0.3% or less over the whole range for both second and third harmonic content. These results are much better than those recorded for the earlier version.

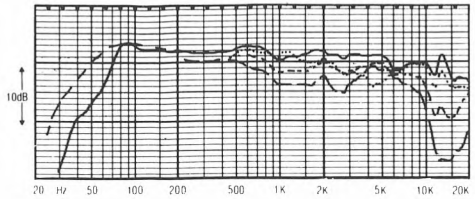
There were no serious impedance anomalies, with the value typically at the 12ohm level, and the *Studio* may thus be classed as a good amplifier load.

**Summary**

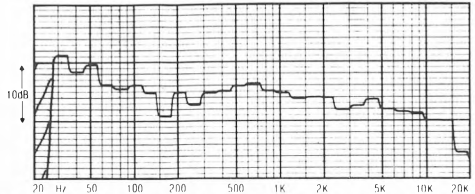
Since the last issue Rogers have further improved the *Studio One*. When partly remeasured, the frequency response was very similar to that previously recorded, but with a significant 2dB increase in sensitivity to 88.5dB/W; a good level. The bass register now appears to be in better proportion, and still maintains its above average extension, (-6dB at 38Hz.) It is not quite such obvious good value as the *LS7*, but this smooth and civilised performer represents good audio and engineering value, and our recommendation is therefore continued here.

**GENERAL DATA**

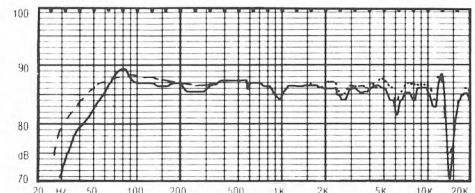
Size (height x width x depth) ..... 63.5 x 30.5 x 30.5cm  
 Recommended amplifier power per channel  
 (for 96dBa minimum per pair at 2 metres) ..... (20)—200W  
 Recommended placement .....  
 Frequency response, within ± 3dB, at 2 metres ..... 42Hz to 20kHz  
 Low frequency rolloff (-6dB point) at 1 metre ..... 36Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre) ..... 86.5dB  
 Approximate maximum sound level (pair) at 2 metres ..... 104dBa  
 Impedance characteristic (ease of drive) ..... very good  
 Forward response uniformity ..... very good  
 Typical price per pair, inc VAT £380 when reviewed, now  
 £397



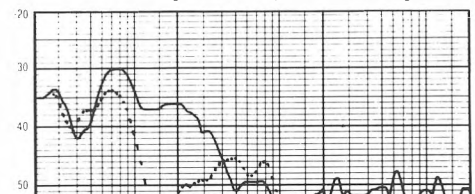
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



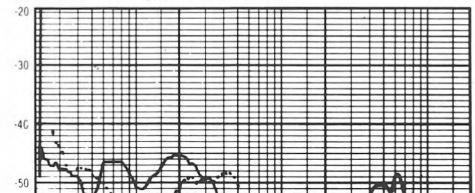
Averaged forward characteristic response in room at listening position.



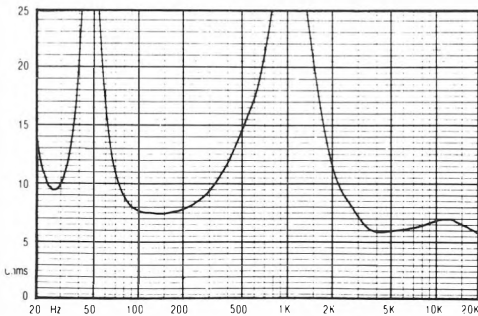
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

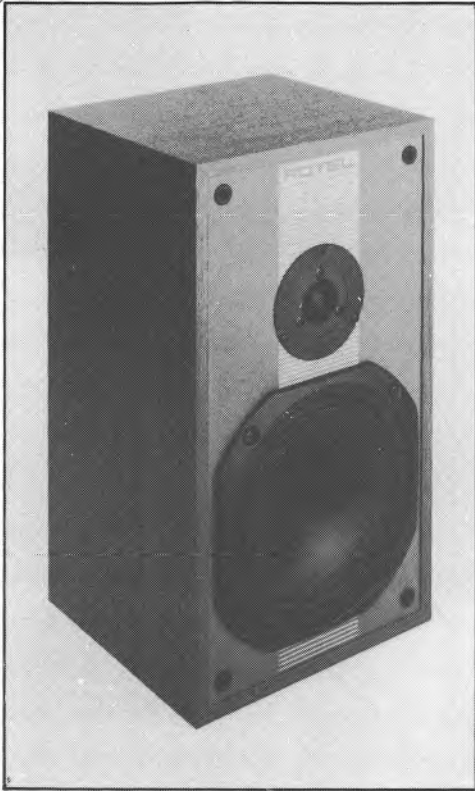


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Rotel RL850

Rotel Hi-Fi, 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks  
Tel (0908) 317707

RECOMMENDED



A standard, two-way sealed box system, this 20 litre speaker is built in Denmark for this Japanese-based company. But the design is UK-inspired and uses a British Elac 220mm pulp cone bass/mid range fitted with a modest magnet and built on a strong pressed steel frame. The treble is handled by a Peerless 25mm soft fabric dome, and the connections are hard wired in oxygen-free copper cable, using a simple three element crossover network, with an additional resistor to provide attenuation for the treble. Built from 15mm thick chipboard, the enclosure is finished in vinyl 'walnut', and well filled with acoustic absorption.

The grille panel is unrebated and 15mm thick — it probably should be discarded to get the best sound. On the rear panel 4mm socket/binding posts are fitted for speaker cable connection.

## Sound quality

Scoring 'above average' on listening tests, the *RL850* did well in its category; it costs less than half the group average.

Some coloration was evident, namely a softening in the bass and a touch of boxiness in the mid, plus a muted fizz in the treble. The frequency response sounded quite even, if slightly dulled, while the upper-mid and treble lacked detail, with an inconsistency here depending on the type of programme played.

Stereo images were good, in terms of width, but central focus was not particularly strong, and depth was muted. Despite the latter characteristic, the speaker sounded fairly big hearted, and could convey some of the weight and ambience present in the programme. Voice quality was quite good, and the speaker also handled high power inputs gracefully, proving quite happy up to 220W peak programme.

## Lab report

Pair matching was found to be very good — to within  $\pm 0.5\text{dB}$ , which is a great achievement for such an inexpensive speaker. The grille has some effect on the treble response and is better left off. The reference sensitivity measured an average 87dB/W and in conjunction with the generous power handling, this means that levels of up to 105dB are possible from a stereo pair, assuming that you have a large enough amplifier. Fairly smooth and well balanced, the response met  $\pm 2.5\text{dB}$  limits from 66Hz to 20kHz, while the -6dB bass rolloff came in at 52Hz, which is about average.

Out at 2 metres, the forward response family was fairly well integrated. A dip at 4kHz occurred above axis suggesting that this speaker ought to be at, or alternatively directed towards, ear level. The lateral responses were nonetheless good.

Driven to 96dB spl, the distortion measured 1% for second harmonic, and rather less for third. Below 100Hz there was a usual increase to 3% or so was seen. When sound level was reduced to 86dB, distortion improved significantly to a good level to typically 0.4%. Compression was poorer than average at 2.7dB, but the bass-mid intermodulation figure was very good at -48dB.

The impedance curve indicated a normal 8 ohm load, typically measuring 10 ohms at higher frequencies, and posing no problem at all for a modern amplifier. Driving the listening

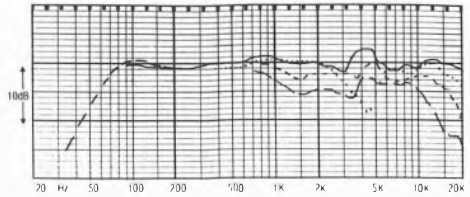
room, the speaker produced a well balanced and extended response. Within that general trend however, the mid showed some prominence at 800Hz while a forward energy notch was clearly present at 2.8kHz, indicating poor phase control through crossover, and this left the treble somewhat isolated as well as uneven.

**Summary**

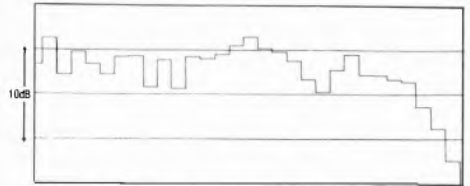
While some quirks have been unearthed in the performance of this speaker, the fact remains that it nonetheless offers very good value. A powerful, competent two-way system with a 200mm driver, when most in this category have 110mm, the 850 achieves Best Buy status. With a little more attention to the crossover, it could possibly be even better!

**GENERAL DATA**

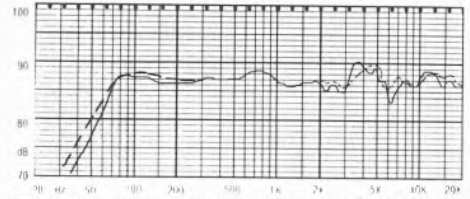
Size (height x width x depth).....44 x 25 x 25cm  
 Recommended amplifier power per channel  
 (for 96dB/A per pair at 2 metres minimum).....(15)—150W  
 Recommended placement.....on open stands  
 Frequency response, within +3dB at 2 metres.....63Hz-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....52Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....87dB/W  
 Approximate maximum sound level (pair) at 2 metres....103dB/A  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good  
 Typical price per pair, including VAT.....£80



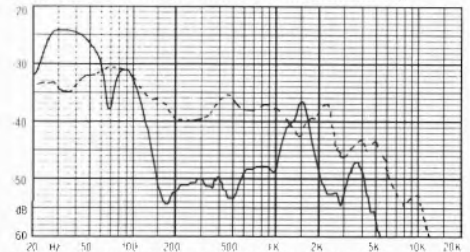
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



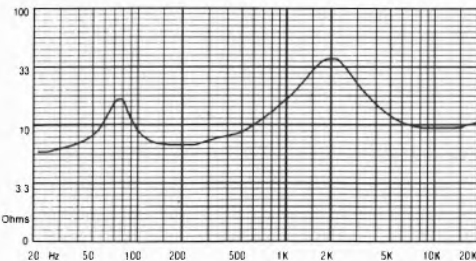
Averaged forward characteristic response in room



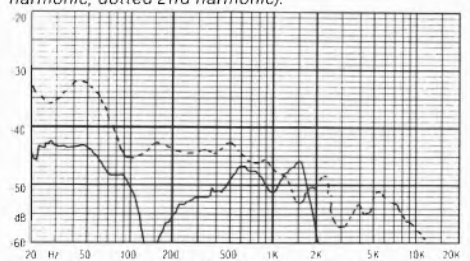
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# SD Acoustics SD2

SD Acoustics, Unit 1, The Mill, 41-42 Cottage Grove, Surbiton, Surrey KT6 4JH  
Tel 01-399 0778



SD Acoustics are a recently-established UK company with some interesting ideas on speaker system design, but the bluff-looking SD2 is actually quite a straightforward model. A sizable, sealed box, two way system, it has an internal volume of some 50 litres. The drivers are larger than usual; both come from Son Audax and comprise an efficient, pulp-cone 250mm bass-mid, built on a pressed steel frame, with a 34mm soft fabric dome tweeter. The latter is well placed acoustically and is usable at lower than normal crossover frequencies.

Sturdily built from 20mm thick board, the enclosure is well finished in real veneer, and reinforced by multiple internal bracing. A superior foam grille has been fitted, and the properly recessed drivers are screwed and glued in place — rather a problem for servicing, I should have thought. The speaker is carefully

built, and hardwired, with the two crossover sections brought out on the back panel. These may be paralleled for normal working or separated for experiment with distinct cables or double amplifiers, a sort of bi-amp working.

## Sound quality

This speaker in normal working mode scored a straight 'average' on panel audition. Panel results were mixed, and although it is reputed that some sound improvement results from using double cable, we unfortunately did not have enough time to verify this.

A definite 'character' was evident, with a 'speakerish' mid coloration occasionally apparent. The treble was uneven, nasal and yet muted on strings. It showed an open, somewhat forward balance with some loss of depth in the stereo image, while stereo focus was not considered to be very sharp; a good stage width was however in evidence. While fairly detailed, the SD2 was not considered to be very transparent. The bass was well controlled but felt to be too dry, this emphasised by the mid prominence. In the treble, the effect was again one of a good, though of isolated area. On rock some panelists favoured it, while on classical programme others marked it down.

## Lab report

System resonance was at 55Hz, the Q factor rather low as the -6dB point was also 55Hz, high for the size of box. Reference sensitivity measured an above average 90dB/W, and this, in conjunction with its healthy 200W power handling meant that substantial 108dB sound levels would be possible from a stereo pair. Good pair matching was demonstrated, while as expected the grille had no untoward effect. The reference frequency response met  $\pm 3.5$ dB limits, 60Hz to 20kHz, this included some irregularities. Out at a 2 metre microphone distance, these were more clearly shown. Here the response rose from 100Hz to 1kHz, a 'forward midrange' effect, to be followed by a trough of several dB from 1.5 to 6kHz. Above this the treble reappeared, isolated and again sloped up with rising frequency. Driver integration was otherwise quite good, with the off axis response typical of a larger than usual treble unit.

Distortion was moderate at 96dB sound pressure level, measuring well under 1%, while at the reduced 86dB level, the distortion was



further improved, to a 'very good' standard. Compression was average at 1.7dB, while the intermodulation product was fine at better than 45dB down. Well controlled, the impedance curve showed no out-of-spec dips and it met the 8 ohm standard without any problems.

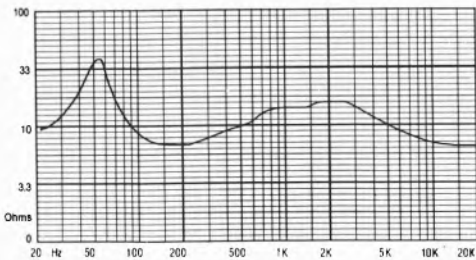
The room characteristic curve showed that the bass was indeed extended, but depressed relative to the mid band plateau, the latter extending from 400Hz to 1.6kHz. The treble also looked isolated.

**Summary**

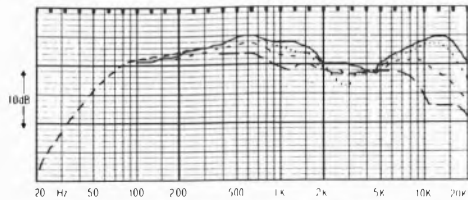
Superbly built and finished with a high dynamic range, good sensitivity as well as low distortion, the SD2 has its own specific character. The panel results showed good things lie within this box, making it worth trying; conversely its sound varies somewhat with programme. Worth auditioning, it could well suit your room or system, and as it stands a cautious commendation is possible for this interesting design, which was however thought too expensive for full recommendation.

**GENERAL DATA**

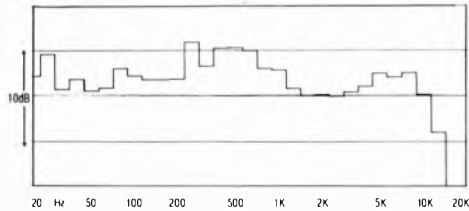
Size (height x width x depth).....	55 x 38.5 x 35cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(20)—200W
Recommended placement.....	on stands, near rear wall
Frequency response, within ±3dB at 2 metres.....	65 Hz-20kHz
Low frequency rolloff (— 6dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	90dB/W
Approximate maximum sound level (pair) at 2 metres... 108dBA	
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, including VAT.....	£450



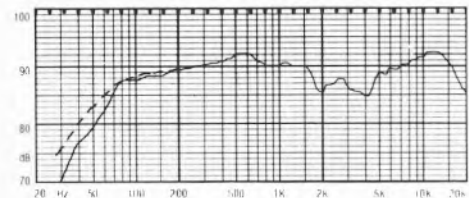
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



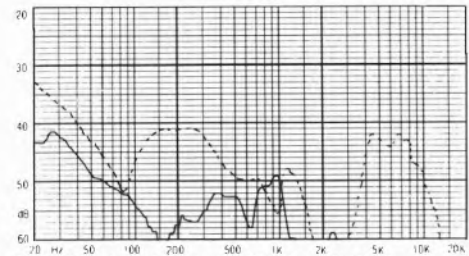
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



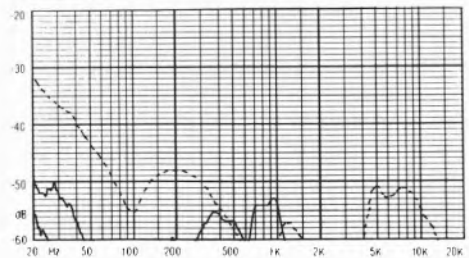
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Sony APM22ES

Sony (UK) Ltd, Sony House, South Street, Staines, Middlesex TW18 4PF  
Tel Staines 61688



Sony, in company with several other Japanese manufacturers, have been developing planar drivers. First seen in the expensive 'Esprit' speakers, the APM piston technology has been brought down market to a point where a two way system could be developed to supercede the successful G1. The APM22 is built in Germany at Sony's Wega plant, using two Japanese drivers; these are a 220mm square bass/mid and a 25mm square treble, both with extra light, strong aluminium honeycomb diaphragms. The bass driver is built on a fine die cast frame and is fitted with a generous magnet, and a high quality five element crossover is used. The 30 litre enclosure is reflex tuned by a rectangular port 75mm deep, its 44 square centimetre area equivalent to a generous 7.5cm diameter aperture.

Finished in vinyl laminate, the solid enclosure has some bracing, and is built from

high density chipboard. Sensible 4mm socket/binding posts are provided for electrical connection, and while shelf use is possible, this system gives of its best on rigid stands, well clear of room boundaries.

## Sound quality

Scoring well on the panel tests, the APM22 achieved a 'good plus', which was very fine for the price. Clearly impressed, the panel actually found little to criticise. The bass was powerful and tuneful, with a hint of excess, while the mid was a mite thin and forward, showing mild boxiness as well. The treble was judged to be slightly bright but of very good quality — 'near electrostatic' was one comment.

The APM22 sounded notably clear and clean with excellent dynamics, an 'open' explicit presentation plus a pleasing transparency. Stereo images were well focused and both depth as well as the recorded acoustic were well presented. It also handled high powers well, surviving 300W programme with no limiting, and really high sound levels were produced in the process.

Coloration, particularly of the 'cone' variety was found to be quite low, which was appropriate in view of the absence of driver cones!

## Lab report

Reflex tuned to 55Hz the speaker showed about average sensitivity, at 88.5dB/W. Pair matching was excellent, to within  $\pm 0.5$ dB while the  $-6$ dB low frequency cutoff was a respectable 46Hz — good for the size. The grille did not impose unduly on the treble response, but this was still better with the grille removed. Out at 2 metres the axial response was exemplary, meeting fine  $\pm 1$ dB limits from 60Hz to 20Hz. The off axis family of responses looked tidy with the 3kHz crossover dip in the vertical plane suggesting that the speaker should be near ear level or at best directed towards it. At 96dB sound pressure level, distortion was pretty good, though rising to normal values below 200Hz; while at 86dB, it was much improved, though a mild peak in third harmonic was evident at 1kHz. Compression was poorer than expected at 2.5dB but the intermodulation product was excellent at  $-51$ dB.

Dipping just below 6 ohms at 170Hz, the impedance curve was otherwise well controlled, and will present no good amplifier

with any problems.

In the listening room, the computer-averaged response confirmed the listening test results. The curve showed a well balanced output, with good integration and some moderate bass excess at 50Hz. The treble was particularly good.

**Summary**

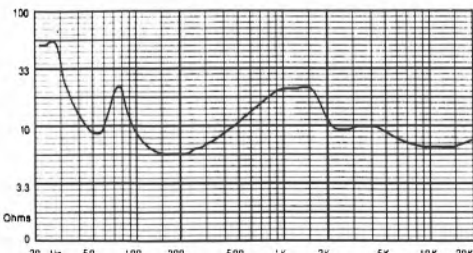
Here is the classic 'Best Buy' loudspeaker. Well engineered, it offers an essentially neutral, open, transparent sound, full of detail and life. The response is wide, the stereo good and the distortion moderate, while the sensitivity is above average. Furthermore it is easy to drive and usefully compact, interfacing well with our listening room. High sound levels of up to 105dB were also possible.

This speaker should easily replace the position occupied by its predecessor the *G7*, and is even better value than the older model; Best Buy status is confidently achieved here.

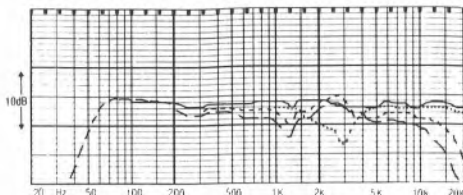
*(Note: A final production sample showed cosmetic improvements, with a sweeter tonal balance and slightly firmer bass.)*

**GENERAL DATA**

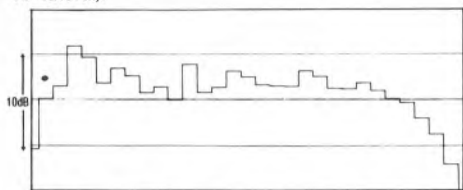
- Size (height x width x depth).....51.5 x 29 x 30cm
- Recommended amplifier power per channel (for 96dB per pair at 2 metres minimum).....(15)—200W
- Recommended placement.....on open stands
- Frequency response, within ±3dB at 2 metres.....53Hz—20kHz
- Low frequency rolloff (−6dB point) at 1 metre.....46Hz
- Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....88.5dB/W
- Approximate maximum sound level (pair) at 2 metres....106dB
- Impedance characteristic (ease of drive).....good
- Forward response uniformity.....very good
- Typical price per pair, including VAT.....£225



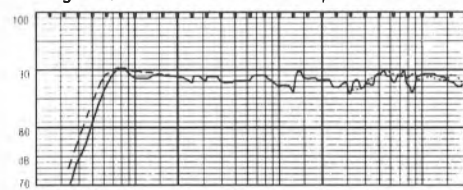
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



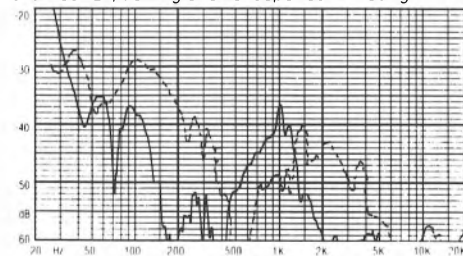
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



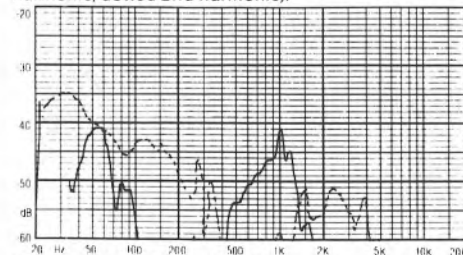
Averaged forward characteristic response in room



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

RECOMMENDED

# Spendor SA1

Spendor Audio Systems Ltd, Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER Tel (0323) 843474



The diminutive Spendor SA1 has been available for some years now, but has been somewhat neglected by the press. In fact it was last reviewed in *HFC* a few issues back, and as there had been strong hints that this could be a 'sleeper' model, we felt it was time we had another go at it.

In a sense the SA1 is Spendor's own earlier equivalent SL6, these miniature 10litre sealed box systems using a high-power 160mm plastic cone bass/mid range unit which possesses a critical cone flare and termination. Both units use decently sized magnets and cast alloy frames, but the SA1's 25mm fabric dome tweeter is possibly not as good a companion as the midrange driver deserves. However the SA1 is certainly a lot cheaper than the SL6!

Intended primarily for use as a miniature broadcast monitor, and avoiding the deliberate 'voicing' tweaks of the LS3/5A, the SA1 is

superbly built in thinwall multi-ply with heavy wall damping and internal absorption. An-echoically 'flat', it performs best in free space on relatively high, open stands, about 45cm off the floor. The grille frame is however rather close to the tweeter considering the small front panel dimensions, and this would be expected to cause problems.

## Sound quality

Considering its size and low sensitivity, the SA1 did remarkably well in the 'blind' listening trials. Considered to be tonally accurate with fine voice reproduction, the sound was well balanced as well as transparent. The response sounded smooth and tidy, with reasonable bass extension and no boominess, while stereo imaging was particularly good, showing a pleasing three dimensional effect, depth and ambience, with and sharp frontal plane focus.

Unless driven very hard with over 100W per channel, the bass was reasonably clear and clean, while the speaker sounded well controlled and low in distortion. Understandably, the sound improved in treble sweetness with the grille removed. Coloration levels were quite low — a mild tubbiness in the lower mid, with a trace of sibilance and an occasional sonic hint as to the miniature dimensions of the design.

## Lab results

Measuring a rather low 81dB/W sensitivity, the SA1 needs a minimum of 30W per channel amplifier power. Pair matching was considered very good, while the bass was uniform and of quite good extension to 52Hz, -6dB. The grille did spoil the measured treble response as suspected, and when removed the fine dotted line was measured, this  $\pm 1.5$ dB from 67Hz to 20kHz, which is a very fine tolerance. With a 100W power capacity, high acoustic levels were impossible though the 96dB maximum should be sufficient for most moderate domestic applications.

At 2metres a fine set of forward responses were obtained, especially with the grille removed. The 15° above-axis response was however a little weak and the SA1 should be adjusted in the vertical plane so as to aim at the listeners head. The  $\pm 3$ dB limits were comfortably met from 59Hz to 20kHz.

Like the SL6, this extended-response miniature integrated very well with the room, its high stand mounting position minimising floor reflections. Grille off, the overall characteristic was very promising and correlated well with the

perceived sound quality.

Distortion was average at 96dB, reaching 5% at 60Hz for second harmonic with third a little better. However the distortion was less at higher frequencies even though the system was clearly working hard at this level. At 86dB the SA1 improved considerably with quite good third harmonic distortion level, consistently at 0.3% or below.

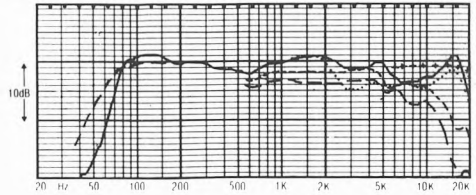
The impedance was rather high, and never fell below 8.5ohms, with its typical value at 16. Obviously this is an excellent load for any amplifier, and in fact these impedance values could be reduced to improve sensitivity without compromising the load characteristic.

### Summary

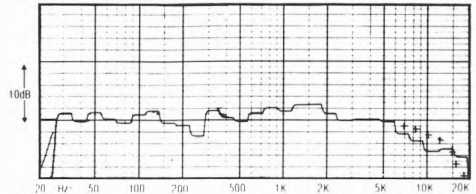
The SA1 achieved an important revival in our tests, using modern digital programme. On grounds of sound quality alone it almost achieves Best Buy status, but when its low sensitivity, somewhat limited maximum sound level and power handling are taken into consideration, a 'recommended' rating would seem more suitable. This surprising miniature is well worth trying on tall open-frame stands, using a generous amplifier. But please, Spondor, do something about that awful grille!

### GENERAL DATA

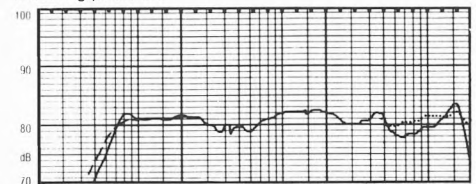
Size (height x width x depth).....	30.5 x 22.5 x 21.5cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(30) — 100W
Recommended placement.....	tall open stands
Frequency response, within $\pm 3$ dB, at 2 metres.....	59Hz to 19kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	52Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	81dB
Approximate maximum sound level (pair) at 2 metres.....	96dBA
Impedance characteristic (ease of drive).....	excellent
Forward response uniformity.....	very good
Typical price per pair, inc. VAT.....	£210 when reviewed, now £234



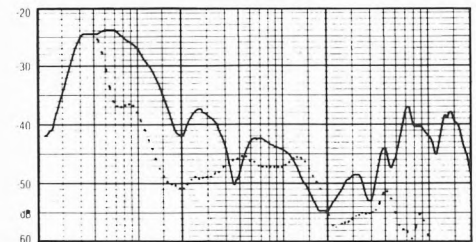
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



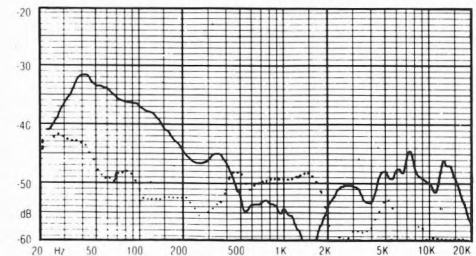
Averaged forward characteristic response in room at listening position.



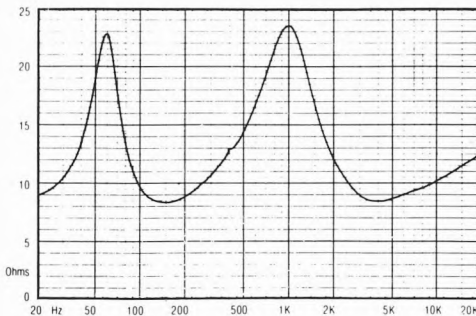
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Spendor Prelude and SA2

Spendor Audio Systems Ltd, Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER Tel (0323) 843474

**BEST BUY**



This review covers both the SA2 and the new *Prelude* from Spendor. Aside from a cabinet change from costly veneered multi-ply (SA2) to vinyl-wrapped chipboard (*Prelude*), the overall engineering and technical performance of the two models is very close indeed. The *Prelude* however offers a cost saving of some 30%, largely due to the cheaper cabinet construction.

The 28litre internal volume is reflex-tuned by a large ducted port, 75mm in diameter. The interior of the thinwall enclosures is damped by a bituminous cladding plus an acoustic foam lining. While the SA2 has a superior foam grille, the *Prelude* is fitted with a attractive framed wooden grille, whose acoustic effects can be seen from the response charts.

A Spendor-designed high-power Bextre-neconed bass unit is fitted to both systems, this using a 40mm pole and massive magnet, and built on a strong die-cast frame. The tweeter is a

selected version of the once ubiquitous Audax 25mm soft dome.

A close-tolerance 8 element crossover carries the units at around 3kHz, with electrical connection made by 4mm socket binding posts in the case of the SA2, and less worthy spring connections for the *Prelude*. Both systems are intended for free space positioning on open stands.

## Sound quality

Taking the newer *Prelude* first, listening panel scores were very promising and placed it in the 'good plus' category which was a fine result at the price. As with the other Spendor models, the midrange tonal quality and balance was a strong point, with voice and piano reproduced well. Overall frequency balance seemed accurate with a wide smooth response, while the bass was firm, and possessed quite good extension — if slightly bumpy or heavy at times, it was nonetheless low in distortion and high in detail.

Good clarity and detail were evident everywhere except in the lower mid where some cabinet boxiness and 'muddiness' were observed. The SA2 also suffered from this phenomenon though this time the result was an over-rich and almost chesty effect and on this aspect, the *Prelude* was ultimately preferred to the SA2.

Both gave fine stereo images with good staging and focus, plus impressive depth. Mild sibilance as well as a little 'slurring' was however observed in the treble. However, it was obvious that the difference in sound quality was not commensurate with the *Prelude's* lower price.

## Lab results

At one metre an above average 88dB/W sensitivity was recorded and the bass was perfectly tuned to rolloff at 48Hz, -6dB.

With a fine 200W maximum power handling the SA2 (and *Prelude*) is capable of a substantial 105dBA sound level in a room, using a stereo pair. Pair matching was itself very good, the two models very similar with the effect of removing the *Prelude* grille shown in the dotted response.

At 2metres the design demonstrated a very even, well-integrated forward characteristic, the overall trend being that of a gentle downtilt with increasing frequency. Limits of  $\pm 3$ dB were comfortably met from 55Hz to 20kHz.

In the listening-room computer-averaged re-

sponse the bass was slightly uneven, and mildly prominent at 50Hz. The mid was broadly uniform, with a slight presence dip evident before the treble rolled gently away.

Driven to a 96dB sound level, fine distortion results were demonstrated, averaging 1% at low frequencies and reducing to 0.3% above 500Hz. At 86dB the distortion improved considerably to a very good level for both second and third harmonic.

Averaging 13ohms, the impedance fell to a minimum of 6.7ohms in the treble. The system may be happily classed as an easy amplifier load, allowing full use to be made of its good measured sensitivity.

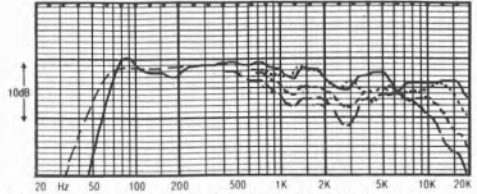
**Summary**

The SA2 version offers a superb finish and construction with a slightly different balance of coloration plus an acoustically-superior grille. It continues to be recommended.

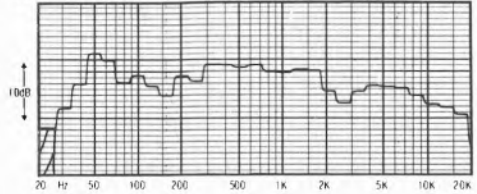
The *Prelude*, at a small sacrifice in cabinet finish achieves much the same performance as the SA2, and in the opinion of some may even achieve a better sound. Good sensitivity, smooth natural sound and fine stereo, all at an extremely attractive price, ensure that the *Prelude* is awarded a Best Buy.

**GENERAL DATA**

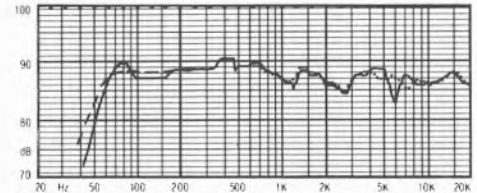
Size (height x width x depth).....	50 x 26 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(15)—200W
Recommended placement.....	open stands
Frequency response, within 13dB, at 2 metres.....	55Hz to 20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	48Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	88dB
Approximate maximum sound level (pair) at 2 metres.....	105dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, inc VAT.....	Prelude £219 SA2 £296



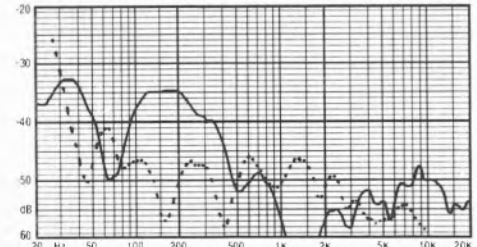
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



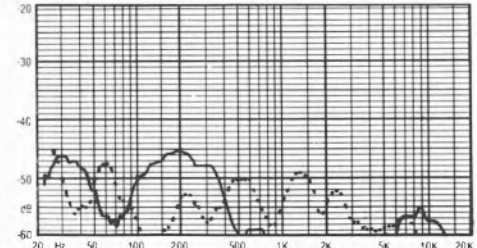
Averaged forward characteristic response in room at listening position.



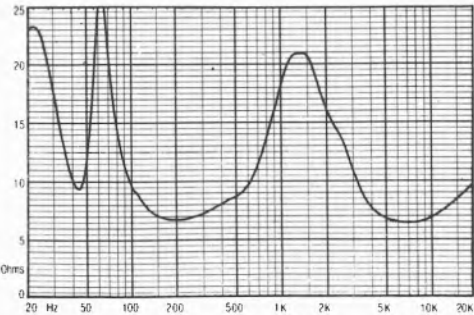
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grille.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



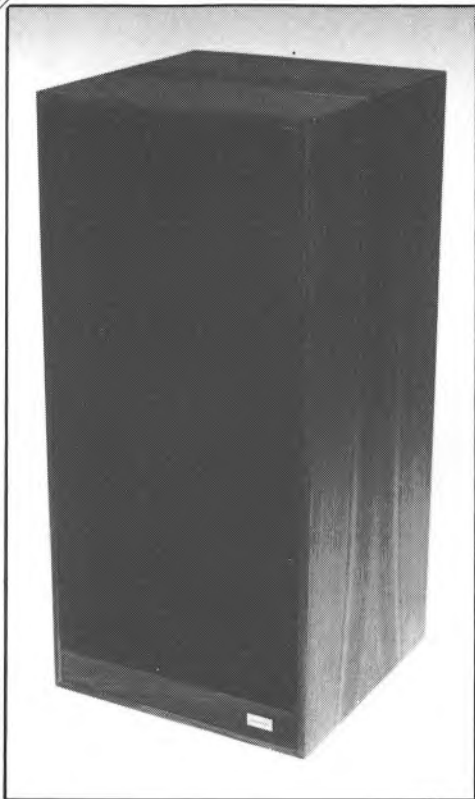
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# RECOMMENDED Spendor SP1

Spendor Audio Systems Ltd, Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER Tel (0323) 843474



version of the Celestion HF1300 dome tweeter takes over, the final half-octave filled in by the Coles 19mm plastic dome unit.

The 44litre enclosure is excellently veneered and is built of thinwall multi-ply, heavily bitumen damped and lined with acoustic foam.

The system is reflex-tuned by a large, offset ducted port and is intended for free space mounting on open stands.

The *SP1*s were initially supplied in a provisional prototype form, but these models were updated with final production samples before completion of the review.

## Sound quality

The *SP1* did well on the *HFC* test programme, providing favourable results on analogue material and even better scores using digital masters.

In balance terms it was felt to be tonally accurate with very good reproduction of human voice, showing natural sibilants and character. The frequency response sounded wide and uniform, with good extension, although with a slight excess in output at the lowest frequencies.

Mid coloration was generally low, the treble sweet and clear, while stereo perspectives were well constructed. Frontal focus, width and depth were all well presented.

High sound levels were possible with low apparent distortion and while some mild lower mid plumminess was observed, plus a touch of 'BBC' nasality this was not considered to be very important.

## Lab results

Measured at 1metre on axis, the *SP1* delivered a smooth response except for a small 3.5kHz peak (improved later on production speakers). The bass was precisely tuned and well extended to 41Hz, -6dB. Sensitivity measured 87dB/W, a little above average and more than double that of the *BC1* (in decibel terms, an increase of more than 3dB), and pair matching was judged very close. The recommended power input range is 12-150W, and maximum levels of up to 103dB were possible, again rather higher than for the *BC1*.

At 2metres the averaged response was very uniform, meeting  $\pm 2$ dB limits for 60Hz to 13kHz. The vertical dispersion was very satisfactory and laterally it proved well above average.

In the listening room the integrated response was very good indeed, and only marred by the slight bass excess noted previously.

Fine distortion results were obtained at 96dB

Over the past years Spendor have produced variants on the theme of the legendary *BC1* — for example, the higher sensitivity *BC2* — but none of them have quite captured the subtlety and midrange quality of the original.

While the new *SP1* is built in the *BC1* tradition, it uses a new grade of polypropylene exclusive to Spendor for the bass/mid unit. This 200mm driver has an extensively-developed cone, intended to work with a larger motor system than the *BC1* in order to provide higher sensitivity and power handling. It is built on a die-cast chassis and energised by a massive magnet assembly. The cone is doped by hand, and has its front pole cavity filled by an alloy plug, this attached to the pole face.

Spendor's traditional radiometal cored inductors are used for the high-quality crossover which also employs plastic-film capacitors. Above 3kHz Spendor's own closely selected



sound pressure level, measuring around 0.3% above 200kHz and holding to around 0.3% at lower frequencies. With the sound level reduced to 86dB, a substantial improvement to 0.8% or better was recorded at low frequencies, with negligible midrange second harmonic and an average of 0.2% third. These were fine results. The impedance curve averaged 14ohms, with a momentary and pretty harmless dip to 5.3ohms at 20kHz, and the SP1 was therefore classed as a very good amplifier load.

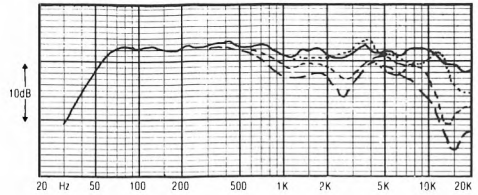
**Summary**

The SP1 has evolved into a subtle and musical sounding performer in the true Spendor tradition. It is expensive, but the good test results go quite some way towards justifying the price. Offering an easy amplifier load plus improved bass power, articulation and clarity, reduced midrange distortion and a higher sensitivity, the SP1 can give a decently high acoustic level. It possesses a clean, neutral tonal balance and should be equally valuable for medium-level monitoring or domestic use.

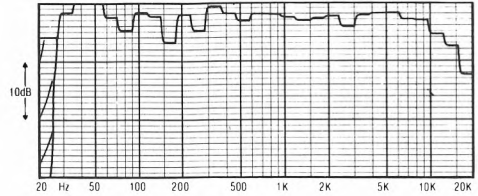
The SP1 receives a warm recommendation and will probably slowly displace the BC1 from its time-honoured position, especially where master-quality programme reproduction is concerned.

**GENERAL DATA**

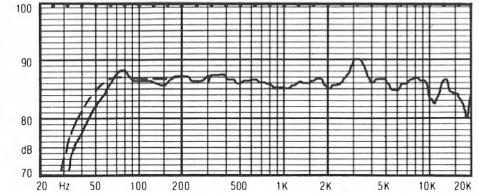
Size (height x width x depth).....63.5 x 29.5 x 30.5cm  
 Recommended amplifier power per channel  
 (for 96dB minimum per pair at 2 metres).....(12)— 150W  
 Recommended placement .....floor stand  
 Frequency response, within  $\pm 3$ dB, at 2 metres .....45Hz to 20kHz  
 Low frequency rolloff ( $-6$ dB point) at 1 metre.....41Hz  
 Voltage sensitivity  
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....87dB  
 Approximate maximum sound level (pair) at 2 metres .....103dB  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....very good  
 Typical price per pair, inc VAT.....£483



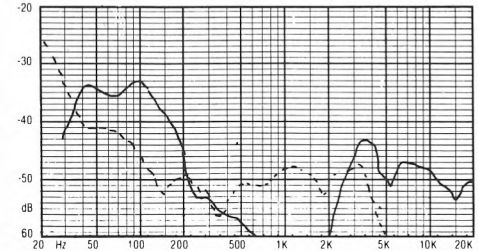
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



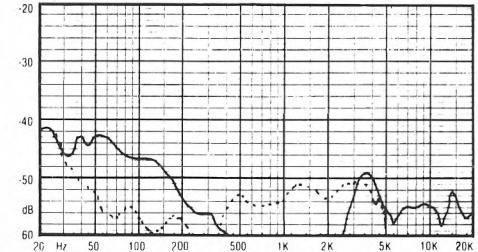
Averaged forward characteristic response in room at listening position.



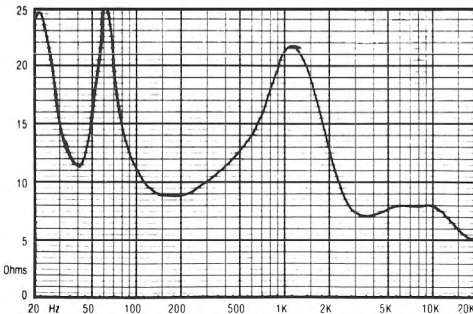
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



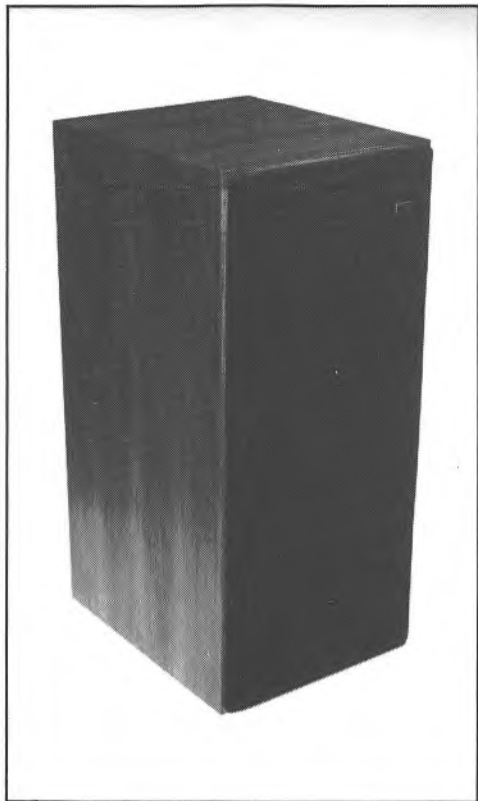
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Spendor SA3

Spendor Audio Systems Ltd, Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER  
Tel (0323) 843474



Reviewed in early form a couple of issue ago, the SA3 seemed due for reassessment in its current production form this time. Our original samples were active versions, but the new samples were passive ones with the normal crossover option — this can be replaced at any time with the necessary amplifier drive system to convert the system into a fully active design. A rear compartment is provided to accommodate the electronics.

Designed specifically for accurately-balanced reproduction of high sound levels, in particular for those applications where considerable bass energy is present in the programme, the SA3 has a massive 120litre bass-reflex enclosure. This is tuned by a high acoustic output ducted port and driven by a specially developed 305mm Bextrene-coned bass unit offering good sensitivity. This is constructed on a rigid alloy frame, and is fitted with a large, high power

motor system. Crossing over at 1.7kHz via a top-quality network, the treble is handled by a sensitive Audax soft-dome tweeter, the high-flux 34mm version, adjusted by Spendor.

Superbly veneered, the enclosure is a braced structure made of thinwall multi-ply, braced and damped to minimise the greater coloration that is inevitable in a system of such extensive panel area.

Using a large amplifier, a loud 107dBA can be raised from a pair in a typical room, while active versions will give 110dBA with slightly improved clarity and control. This corresponds to 115dB at 1metre.

## Sound quality

For a large enclosure intended to drive large acoustic spaces when positioned well clear of room boundaries (which if too near can increase the level of audible cabinet sound), the HFC listening room is in fact on the small side. Experience with this system also indicates that a good stereo focus is not obtained at listening distance of less than 4.5metres.

Within these limitations, the SA3 scored an 'average' rating for overall sound quality. Images were spacious but overwide, and while natural acoustics were reasonably portrayed, image depth was somewhat constricted.

A smooth-sounding performer with subjectively low distortion and a relatively clean, well extended and 'earth-shaking' bass, it often sounded as big as it actually was. Some colorations were observed, namely a tubey, plummy effect in the mid, (a rather rich tone on guitar for example) but quite good detail was illustrated.

## Lab results

At 1metre, the speaker gave a generally smooth response, at a high 89dBW sensitivity.

Bass was well damped and extended to a low 32Hz, -6dB, which is almost a subwoofer performance, while the treble rolled off a little early above 14kHz. Pair matching was quite good, one system possessing a little less output in the presence range by comparison with the other.

Out at 2metres a fine set of lateral responses was obtained. On the '15° above' axis (unlikely to arise in practice!) a 1.5kHz dip was recorded, but below axis (the appropriate axis for normal use) the response was excellent, which is quite an achievement in view of the system size.

Room-averaged, the speaker's rich character was confirmed but the bass was very extended and surprisingly even. The sweet treble was

shown by the classic room response which showed a gentle if slightly premature rolloff. As befits a high-level system, peak distortion was very low, and at 96dB swept distortion was also very good, averaging 0.8% at low frequencies and improving above. The results were even better at 86dB spl, averaging 0.35% at low frequencies and rather less elsewhere.

The SA3 happily met the 8ohm standard with a well-controlled characteristic, and it may be classed as a very good amplifier load.

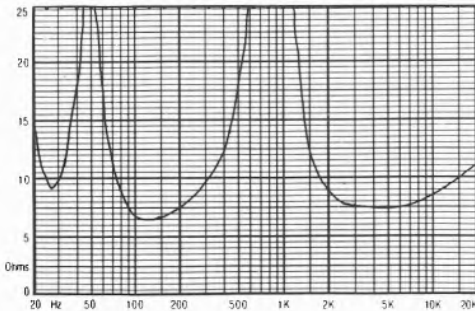
### Summary

The SA3, when not driven hard enough to exploit its wide dynamic range, is outclassed by many smaller and less expensive systems (including some of Spendor's own smaller models) in an average-sized room. Assessed using the latest and best programme the SA3 was censured for its coloration as well as impaired stereo focus, but given a larger space and when mounted on a decently high stand (30-35cm) and well clear of walls, the SA3 can produce an effortless and extended bass, with a musical performance well beyond the smaller domestic boxes.

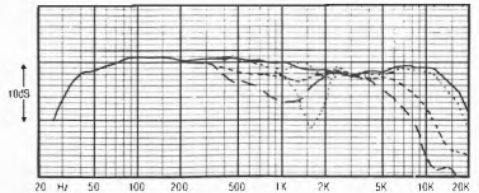
The active version does give a significant improvement in clarity, acoustic level, and control, and for these reasons, the SA3 is definitely worth considering if the conditions are right.

### GENERAL DATA

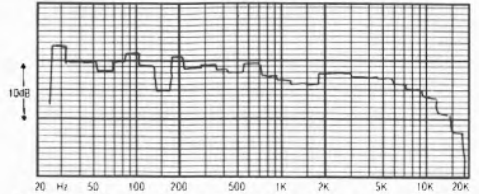
Size (height x width x depth).....	85 x 38 x 46cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(10)—200W
Recommended placement .....	rigid open stands
Frequency response, within $\pm 3$ dB, at 2 metres .....	35Hz to 15kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	32Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	89dB
Approximate maximum sound level (pair) at 2 metres .....	107dB
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, inc VAT.....	£900



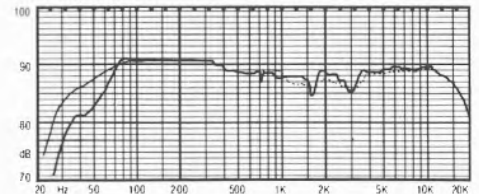
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



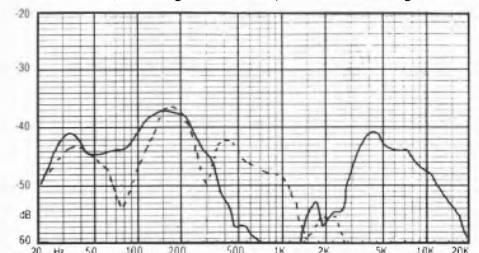
Forward characteristic response ( $1/3$  octave at 2m, dotted  $15^\circ$  vertical, small dash  $30^\circ$  lateral, long dash  $45^\circ$  lateral).



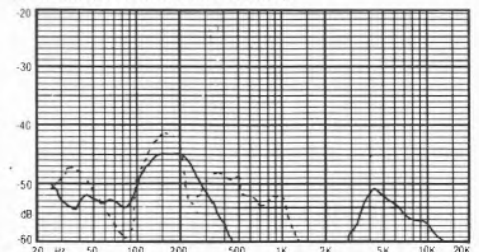
Averaged forward characteristic response in room at listening position.



Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

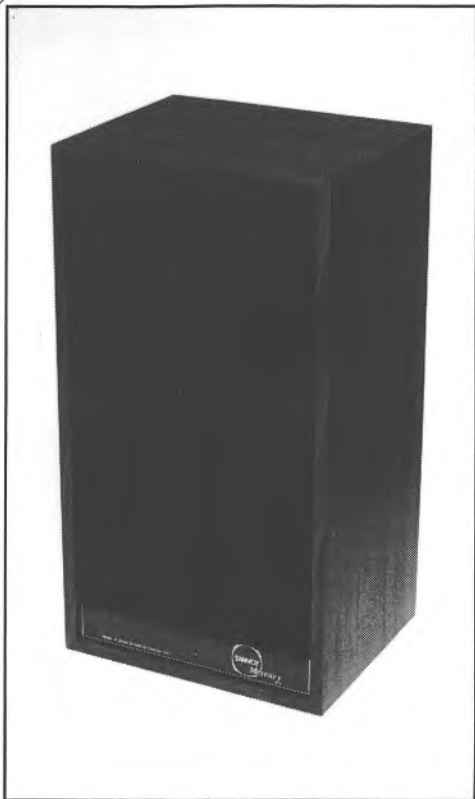


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

# Tannoy Mercury

Tannoy Products Ltd, 21 Canterbury Grove, West Norwood, London SE27 0TW  
Tel 01-670 1131

**BEST BUY**



The *Mercury* is the smallest in a new range of speakers from Tannoy, using their variety of the polypropylene cone plastic which they call 'polyolefin' — a vague-sounding name, though chemically correct! This 19litre enclosure is rigidly constructed from 15mm thick chipboard with a presentable vinyl walnut finish. Bass reflex tuning is employed, the ducted port 50mm in diameter by 70mm deep.

Bass and midrange is provided by a powerful controlled-excursion driver, steel-framed and 200mm in diameter, using a 25mm pole plus a modest magnet. Treble is covered by the popular 25mm soft fabric dome Audax unit, and the crossover is of unusually high quality, employing air-cooled inductors and a plastic film capacitor. 4mm socket/binding posts are used for secure electrical connection, though push-on connectors are used for internal driver wiring.

With a good overall appearance, this system unfortunately has unrebated 9mm thick grille frame — luckily this is easily removed, which will marginally improve the sound.

## Sound quality

The fine panel results bore little relation to this speaker's modest size or price. Rated 'good plus' it was well up in the field, a very promising result indeed.

It was liked for an essentially neutral tonal balance with moderate levels of coloration, but in particular its lively, transparent and detailed nature won it appreciation.

Stereo images were well focused with a fair presentation of depth where appropriate and stereo information was present throughout the range — bass, mid and treble — in a balanced manner. The good quality bass had somewhat limited extension at the lowest frequencies but voices spoke and sang correctly, and the system could convey the natural acoustic present on many recordings.

Some coloration was present but to a mild degree. The usual boxiness, slight featheriness and sibilance in the treble were all evident together with a hint of 'plastic nasality'.

## Lab results

Measured at the standard 1metre distance, this Tannoy provided a pretty uniform frequency response, improved a little by grille removal (dotted graph line). Sensitivity was above average at 88dB/W, and not compromised by the impedance characteristic, whose trends suggested that the *Mercury* was a very kind amplifier load. Reasonable bass extension was noted, to 52Hz, -6dB.

In conjunction with the 100W maximum power handling capability, sound levels of up to 103dBA should be possible from a pair.

At 2metres the speaker's good frequency balance was well established, if mildly flawed by the suppressed treble lump at 14kHz. This speaker proved to be somewhat axis-critical in the vertical plane, both plus and minus 15° off-axis responses showing a 4kHz dip, so the speaker should be positioned to face the listeners head, and mounted on a reasonably high stand to give the best sound. Fine results were obtained off-axis in the lateral plane.

Room averaged, its basic character was plain to see, with a smooth well controlled output shown over most of the range. Bass was reasonably extended and in good balance with the uniform midrange.

At 96dB sound level, distortion was good in the important midrange and about average at lower frequencies, peaking to 8% second harmonic at 100Hz which is probably just audible as a bass tonal quality change. Third harmonic was rather better, this in any case arguably the more important result, averaging 0.2% at both 96 and 86dB spl. At the lower level second harmonic also showed a great improvement attaining a very fine level.

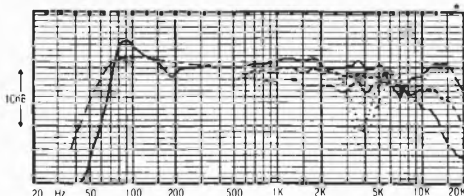
### Summary

Tannoy have an undoubted winner in the *Mercury*. If treated like a big speaker and mounted on stands clear of room walls, a highly satisfactory sound was obtained, with fine detail, clarity and stereo image presentation. Essentially neutral and vice-free, the *Mercury* was usefully sensitive and easy to drive, fully deserving its Best Buy rating. This system will do good justice to some surprisingly expensive ancillary equipment!

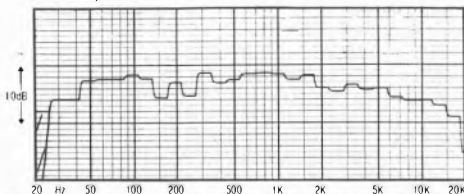
Reauditioned for the new edition, the *Mercury* virtually maintained its previous placing in the listening tests and it happily survived the competition from the newer introductions in its price bracket. With the grilles removed and the cabinet 'toed in' for the axes to cross ahead of the listener, we still rather liked this model, and the best Buy rating is confidently maintained.

### GENERAL DATA

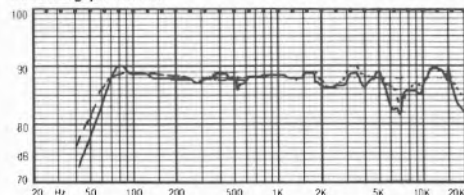
Size (height x width x depth).....	48 x 26.5 x 23cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(12)—100W
Recommended placement .....	open stands or shelf
Frequency response, within $\pm 3$ dB, at 2 metres .....	53Hz to 20kHz
Low frequency rolloff ( $-6$ dB point) at 1 metre.....	52Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	88dB
Approximate maximum sound level (pair) at 2 metres .....	103dBA
Impedance characteristic (ease of drive).....	excellent
Forward response uniformity .....	good
Typical price per pair, inc VAT .....	£120



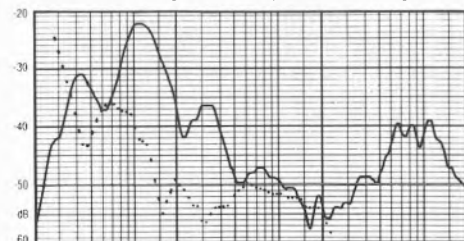
Forward characteristic response ( $\frac{1}{3}$  octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



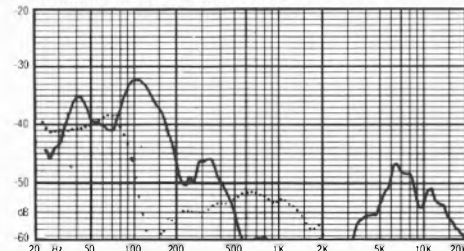
Averaged forward characteristic response in room at listening position.



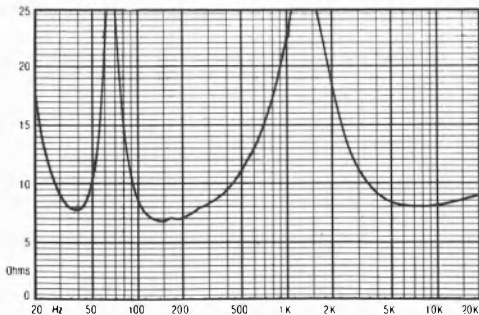
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

**BEST BUY**

# Tannoy Venus

Tannoy Products Ltd, Beadman Street, West Norwood, London SE27 0PW  
Tel 01-670 1131



Tannoy's *Mercury* is an established 'Best Buy' speaker, and so for this edition we have also tested the *Venus* model; in a higher price and quality category, the *Venus* is similarly sized, though with an internal volume of around 30 litres as against the *Mercury's* 19 litres, and comes in a real walnut veneer finish. It has a substantial 6cm diameter and 6cm deep port, this reflex tuning the enclosure to 48Hz.

Both drivers are made by Tannoy and comprise a 25mm plastic dome tweeter with a 210mm bass/midrange. The latter has a generous magnet, the whole being built on a steel frame with critically flared polypropylene cone.

The sturdy enclosure is built of 19mm chip-board, bitumen damped with interior absorbent. The drive units are 'time aligned', in that the treble signal passes through a time delay network to synchronise it with the

midrange, while the crossover is a basic 12dB/octave type; including the time delay network, a total of 16 elements are employed. The 9mm thick grille panel is unrebrated and is probably best left off to ge the best results. 4mm socket/binding posts are fitted for electrical connection.

## Sound quality

Scoring a substantial 'good plus' the *Venus* has done well on audition. It was felt to be well balanced, with an extended wide range response, with a touch of bass excess. Coloration was comparatively low, while the sound was considered 'open' although it stayed 'sweet'. A touch of grain was occasionally noted in the treble.

The stereo imaging was fine, the speaker demonstrating good perspectives with fine depth and ambience as well as good focus and stage width. Coloration was comparatively low, with just a touch of 'plastic cone' and some mid boxiness. It handled high sound levels well, surviving a respectable 300W peak programme and it still sounded civilised and well controlled.

## Lab report

This speaker demonstrated an average sensitivity of 86.5dB/W. Low frequency rolloff was at 47Hz, good for the size and price, while pair matching was also good, with just an absolute difference of just 1dB overall. The axial response was quite smooth, and better still with the grille detached. A mildly downtilted response was indicated, the overall trend meeting  $\pm 2.5$ dB limits from 50Hz to 20kHz, grille detached.

With a 200W power handling maximum sound levels of 104dB should be possible from a stereo pair, particularly as the impedance does not fall below 6.4 ohms, allowing an 8 ohm rating for this well balanced design. Driven to 96dB, distortion was higher than expected, though still mainly innocuous second harmonic. At a reduced 86dB level, it improved to a satisfactory level. The compression test was well handled, with 1.7dB of loss and a fine -46dB figure for intermodulation.

Out at 2 metres, the foward response family showed excellent integration with the benefits of time alignment fully realised. This was as perfect a medium-sized two way as I have seen.

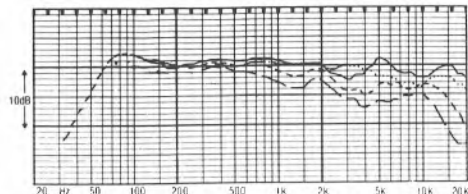
Charted by computer integrated responses in the listening room, the *Venus* showed some low frequency excess plus a fairly well balanced mid band, a mild presence loss, leaving the 4-4kHz range a trifle exposed.  $\pm 4$ dB limits were possible from 25Hz to 8kHz, a good result.

### Summary

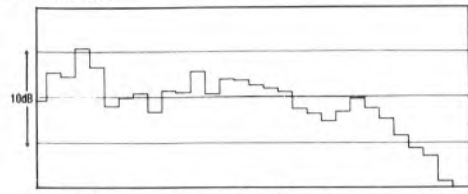
Smooth and sweet was the panel's impression of this well finished and carefully built loud-speaker. It does most things pretty well and is also easy to live with. Its subtlety and good stereo pleased the panel, whose scores suggest that Best Buy rating is appropriate here.

### GENERAL DATA

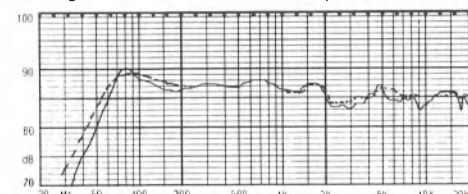
Size (height x width x depth).....53 x 30.5 x 27cm  
 Recommended amplifier power per channel (for 96dB/A per pair at 2 metres minimum).....(15)—300W  
 Recommended placement.....on open stands  
 Frequency response, within  $\pm 3$ dB at 2 metres.....48Hz-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....47Hz  
 Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....86.5dB/W  
 Approximate maximum sound level (pair) at 2 metres....106dB/A  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....excellent  
 Typical price per pair, including VAT.....£235



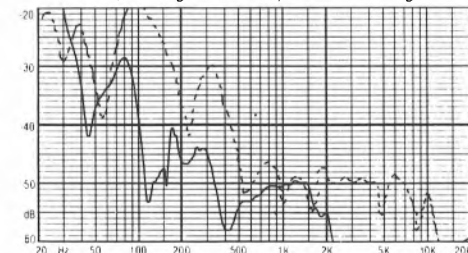
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



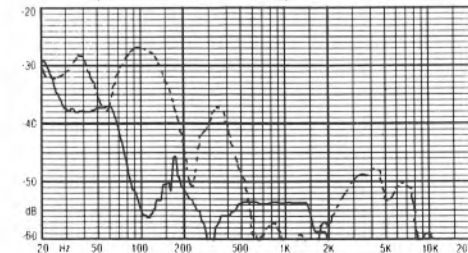
Averaged forward characteristic response in room



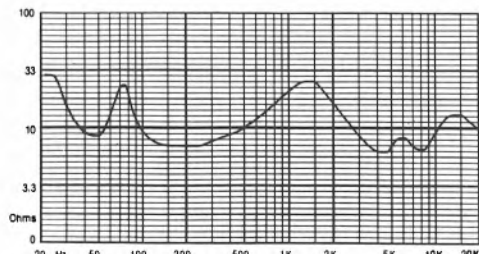
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



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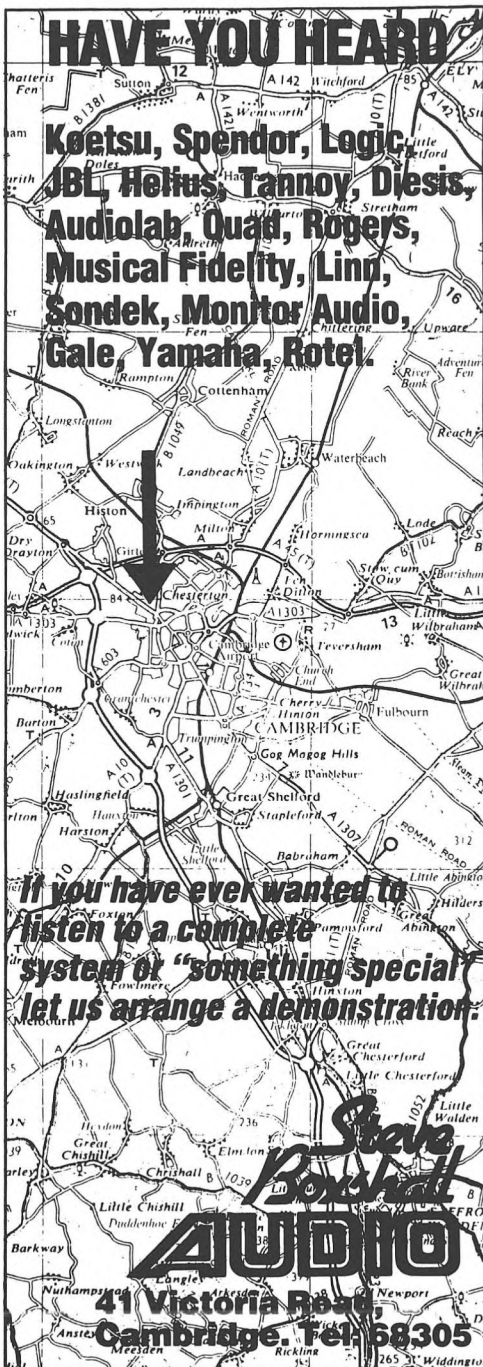
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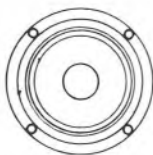
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# Tannoy Dover

Tannoy Products Ltd, Beadman Street, West Norwood, London SE27 0PW  
Tel 01-670 1131



Apparently containing only one drive unit, this 33 litre sealed box enclosure is nonetheless a two way system. The 255mm unit is one from the famous Dual Concentric series, the 50mm centre pole being hollowed out to form the first horn section of a treble driver, which is mounted on the back plate of the magnet and sharing the same ferrite ring. The outer section of the main driver cone is appropriately flared, and forms the continuation of the central horn, the whole built on a rigid cast frame. A high quality four element crossover integrates the units, together with some attenuating resistors. The real wood-veneered carcass is solidly built in 20mm chipboard, undamped but lined with absorbent material, and although the grille is an unrebrated 20mm thick panel, it is probably of little consequence in view of the directional properties of the treble. Electrical connection is made by means of 4mm socket/binding posts.

## Sound quality

Considering the price, which is well above the group average, the *Dover* did not do well in the listening tests, where it scored below average.

The sound was marred by a prominence in the upper midrange, which produced a hard, nasal effect. It thinned the tonal balance, and emphasised a 'small' boxy quality. Furthermore, the treble was rather fierce with a gritty, fizzy quality in the upper register. The bass was however quite extended and fairly dry with above average articulation and detail.

Stereo images were well focused but depth effects were spoiled by the odd midrange perspectives. On the other hand, it did have some good points, and was saved by the particular performance of the Dual Concentric driver, which produced a good clarity with lots of detail. Being so informative about the programme is an essential characteristic for monitor applications, and indeed Dual Concentric Tannoys have been widely used in studios for many years.

## Lab report

Pair matching was very good, at  $\pm 0.7$ dB over the whole range. Sensitivity was above average at a mean of 88dB/W, and with a 300W power handling, maximum sound levels of 107dB will be available from a stereo pair. Bass rolloff came in at a respectable 49Hz. On axis the grille was found to have a surprisingly severe effect on the upper mid and treble, and owners should try experimenting here. The response showed an upper mid prominence followed by an erratic presence band and a treble notably broken up compared with the norm, this caused by the higher horn modes.

Out at 2 metres the averaging smoothed things out and allowed a better assessment of the trends, still that of a forward mid and treble. Here  $\pm 2.5$ dB limits sufficed for a 70Hz to 20Hz range, and the merit of the coaxial driver may be seen in the excellent set of off-axis curves.

At 96dB spl, distortion was moderate and it improved notably at 86dB for the second harmonic. Third however remained a little high, at 1%, 1kHz. It rated average on the compression test at  $-1.9$ dB, with  $-37$ dB of intermodulation.

Not even falling to 6.4 ohms, the impedance characteristic was that of an easy 8 ohm amplifier load. System resonance was seen at

60Hz, which is rather high for the price level.

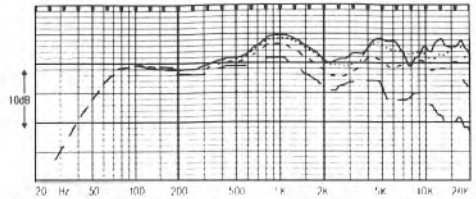
Room averaged, the response told its own story. An otherwise well behaved response was spoiled by a major midrange energy prominence, from 800Hz to 1kHz, some 7-8dB high. In view of this, the subjective rating was quite reasonable.

**Summary**

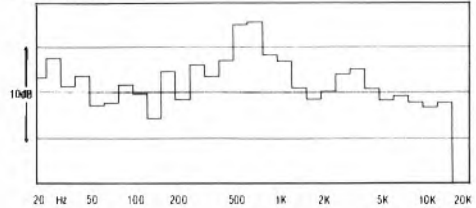
This Tannoy has some traditional virtues — good clarity, moderate distortion, wide dynamic range and excellent build quality. However, it is too thin in tonal balance and the sound is dominated by a serious energy prominence in the upper midrange. Given attention to this, the *Dover* might well be transformed. The grille effects also need investigating.

**GENERAL DATA**

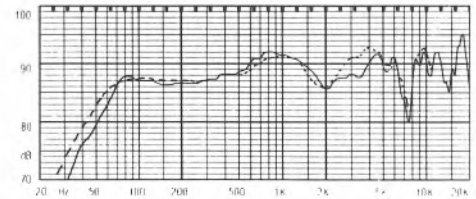
Size (height x width x depth).....	53.5 x 31 x 28.5cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(15)—300W
Recommended placement.....	on open stands
Frequency response, within ±3dB at 2 metres.....	63Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	49Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	88dB/W
Approximate maximum sound level (pair) at 2 metres....	107dBa
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	excellent
Typical price per pair, including VAT.....	£500



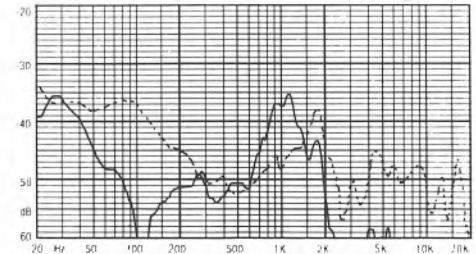
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



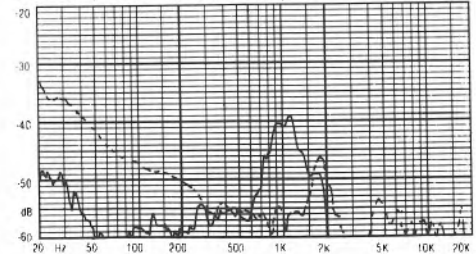
Averaged forward characteristic response in room



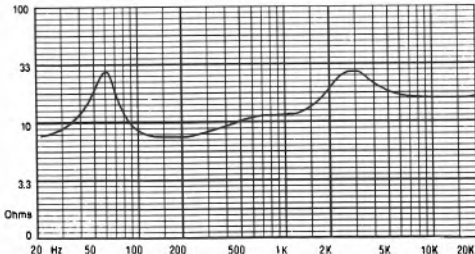
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Wharfedale Diamond

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF  
Tel (0274) 611131

RECOMMENDED



The *Diamond* was born out of the *TSR102* project, which resulted in an the development of an appropriate small, long throw bass/mid driver with a modern polypropylene cone. While two are used in the '102, the *Diamond* has only one, its tiny 5.2 litre volume reflex-loaded by an equally small ducted port 30mm in diameter by 65cm long, this positioned on the rear panel. The bass alignment is in fact 5th order since a large series capacitor is also used.

The 120mm bass unit is built on a steel frame, with treble allocated to the 19mm Son Audax plastic dome/cone tweeter. The crossover is very simple, comprising just two elements plus an attenuating resistor for the treble.

Built from plain 12mm thick chipboard, vinyl coated, the cabinet has a 12mm thick unrebated grille, and spring clip terminals are

provided on the rear panel for electrical connection.

## Sound quality

For the price the *Diamond* did reasonably well, but its absolute rating on the listening tests was not too promising, with a well below average score. The panel results were confusing, some listeners liking this speaker fairly well while others considered it to be too weak for serious attention.

Almost all the panel recognised its as a small box, and it was criticised for 'boxy' coloration as well as a thinned midrange, and an uneven treble which tended to emphasise background hiss. The bass was soft and weak though reasonably balanced and extended, in fact more so than one would expect. Positioned close to the wall it managed to produce a fairly big sound though depth effects were fairly muted. Left to right imaging was fairly good.

Some merit definitely lurked within, and once one had become accustomed to the sound, it began to make its own impression, quite respectable for the size and price.

## Lab report

Pair matching was fine to 2kHz, but poor thereafter with up to 4dB of mismatch. This could well account for the just passable stereo focus. Reference sensitivity averaged 86dB/W, taking into account normal wall mounting. The bass -6dB point was rather high at 74Hz, which was not unexpected in view of the size of the speaker. The reference axial response was uptilted, and the irregularities in the upper range were partly the responsibility of the grille (better detached) as well as the lack of crossover for the bass unit, this notching the treble response in a variable manner at 13kHz.

Out at 2 metres, these effects are smoothed out with the analysis averaging, but the lumpy quality remained. The 100Hz to 20kHz range required  $\pm 4$ dB limits, although the family of forward responses were quite good.

Driven to 96dB sound level, the distortion was unacceptable; typically 3% of second harmonic and 1% of third. At the reduced 86dB level, a moderate improvement occurred, though the third harmonic still did not improve much in the midrange. It survived the compression tests with a poor 3.5dB of loss, and -19dB for the intermodulation product.

The impedance curve did not fall below 6.4

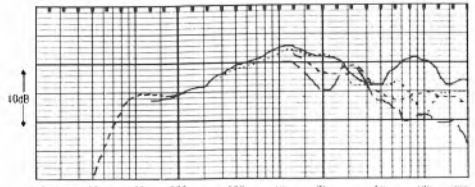
ohms, and the *Diamond* can be regarded as a safe 8 ohm type amplifier load. Out in the room the averaged forward response clearly showed the speaker for what it was, a seriously midrange-forward design. Bookcase mounting will help but will not entirely solve this aberration.

**Summary**

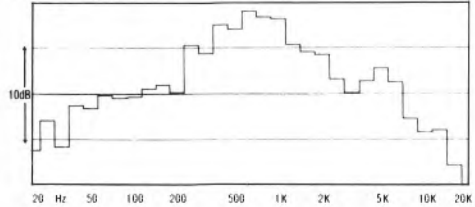
An interesting and inexpensive miniature, the *Diamond* appealed to some panelists; but conversely others could not get on with it. Limited in power handling as well as bass, it did not stand up well to the speakers from the next price group up, these including Wharfedale's own *Laser 90B*. On value grounds it just manages a recommendation, but should be auditioned before purchase.

**GENERAL DATA**

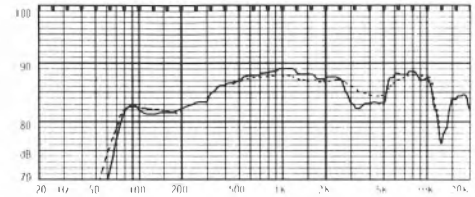
- Size (height x width x depth).....24 x 18.5 x 20.5cm
- Recommended amplifier power per channel  
(for 96dBa per pair at 2 metres minimum).....(15)—50W
- Recommended placement.....15cm from rear wall
- Frequency response, within ±3dB at 2 metres.....see text
- Low frequency rolloff ( - 6dB point) at 1 metre.....74Hz
- Voltage sensitivity  
(ref. 2.83V or 1 watt into 8ohms at 1 metre).....86dB/W
- Approximate maximum sound level (pair) at 2 metres.....98dBa
- Impedance characteristic (ease of drive).....very good
- Forward response uniformity.....good →
- Typical price per pair, including VAT.....£69



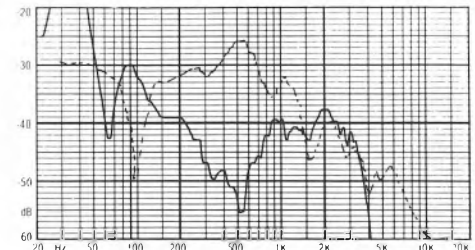
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



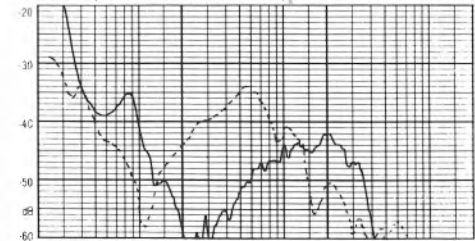
Averaged forward characteristic response in room



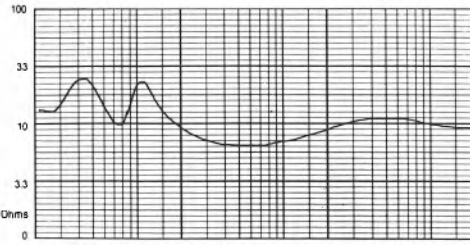
Reference sine wave response (1m on axis, 2.83V input shows sensitivity) Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic)



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

**BEST BUY**

## Wharfedale Laser 90B

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF  
Tel (0274) 611131



Reviewed last year as the *Laser 90*, this speaker has since undergone some revision, notably the shift inwards of the rear panel leaving a recessed shelf, whose exposed sides act to reinforce the whole structure. This is said to reduce panel coloration and indeed does appear to do so. A 17 litre enclosure, the *90B* is sealed box type and yet offers a 3rd order alignment via a large tuning capacitor in series with the bass unit. The latter is a lightweight flared pulp cone unit with a steel frame, disguised by the metallised plastic trim. The bass/mid comprises a Wharfedale 200mm driver and the treble is covered by a 19mm soft plastic dome tweeter, also made by Wharfedale and ferro-fluid damped. The six element crossover is set nominally at 3kHz, and is of normal commercial quality. The cabinet itself is built from medium density 15mm thick chipboard, with the exterior finished in a vinyl

print. The assembly is completed by an injection moulded grille frame, covered with semi-transparent fabric.

### Sound quality

The *90B* scored a straight 'average' on the listening sessions, which is very good for the price. It had a notably sweet and smooth character which showed in its even-handed performance on a wide variety of material. The bass was moderately extended, if a trifle soft but the upper registers were reasonably articulate and tuneful.

Some coloration was evident, of a 'paper cone' and 'boxy' type in the mid, which could add a degree of muddle on complex material. Some treble wispieness was also apparent, and tonally it sounded a little lightweight as well as mid forward.

On the plus side, however, it was pretty clear sounding, with good integration and detail over much of the frequency range, proving easy to get on with, and frequently surviving criticism by maintaining a low profile. Stereo was well focused with fair depth and an open, articulate quality.

### Lab report

Pair matching was very good, to within  $\pm 0.5\text{dB}$  overall. The grille effect was however severe, changing an amazingly smooth (dotted) response to something really ragged with 10dB peak-to-trough. This is a grille which should definitely be left off. Sensitivity was above average at 89dB/W while the  $-6\text{dB}$  bass rolloff was satisfactory at 60Hz. Power handling was 150 watts, which suggests that maximum sound levels of approaching 104dB would be possible from a pair in a normal room.

On axis the frequency response was remarkably flat, and with the grille off,  $\pm 1.5\text{dB}$  limits were met for a 75Hz to 18kHz frequency range! Out at 2 metres (grille on) the trend was maintained, the response containing a hint of mid excess. The off axis family of curves were also well controlled.

Driven to 96dB, it gave a very satisfactory result for distortion, with around 0.5% for second and third harmonics above 150Hz, and they were still good below that frequency. At an 86dB sound level, the results improved, and were rather better than average. This surprisingly good linearity was confirmed by the compression test with just 1dB of loss and a fine  $-50\text{dB}$  of intermodulation. The

impedance characteristic never fell below 6.4 ohms and the speaker comfortably qualified as an 8 ohm design.

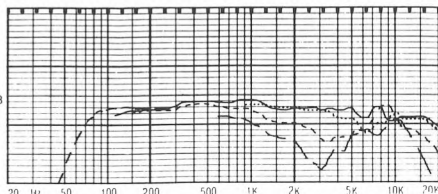
The room averaged curve agreed well with the listening test results, showing a smooth general character with some midrange energy prominence. Little bass was present below 50Hz, while the treble rolloff was quite smooth.

**Summary**

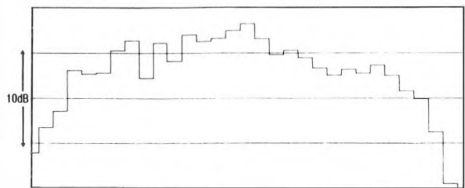
The 90B is quite a good performer with a slightly forward presentation. It sounds uniform and well balanced, and offers low distortion with good stereo. Value is high given the overall performance and a Best Buy rating is justified. The grille should be detached for the best results.

**GENERAL DATA**

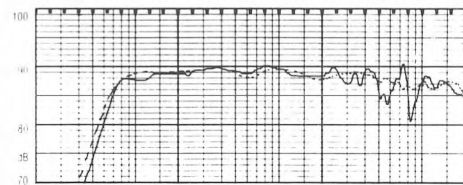
- Size (height x width x depth).....47.5 x 26.5 x 24cm
- Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....(10)—150W
- Recommended placement.....on open stands
- Frequency response, within ±3dB at 2 metres.....65Hz-20kHz
- Low frequency rolloff (-6dB point) at 1 metre.....60Hz
- Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....89dB/W
- Approximate maximum sound level (pair) at 2 metres....104dBA
- Impedance characteristic (ease of drive).....very good
- Forward response uniformity.....very good
- Typical price per pair, including VAT.....£90



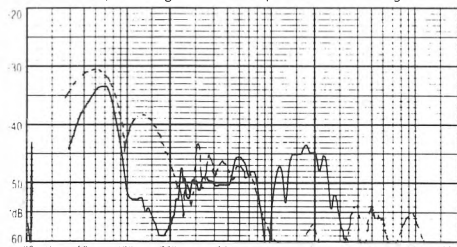
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral)



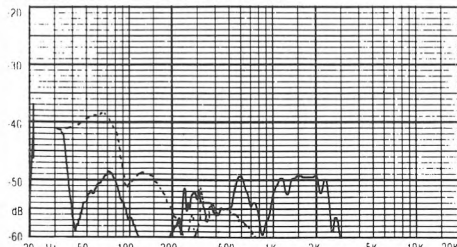
Averaged forward characteristic response in room



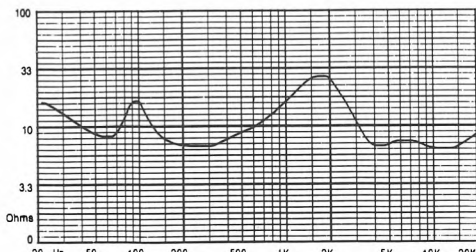
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

# Wharfedale TSR102 TC

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF  
Tel (0274) 611131



This miniature loudspeaker has taken some time to evolve and an earlier version did not do too well on test in *HFC*. However, now in a largely updated form, the current *102* consists of a sealed box just 9.5 litres in volume, tuned to a third order alignment by a  $450\mu\text{F}$  coupling capacitor. Two 120mm polypropylene coned bass units are used, these in parallel up to mid frequencies, with the treble above 3kHz allocated to Wharfedale's 19mm unit with a polyamide dome and ferrofluid for damping and cooling.

The enclosure is carefully built from chipboard with a real veneer exterior and bituminous damping pads within. A 20mm MDF front panel carries the foam grille, superior in acoustic terms to the usual wooden cutout grille frame. Essentially 12dB/octave, the crossover comprises six elements plus two resistors, with one inductor used to roll off a

bass driver, and one capacitor for tuning the bass, electrical connection is via 4mm socket/binding posts.

## Sound quality

Unfortunately the *102* did not acquit itself well on audition, with a mark that can best be described as 'adequate'.

In general terms, it was quite presentable, apparently quite well behaved, balanced tonally, as well as reasonably smooth and well integrated over the range. Comments of a 'bland' rendition excluded peakiness and other irregularities from the discussion; however it was the very blandness as well as its lack of dynamics and impact, which seemed to be its weakest point. The bass was fairly extended but lacked either control or articulation while the mid often sounded muddled or boxy. Depth effects were restricted in the stereo image though the frontal focus was quite presentable. Power handling was good in the absolute sense but the speaker did not sound very tidy above 100W/channel of peak programme.

## Lab report

Pair matching was very good, meeting fine  $\pm 0.5\text{dB}$  limits. Reference sensitivity was fairly low, judged to be 84.5dB/W which was below average. The  $-6\text{dB}$  bass rolloff came in at a reasonable 60Hz. On axis the 1 metre output suggested some treble depression, 1-2dB, but was otherwise pretty uniform, while out at 2 metres, the set of forward responses were very tidy indeed. The speaker's output was consistent over a range of forward axes, while on axis it met close  $\pm 2\text{dB}$  limits from 87Hz to 20kHz.

At 96dB the *102* was working rather hard with second harmonic at 100Hz approaching an excessive 8% with 2% mid band. Third harmonic was much better. Down at 86dB third continued to improve to a very good level, while the second harmonic was also much reduced. The compression test was handled well, with just 0.4dB of loss and a fine  $-54\text{dB}$  of inter-modulation.

The impedance characteristic was quite smooth, and in not even falling to 6.4 ohms, and happily qualifies as an 8 ohm rated amplifier match.

Out in the listening room, the computer analyser showed a tidy and fairly well balanced output, mildly mid dominant but notably even.



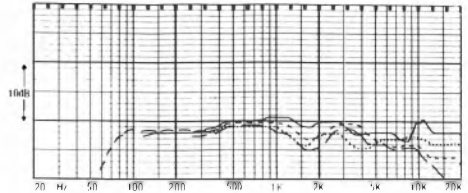
Quite good bass extension was apparent, if a little depressed.

**Summary**

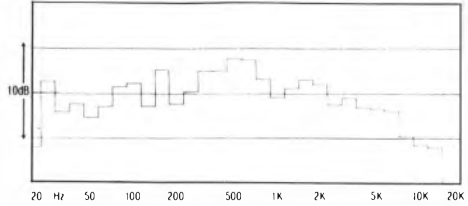
A competent and well designed loudspeaker, the 102 shows a generally favourable tonal quality and when driven at moderate levels, is quite low in distortion. However the panel remained unconvinced, finding that it lacked either impact or drama. It cannot quite overcome its size limitations, and cannot be recommended; overall, Wharfedale's *Laser 90B* would be a much better buy.

**GENERAL DATA**

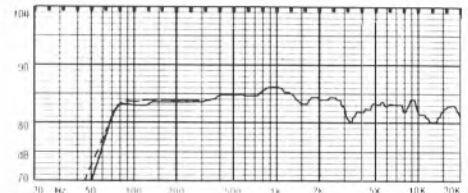
Size (height x width x depth).....	42 x 18.5 x 22cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(25)—100W
Recommended placement.....	on open stands
Frequency response, within ±3dB at 2 metres.....	80Hz-20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	60Hz
Voltage sensitivity (ref. 2.83V or 1 watt into 8ohms at 1 metre).....	84dB/W
Approximate maximum sound level (pair) at 2 metres....	101dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	excellent
Typical price per pair, including VAT.....	£160



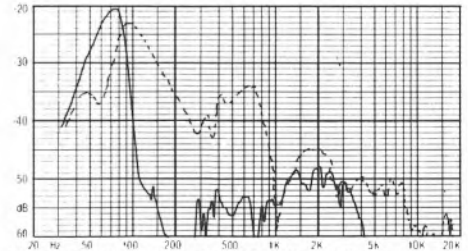
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



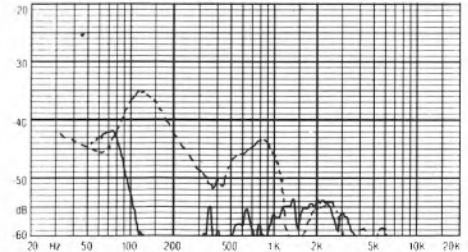
Averaged forward characteristic response in room



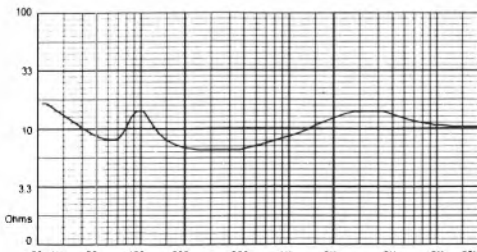
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

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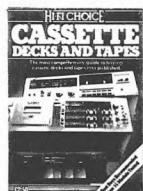
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RECOMMENDED

REVISED AND REPRINTED

# Yamaha NS1000

Natural Sound Systems Ltd, Unit 7, Greycaine Road, Watford Herts WD2 4SB  
Tel (0923) 36740



Still current, the Yamaha *NS1000* was in fact originally reviewed several years ago in the first issue of *HFC Loudspeakers* (1976), when the author Angus Mckenzie, purchased a pair for high-level monitoring. Though it had been re-tested for subsequent editions, we nonetheless felt that the Yamaha 'flagship' should again be completely reassessed, and very worthwhile this proved to be.

The *NS1000* is a relatively compact, superbly-crafted three-way sealed-box speaker, of a highly rigid and braced construction, with an exterior black paint surface that is best described as 'piano' finish. Working best on strong stands, it can also be placed near, but not too close to the rear wall; about 30cm is about right.

The bass driver is a top-class 300mm pulp cone unit, built on a die-cast alloy frame and employing a massive motor system. The protective grille over the bass driver rings a little, and

fussy owners could discard them, as we did for our tests. The mid and treble units, 85mm and 30mm respectively, are Yamaha's unique ultra-hard beryllium dome units, both fitted with frontal phase correctors. Level controls are also provided for mid and treble, and we obtained the best balance and curves with mid at '-2' and treble '-1'.

A high-quality, high-power crossover divides the frequency range at around 600Hz, and 5kHz, with spring clips for electrical connection at the rear of the speakers.

### Sound quality

This speaker has historically attracted some censure, notably on analogue-based programme. Past criticisms included a bass that was too damped and dry, with a somewhat colored mid and a treble that was a trifle fizzy and uneven. However this time round, using mainly digital programme, the speaker appeared to 'come to life', and produced an impressive sound. The bass was quite exceptional, with superb control and articulation, as well as fine depth to formant frequencies. It appeared to produce good stop-start transients, and was also sufficiently transparent to reproduce the natural acoustic on many recordings. Stereo images were also well focused and a decent depth effect was obtained.

Some coloration was still evident, namely a slightly deadened presence range with some mid nasality and a trace of lispiness and grain to the treble, this accentuated on distorted programme.

On high-quality material however its 'monitor' label appeared justified judging by the results, and high sound levels were also possible, with negligible subjective distortion.

### Lab results

A high 90dB/W sensitivity was recorded, this being slightly compromised by the impedance, which dropped to 4ohms at 80Hz. This qualifies the speaker as a fairly difficult load.

System resonance was 35Hz, which was lower than the previous samples, and good bass extension to 40Hz, -6dB, was achieved, with a desirably slow damped rolloff below this point. The axial response was pretty uniform at 1metre but by 2metres some 'lumpiness' had crept in through the mid treble. Aside from this however the forward integration was very good over the range of measurement axes.

Turning to the computer-averaged response,

the clean extended bass was clearly evident, while the treble register is well shaped; overall, quite a balanced result.

At 96dB sound level, distortion was remarkably low, with third harmonic much less than 0.1% above 500Hz and second averaging just 0.3 to 0.5%, even at lower frequencies. At the 86dB level, distortion was exemplary, with a further improvement in third harmonic, second averaging 0.15% above 200Hz, and 0.3% at lower frequencies. This makes it the best in the issue as far as distortion results are concerned.

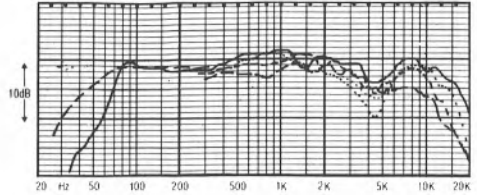
The speaker had a peak power capacity of up to 200W and high sound levels were possible from a stereo pair — up to 108dBA in a typical room!

**Summary**

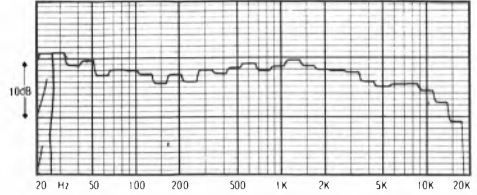
The long-lived *NS1000* remains competitively priced. Superbly engineered and finished, it can provide powerful, clean, articulate and extended bass despite its compact dimensions, and also sets a good standard elsewhere. Stereo images were well formed, the distortion was excellent and available sound levels high, as was the sensitivity. Satisfactory on analogue sources and really coming into its own on digital, the *NS1000* is a worthy contender, and the *HFC* recommendation continues.

**GENERAL DATA**

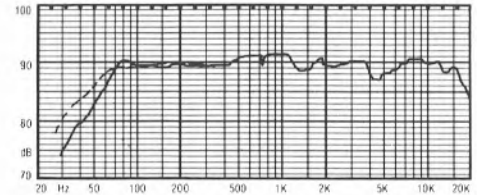
- Size (height x width x depth).....67.5 x 37.5 x 32.5cm
- Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....(10)—200W
- Recommended placement .....30cm from wall on rigid stands
- Frequency response, within 1dB, at 2 metres.....50Hz to 16kHz
- Low frequency rolloff (—6dB point) at 1 metre.....40Hz
- Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....90dB
- Approximate maximum sound level (pair) at 2 metres .....108dBA
- Impedance characteristic (ease of drive).....below average
- Forward response uniformity.....very good
- Typical price per pair, inc VAT.. £600 when reviewed, now £725



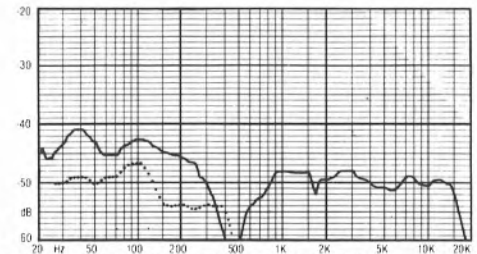
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



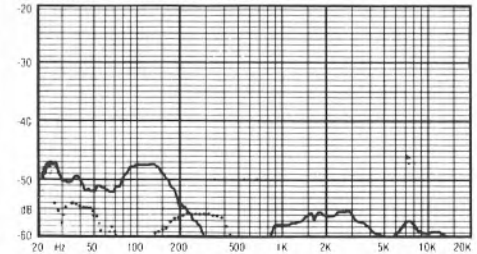
Averaged forward characteristic response in room at listening position.



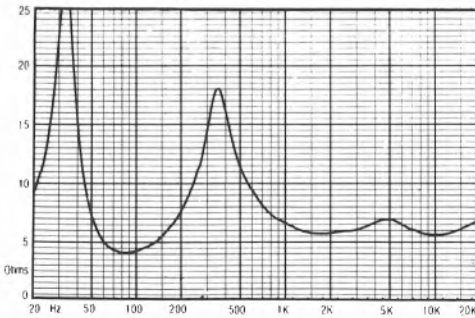
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

RECOMMENDED

## Yorkshire 1/3

Yorkshire Hi-Fi, Coltgate Hill, Ripon, N Yorks  
Tel (0765) 5739



This compact loudspeaker verges on the miniature class with its internal volume of 11 litres. Yorkshire have been making some play concerning their special crossover networks, which employ compensation to linearise the load impedance. This technique is not extended to the bass, as is done in the KEF 104 for example, and the system can be seen to be resonant at 58Hz, reflex tuned by a small 35mm diameter by 80mm long port.

Both units are built by Elac to Yorkshire spec, the bass/mid being a 170mm steel frame bass-mid fitted with a Cobex pvc cone. Treble is handled by a 25mm fabric dome, with the crossover set as usual near 3kHz.

Our samples were in wood veneer but a less costly version is also available in vinyl, and our value ratings correspond to that finish. The crossover is of good quality components, as is the compensation, and the cabinet interior is

foam lined as well as fitted with a front-to-back brace. Plain 4mm sockets are used for electrical connection, and the speakers come supplied with 'ADP' pads which are intended to be placed under the enclosure to improve the sound. We tried these during one session but without a any conclusive result.

### Sound quality

The 1/3 scored a respectable 'average' on the listening test, which was quite good for the price and particularly good for the size. Panel comments were mixed with some listeners favouring it and others finding it disappointing. The midrange was somewhat forward, with a degree of 'cuppy' coloration, and the treble showed a touch of 'fizz' high in the range, although this was not too serious. The bass was quite presentable with fairly good extension and fair control.

Stereo images were well focused with moderate depth and some recorded acoustic. It was quite transparent and proved revealing of programme detail. It handled power up to 100W comfortably, and remained in good control.

However some variability with programme was apparent; for example, it got a poor rating on solo piano but a good result on modern rock programme.

### Lab report

Pair matching was fine, within 0.5dB on our samples, with reference sensitivity a moderate 85dB/watt which in conjunction with the 100W power handling will provide maximum sound levels in a room of around 100dB. The grille had a minimal effect on the sound, or measured response, while the -6dB bass rolloff was noted at 60Hz, typical for the size of enclosure.

Out at 2 metres the overall reponse character may be seen, with some plateau lift in the mid followed by a mildly depressed treble, rising again at 15kHz. In fact,  $\pm 2.5$ dB limits sufficed for an 80Hz to 20kHz range. Very good in the lateral plane, the speaker showed a serious phase dip in the vertical plane, 15° above axis, and by implication, the 1/3 must be used with the central axis directed at the listener, ideally with it placed on a decent stand height (minimum 42cm) At 96dB sound level, distortion was satisfactory, except for an odd peak of second harmonic at 740Hz — the compensation network perhaps?

The peak remained at 86dB, improving to a 3% level but still potentially audible. Third harmonic was however fine. On compression the 1.5dB loss was satisfactory while the intermodulation was very good at -50dB. As claimed, above 200Hz the impedance was very flat and the speaker presents a most uniform 8 ohm load over the range, and should be easy to drive.

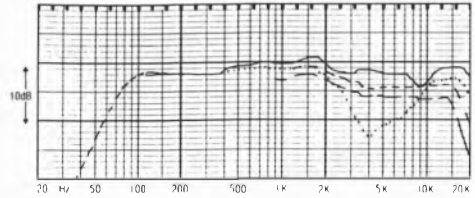
The room response showed a forward, uptilted midrange with a depressed treble but with fair bass extension, although this was also depressed.

**Summary**

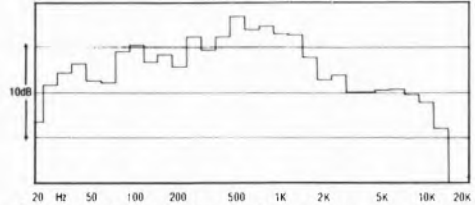
While its basic performance would otherwise quality this speaker for a recommendation, this speaker's mixed reception means that it is in our view not sufficiently accurate in tonal balance terms to purchase it without prior audition. The distortion peak may be anomalous, or associated with the impedance compensation, and while the foam pad isolators altered the sound slightly, the change was not considered significant enough to alter the performance materially and so affect the speaker's rating.

**GENERAL DATA**

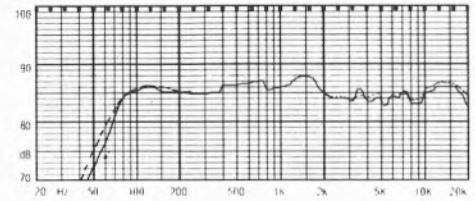
Size (height x width x depth).....37 x 23 x 18.5cm  
 Recommended amplifier power per channel  
 (for 96dBA per pair at 2 metres minimum).....(12) — 100W  
 Recommended placement.....on stands or shelf  
 Frequency response, within ±3dB at 2 metres.....70Hz-20kHz  
 Low frequency rolloff (-6dB point) at 1 metre.....60Hz  
 Voltage sensitivity  
 (ref. 2.83V or 1 watt into 8ohms at 1 metre).....88dB/W  
 Approximate maximum sound level (pair) at 2 metres....100dBA  
 Impedance characteristic (ease of drive).....very good  
 Forward response uniformity.....good +  
 Typical price per pair, including VAT.....£145



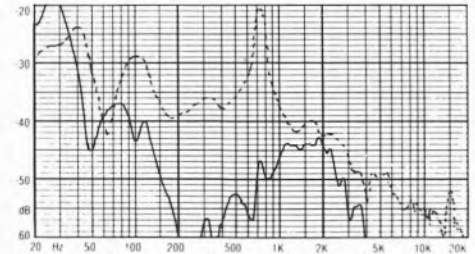
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



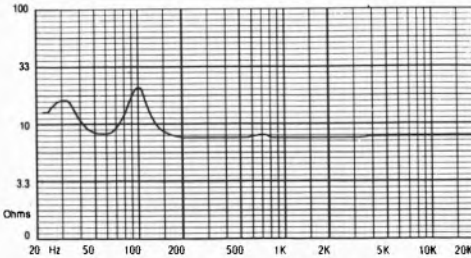
Averaged forward characteristic response in room



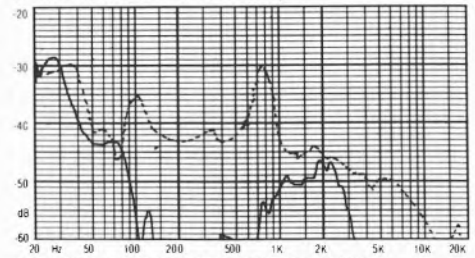
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

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**B&W DM110**

**Heybrook HB1**

Celestion 100

Celestion 110

Celestion SL6/600

Gale GS402A

Harbeth ML

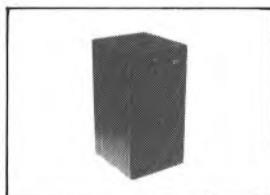
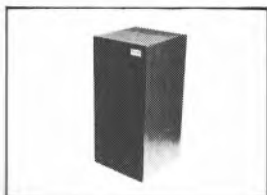
Harbeth HL1 III

Heybrook HB1

Heybrook HB2

Kef Coda III

Kef Chorale III



**Rogers LS7**

**Spendor Prelude**

Linn Kan

Linn Sara

Magnaplanar

Mission 70 II

Mission 700S

Quad ESL-63

Rogers LS1

Rogers LS7

Spendor SA1 and SA2

Spendor Prelude

Spendor SP1

Spendor SA3

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**SPALDINGS**



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# SUMMARY REVIEWS

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In this book, we have included as many full reviews of new and current models as space allows. In addition, we have data on many other models which are still available, but reviews of which we are no longer able to print in full. These are included here in summary form.

Inclusion of a particular model in this section does not necessarily imply that it is inferior to those covered in the full reviews, as many of those here did well in earlier tests. Note that 'end of line' price cutting may make some models cheaper, and so better value, than the nominal prices quoted. Recommended amplifier power figures are given in brackets.

## Acoustat Model II

When tested a couple of issues ago, the *Model II* was thought to have significant failings despite its near 'magic' midrange. The latest 2+2 model appears to have overcome these criticisms and offers a fine sound. (80-100W)

## Acoustic Research AR8LS (£75)

Along with other AR models here, the *8LS* is now scheduled for replacement but at the time of writing is still available. When reviewed it was criticised for a 'shouty', 'loud' characteristic which made it less than fully competitive at the price, but was rated worth considering. (10-50W)

## Acoustic Research ARS18S and AR18LS (£80)

A long-running AR bestseller, the *18S* was nonetheless criticised for a 'peaky' and 'forward' sound quality. It rated as worth considering, for wall or bookshelf mounting. The 'LS' showed mainly cosmetic changes. (10-75W)

## Acoustic Research AR28LS (£120)

This larger AR model was again criticised for midrange coloration which offset its virtues of good attack and bass definition. (10-75W).

## Audio Pro 4-14 (£750)

This Swedish-built active speaker design received a strong recommendation a couple of issues back, despite some mild criticisms. Since our original review, some refinements have been made to further improve the sound of the midrange driver. Outstanding features were exceptional bass depth, with freedom from boom, overhang or 'chesty' effects.

## Audio Pro B240 Subwoofer (£280)

Recommended in earlier editions, the *B240* is now available in *Mark II* form. This effective

subwoofer system was found to give a very worthwhile bass enhancement, given suitable programme material, when using speakers of Celestion *SL6* size and quality. Power amplification is built in and the crossover to the main speakers is adjustable.

## Bang & Olufsen S80 II (£225)

A compact three way design, the characteristic B&O styling, the *S80 II* rated a somewhat disappointing 'average' on our tests. Criticisms included lack of attack, boxy and 'cuppy' colorations, and a veiled effect. (25-100W)

## B&W 802 (£650)

A large but slim floor-standing speaker, the *802* is a development of the massive *801* monitor, using the same 'head' assembly which comprises a 100mm midrange unit in its own moulded enclosure, plus a 25mm tweeter mounted on top with no baffle. The main enclosures each contain a pair of matched 200mm bass units. The complex crossover also incorporates APOC electronic overload protection. With excellent engineering, fine finish and consistently well integrated sound, the *802* was still criticised by some panelists for some loss of subtleties and masking of detail, and a 'bland' nature. It was rated as very much worthy of consideration, but not an outright recommendation in the context of the most recent competition. (15-200W)

## Castle Conway IIA (£425 inc stands)

Still available alongside more recently introduced Castle models, the *Conway* is a large speaker which in its final form comes complete with integral stands. Both measured and subjective results were fine, and, in two earlier issues, this model was rated a Best Buy. It rated highly on stereo imaging, with depth, precision and ambience all well conveyed. It could be driven to high levels without sounding 'loud' in the fatiguing sense. Criticisms were mild, centring on a slightly 'fizzy' top end and a trace of mid 'wiriness'. The speaker demonstrated good dynamic range and detail rendition, plus clean, extended bass. (20-200W)

## Castle Howard II (£550)

In many ways this model is an enlargement of

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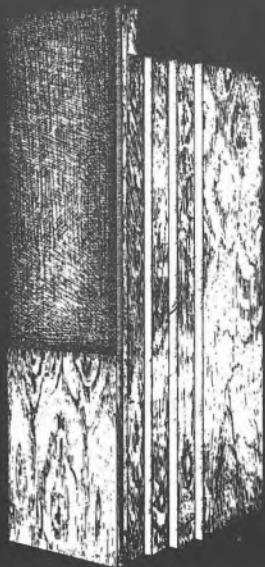
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the established *Conway II*, and has exceptionally well extended bass. Despite this advantage, in other respects the *Conway* was somewhat preferred both in terms of neutrality and overall balance, the *Howard* tending to sound rather 'rich', with perhaps an overabundance of bass in the listening room. (25-200W)

### **Celestion Ditton 110** (£99)

This well-behaved compact speaker system could be regarded as Celestion's answer to the KEF *Coda*. It gave an open, punchy sound, with an 'up front' presentation, with bass relatively clean and articulate, if not very extended. Criticisms were made of some midrange congestion, with a 'loud' effect, and of 'tunnelly' and boxy effects in the lower mid-range. The treble became a little smoother and better detailed with the grilles removed. The *110* was recommended in the last edition, when in our view it missed a 'Best Buy' rating by only a small margin. (10-100W)

### **Celestion 662** (£500)

A very large loudspeaker in the tradition of the old *Ditton 66*, the *662* gave a good performance in many respects, and recommendation was only withheld in earlier editions because of the fairly high price. (12-300W)

### **Gale GS401A** (£563, matt black; £632, chrome)

Though the *GS401* is a very distinctive speaker which has gained an enthusiastic following over the years, it did not manage to gain a recommendation in *Choice* — unlike the new and rather less expensive *402* reviewed fully in this issue. It scored divergent marks among the panelists, indicating that some potential buyers might like it very much and others reject it. Weaknesses included a definite lack of depth and precision in the stereo image, plus some colorations, and the speaker presents quite a difficult amplifier load. Careful auditioning and choice of ancillary equipment is essential. (25-150W)

### **Heybrook HB3 II** (£425)

A medium-sized three-way speaker, the *HB3 II* is well engineered and finished, and now has a textbook 8 ohm load characteristic, making it very easy to drive. On test, panelists criticised several coloration effects, and despite some strong features, the speaker did not score sufficiently highly for a recommendation.

However, it is only fair to point out that the speaker is claimed to be designed strictly for analogue programme and certain combinations of ancillary equipment, with which it should perhaps be auditioned. (15-200W)

### **IMF Compact Monitor 3** (£275)

This compact three-way system was criticised for a degree of mid/treble hardness, wiriness and brightness, coupled (paradoxically) with a richer, thicker boxiness in the upper bass/lower mid region. Bass was felt to lack some of the definition and clarity now available in this price range, and the speaker's 'average' score was insufficient for recommendation, but made it worth considering. (20-100W)

### **IMF HPCM** (£550)

Demonstrating a consistently good sound quality on all programme material tried, the *HPCM* did justice to the 'Control Monitor' part of its name; hallmarks were moderate coloration, extended 'air moving' bass, and open, lively character, with fine musical detail. Impedance dips to around 4 ohms make it a somewhat demanding load, which will require a suitably tough amplifier to drive it well. The *HPCM* was recommended in the last issue. (20-200W)

### **JBL L112** (£899)

Physically, this JBL speaker resembles an *L150A* minus the lower ABR section of the cabinet. The *112* does not have the *150A*'s symmetrical driver layout, being designed presumably to give the option of sideways mounting on larger American-style shelves or bookcases. It proved slightly less sensitive than the *L150A*, and sonically inferior as well, although the sound was still liked for its impact, clarity and overall balance — criticisms were centred on the stereo image capabilities, slightly coloured, over-rich bass, and some mid 'hardness' and 'thinness'. Though finely made, the *112* was not recommended. (15-400W)

### **KEF Carina** (£140)

This speaker is a two-way design, but uses three drive units — a pair of 200mm bass units are married to a 25mm soft fabric dome tweeter. With somewhat above-average sensitivity, the *Carina* will produce high sound levels from amplifiers of 20W or less per channel. Sound quality was sufficient to earn a 'worth considering' last time, but was

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- Marantz LD30/2.....
- Marantz LD50.....
- Mission 70/2.....
- Mission 770.....

- Monitor Audio R352.....
- Monitor Audio R152.....
- Mordaunt-Short MS20.....
- Mordaunt-Short Carnival 3.....
- Mordaunt-Short MS40.....
- Quad ESL-63.....
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described as rather over-full in the lower mid/upper bass, with an apparent lack of sparkle and transient attack on some instruments, and with seemingly subdued depth impressions, the speaker somehow never 'came to life' for the panel. (10-75W)

## **KEF R105.4** (£650)

Developed from the *105.2* reference model, the *105.4* has a smaller bass enclosure which houses a pair of 200mm units operating in parallel, rather than the costly 305mm unit used in the *105.2*. The 'head' assembly contains a 110mm midrange and 25mm tweeter in stepped array. Despite its somewhat lower price, the *105.4* matched the scores gained by *105.2* in earlier editions, and was described as more 'open', and 'livelier', with some extra detail. While recommended two issues ago, the *105.4* appeared less strong on digital programme in the last edition, bass seeming to lack some attack and definition, and with some fine detail and transparency lacking. Nonetheless, the *105.4* remained highly satisfactory on conventional programme, and is capable of high levels — while protected from overload by elaborate protection circuits. (up to 500W)

## **Koss Kossfire 110** (£190)

With an impressive array of four drive units, the *Kossfire* appears to offer a lot of speaker for the money; unfortunately it did not score well in our panel listening tests. The sound was thought confusing, lacking in detail, with a midrange forward as well as hard, and rather boomy bass. Treble quality was described as scratchy and tizzy. (10-50W)

## **Mission 700S** (£139)

Attaining a 'Best Buy' rating in the last edition, the *Mission 700S* offers high sensitivity, low distortion and uniform response together with fine dispersion. It scored a convincing 'good' on the panel sessions, with an open, lively and transparent character, good stereo staging, and articulate if only moderately extended bass. Tonal balance was on the bright side but not severely so. While *Mission* have considered a drastically revised version of the *700S*, it appears at the time of writing that the model will continue in its 46 × 26 × 25cm form, described above, for the rest of its life. (10-100W)

## **Mission 737** (£240)

Superbly finished, the *737* cabinet contains the established *Mission* 200mm high-power polypropylene bass/mid unit, with a 25mm *Son Audax* tweeter. On blind tests, the speaker was ranked rather below average, which is poor for the price, with noticeable colorations observed — including dulled, metallic, 'cuppy', boxy and chesty effects. Unfortunately these ratings precluded recommendation. (20-150W)

## **Revox Symbol** (£920)

A massive and costly floor-standing system, the *Revox Symbol* features a driver line-up somewhat similar to the long-lived (now discontinued) *Celestion Ditton 66*; it has a 300mm pulp cone bass/midrange, augmented by a passive 300mm ABR (auxiliary bass radiator), a 55mm soft dome midrange, and a 25mm dome tweeter. The panel comments described a seriously coloured loudspeaker, well behind modern standards of sound reproduction, and so despite its ability to take massive power inputs, and to produce near-deafening levels, it could not be recommended. (10-200W)

## **Spendor BC1** (£380)

A long-term reference, this classic model was actually introduced in 1969; apart from a revision to the bass/mid unit in the mid 1970s, design changes have been very minor ones. High subjective ratings assured the *BC1* of a 'Best Buy' rating in earlier issues, but with the last edition it was felt that a 'recommended' rating only should now apply. Despite the almost unrivalled mid and treble performance, the *BC1* left something to be desired in terms of bass neutrality and damping, as well as overall power handling and sensitivity. (30-130W)

## **Visonik David 7000** (£124)

An ultra-compact miniature speaker, the *David 7000* is designed for wall or bookcase mounting, but may also be partnered by the *Visonik Sub 3* subwoofer (£112), to provide a complete full-range system. Reviewed in this form, it did not find favour with the listening panel; the sound was dominated by an excessively bright tonal balance, the dominant upper-mid and treble lending a fierce, spitty and sibilant effect with emphasised surface noise and distortion. The *Sub 3* did not provide sufficiently high or even bass output to give a well-balanced overall effect. (10-100W)

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**With so much test data as well as a wealth of subjective judgements to draw on, it is worth surveying the results from a general standpoint, and trying to assess the patterns and correlations which have developed from the project as a whole.**

It was abundantly clear that a great improvement in overall standards had occurred during the past year or so with respect to the lower priced loudspeaker models — to such a degree in fact, that many formerly reputable and historically sound examples were, in our judgement, ousted from their comfortable, high ranking places.

Some models costing under £100 a pair — a level previously considered to be 'sub hi-fi' — this time round have demonstrated a true high-fidelity performance, attaining subjective scores that have equalled other established models selling for as much as £500 a pair. These results have necessitated our revising the Best Buy criteria, and for the first time in many issues we have managed to reduce the Best Buy threshold price, this despite inflation!

In fact, the sound quality scores achieved by the most successful models under new £285 Best Buy upper limit were so good, that considerations of 'especially good value for money' in the case of more expensive systems seemed nonsensical.

## **New programme**

Some readers may feel that it was unwise of us to use such a high proportion of the new digital programme material for listening tests, more particularly with the cheaper systems which, for the foreseeable future at least, are unlikely to be used with digital players on the grounds of cost alone.

In the case of speakers which show a tendency to treble unevenness or brightness, such characteristics may be quite tolerable on master-quality programme — good Compact Discs and the like — but may prove less acceptable when partnered by an inexpensive, ill-matched analogue cartridge. But *Hi-Fi Choice* has always tried to establish consistent standards for tonal accuracy, stereo clarity and coloration with the long term aim of providing a satisfying and musical performance for the purchaser. The more accurate, consistent and revealing the programme, then the better will be the panel's discrimination of the faults and merits of the speakers on trial.

For example, using digital programme it is far easier to determine and identify whether a speaker has possesses marginal bass definition verging on boominess and with below

average articulation. To state that such judgements would be harder to achieve on analogue, and that the effects might then pass unnoticed, surely implies a 'head in the sand' attitude. Good sound quality is surely what we are required to identify.

Fortunately, the majority of the highly rated models in this issue will do justice to both digital and analogue programme. If a speaker sounds accurate, neutral, and low in distortion using studio masters but sounds 'wrong' on analogue discs, then in the absence of other special interactions, the blame must surely lie with the analogue record. Here, sufficient differences in tonal quality and balance do exist between turntables, arms, mats, cartridges and indeed the head-amp equalisers incorporated into many amplifiers. In combination these individual variables may conspire to produce a result of possibly pleasing musical character, but one nonetheless worryingly different to the original master.

The solution is surely not — as has been seriously suggested by some — to run two hi-fi systems optimised for analogue and digital, but rather must be to gradually bring an existing analogue system into line so that a closer match to studio quality standards is achieved.

In fact, it would appear that most speaker manufacturers are welcoming the introduction of CD as at last providing the industry with a consistent frame of reference for comparisons, plus a uniformly high programme standard for all dealers and eventually all homes to benefit from.

## **Stereo quality**

While most systems appear to provide a fairly presentable standard of stereo reproduction with a degree of depth and space, plus satisfactory frontal localisation, there is no doubt that some designs do it significantly better than others. The smaller and narrower systems do tend to provide better stereo focus and, if sufficiently low in coloration, they can also give better depth.

However, when the reverberant energy in a room is taken into account, established theory predicts that the smaller speakers could be expected to show a poorer direct-to-reverberant energy ratio which should degrade imaging. One authority has proposed that speakers



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should have a controlled directivity in order to improve the direct sound proportion, which would serve to sharpen images, but our test findings actually suggest the reverse. We found that the larger the speaker the larger the apparent source radius and the easier it is for the ear to localise images at the boxes and not in the space between them.

Uneven frequency responses also upset imaging by smearing the depth perspectives; the latter rely on a natural tonal balance with a proper loudness relationship between fundamental and harmonics for each instrument and source reproduced. As a basic rule, speakers with vertical-in-line driver arrays do provide the best stereo but two examples in this issue proved that there are always the proverbial exceptions that more or less 'get away with it'. These were the Goodmans *Mezzo* and the Gale 402, which have mid and treble units horizontally disposed. In this instance the general clarity as well as good driver integration exhibited by these systems helped to offset the disadvantage due to the drive unit disposition.

On the other hand, it was also abundantly clear that the obviously-coloured speakers — those described as 'boxy', 'fizzy', 'horny' etc — could not reproduce depth effects in the sound image and with these models the stereo image was notably flat sounding with little recorded ambience or natural acoustic discernible.

A couple of wall-mounted speakers were sufficiently good year to demonstrate that one could achieve a semblance of subjective stereo depth despite boundary limitations — the Linn Sara was one of these. However the depth effects were not as satisfying as those achieved by some of the more remarkable open-space performers — for example the Celestion *SL600*, when optimally mounted, could project a stereo image of quite remarkable depth and ambience, and on some programme we could even distinguish a convincing acoustic perspective for the orchestra and the hall, the later including the rear walls (try Dvorak 9th on Decca CD).

## Frequency response

It was interesting to note with digital programme that while basic colorations and unevenness in the frequency responses were pretty obvious subjectively, the broader abbreviations in frequency balance, whether too rich or too bright, were less noticeable, and indeed more easily tolerated.

With imperfect programme there is a con-

stant struggle to play the system loud enough to get a good level of detail and, for the same reason, to operate on the presence and the treble band to try and give an effect of 'life'. However at the same time the level of 'mud' and distortion on analogue programme means that these adjustments must of necessity be subtle.

With digital programme the clarity is effortless, with negligible distortions and 'hyped up' balances are unnecessary — for example, if a speaker is smooth but a little bright it stays that way using digital material, and doesn't turn 'nasty'. Conversely, if the speaker is a little rich or dim, again good detail can still be heard despite the balance. With analogue such a system could well be criticised for a lack of clarity as well as a 'dead' sounding character.

At the very highest quality level, digital still lacks some of the final touch of the far space acoustic or ambience, and with the finer loud-speakers, analogue material helped provide the ultimate discrimination.

## Measurement

While the axial reference response continue to tell how well matched and aligned a system is, the group of forward responses reveal more about the integrity and inner balance of the system. These are backed with increasing confidence by the computer derived room average which, with further refinements of technique this time round, is providing impressive correlation between perceived frequency response and the room-integrated value charted. A fascinating aspect was the different way in which various systems integrated with the room at low frequencies, in a manner not immediately obvious from their anechoic responses. Sufficient data is becoming available to indicate that a new set of low frequency alignments is needed, each adjusted to a speaker's intended low frequency bandwidth, and tailored to provide a uniform room coupling for a smooth, extended subjective response.

A flat, smooth response curve is still a priority for a speaker's specification, but within relatively broad  $\pm 3\text{dB}$  amplitude limits a designer can do a lot to adjust for speaker size, intended mounting, tonal balance, room interfacing and driver compensation. A perfectly, flat ruler-straight response is most definitely not the objective, for although it may sound correct for a certain size and bandwidth speaker, variations in cabinet width, driver coloration, directivity, height from the floor or intended distance from

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a room boundary wall, can all dictate that small variations in the axial response will be essential to ensure the best subjective result.

## Distortion

In this issue the measurements were intended to include assessment of distortion down to 0.1% — an increased resolution felt necessary in the light of CD programme. Admittedly some speakers with just adequate distortion results managed to achieve good subjective results, but undoubtedly those speakers considered the cleanest and clearest also provided low levels of distortion, approaching 0.1-0.2% midband, below 90dB sound pressure level.

Below 100Hz somewhat higher distortion levels are considered permissible, with the reducing aural sensitivity to such effects. Nonetheless it would seem worthwhile to hold second harmonic in the 50-100Hz range to 3% or less and third to 1% or under.

Looking back at earlier reviews it seems clear that as a general trend, distortion levels have been steadily improving. Good levels are now attainable as typified by the Quad *ESL63* and Yamaha *NS1000*, which at moderate sound levels were capable of distortion readings of around 0.1% for all harmonics over a wide range of many central octaves.

Originally, the peak distortion measurements proved useful in identifying those models which had some failure to crossover design, or where a component had an inadequate current or voltage rating. Fortunately these days such offenders are few and far between at the quality end of the market, and single peak level power distortion measurement has become less useful. In future, this could perhaps be extended to cover a wider range of levels and frequencies, and would once more become a worthwhile tests.

## General trends.

The test results show that quite modest but carefully-designed speakers can produce a high standard, sufficient for most domestic hi-fi situations. Two-way systems of 15-45 litre internal volume with a 200mm bass-mid driver and a 19-25mm dome tweeter have obviously become the most successful quality speaker designs ever.

Some deviations from this formula obviously exist, but they are rare and usually involve considerable extra expense or compromises in other directions — say, in dynamic range or cabinet size.

We found that these essentially two-way systems could span a price range as wide as £80 to £500, the results dependent on the designers' intended application, care and ingenuity.

With this issue we at last seem to be seeing the demise of the 'boom and tizz' brigade, speakers with a false boomy bass and emphasised, sibilant and fizzy treble. Even the least expensive models this time round appeared free from this previously frequently encountered complaint.

We look forward to a further consolidation of the new higher standards in subsequent editions, and hope that next time around the designers will have proved more successful in tackling the problems of quality in the £300 to £1000 system price range.

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# BEST BUYS AND RECOMMENDATIONS

Drawing on the experience of previous editions as well as the new reviews included this time, the recommendations here are in effect selected from a pool of over 150 models. Inevitably, with each succeeding issue, the poorest models have been weeded out and the number of Recommended and Best Buy models has increased, reflecting higher market standards.

While the principles on which we have chosen Best Buys and Recommended models remain unchanged, readers should bear in mind that in this edition they reflect a generally higher level of attainment than in the last issue.

**Best Buy** denotes exceptional value for money, and indeed there are a good number of speakers which achieve very high performance at a reasonable price. With this in mind, we have again drawn an upper price limit for the Best Buy category, this time at £285 — above this price, the 'law of diminishing returns' seems to come into effect, and so the better examples priced at more than £285 are 'Recommended' instead.

**Recommended** means that either the performance was particularly good irrespective of price or alternatively that a good value standard is achieved but overall attainment falls short of Best Buy classification. However the dividing line between what constitutes a Best Buy or a Recommended system is often quite hard to draw, and obviously depends on our interpretation of performance characteristics; as such, given a sensible trial, you could quite possibly prefer a 'Recommended' model to a 'Best Buy', at the same price level.

## BEST BUYS: UNDER £110

Here we have a good selection which includes the **Castle Clyde** (£99), **Mordaunt-Short MS20** (£105), **Mission 70 II** (£99), **Marantz LD20** (£79), **Rotel 850** (£80.00), **KEF Chorale** (£85), **KEF Coda** (£105), **B&W DM110** (£105) and last but not least the **Wharfedale Laser 90B** (£95). These inexpensive models really offer very good value, and all attained a fine standard. Taken individually, the **DM110** is a strong performer capable of good sound levels, a fine tonal balance and good all round ability. The **KEF Coda** scores on good bandwidth for the size, with a smooth character, and is now joined in this by the competitive **Wharfedale Laser 90B**. The **Chorale** has an exceptional midband, which is particularly subtle on classical material while the **LD20** offers a high dynamic range for the size. The **Mordaunt-Short MS20** possesses a crisp, slightly forward presentation which is well controlled, and the **LD20** is also surprisingly civilised. The **Rotel**

**850** now joins this group, and with its somewhat 'distant' balance, nonetheless gives fine value for the size. Finally, we have the redoubtable **Clyde**, which continues to set its own pace for sheer detail and clarity, all produced by a real miniature which still retains a real wood veneer exterior.

## RECOMMENDED: UNDER £110

These models comprise the **Wharfedale Diamond** (£70), **JPW JPI** (£90) **Celestion 100** (£85), **Marantz LD30** (£99) and **Keesonic Kub** (£90). The diminutive **Diamond** still represents substantial value, but with some limitations due to its small dimensions. The **JPI** is a commendable first entry from JPW, with its solid construction and excellent real wood finish. Two older stalwarts still merit recommendation, namely the **Ditton 100** with its forward, lively balance and the **Kub**, a fine choice for bookcase mounting, though the treble is beginning to sound a bit dated.

## BEST BUYS: UNDER £200

Here we have the **Marantz LD50** (£140), **Mordaunt-Short MS40** (£170), **Sony APM22ES** (£199), **Tannoy Mercury** (£135), **Heybrook HB1** (£140) and **Monitor Audio R352** (£145). Giving combinations of lower coloration, greater power and generally more extended bass than the cheaper models, these under £200 speakers also represent exceptional value for those who require quality and finish that is a cut above the basic standard.

The **Mercury** is deservedly popular, and has a particularly neutral midrange, while the **LD50** is exceptionally sweet and 'well-mannered', with an unusually deep bass register. The **MS40** is a clean, articulate sounding model, without vices, and the **HB1** is efficient, with a lively and detailed sound. The **R352**, a well-finished powerhouse of a speaker, is decently sized and produces a clean sound, while the **APM22ES** offers enhanced transparency as well as dynamics, through its 'high tech' drivers.

## RECOMMENDED: UNDER £200

These comprise the **Rogers LS1** (£150), **B&W 220** (£189), **Yorkshire 1/3** (£145), **Castle Lincoln** (£165), **Goodmans Mezzo** (£135), **Heybrook HB2**

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# BEST BUYS AND RECOMMENDATIONS

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(£190), **Mordaunt-Short Carnival** (£140), **BBC LS3/5a** (£190) and **Diesis Solitaire** (£199).

There's quite a choice with this group, which range in size from the tiny *LS1* and *LS3/5a* to the quite large *B&W220* while the *LS3/5a*, despite the limitations of its size continues its legendary monitor class transparency and detail. We then come to the larger models, with the *Mezzo*, a low-priced powerhouse and the *B&W 220*, a high-quality, high-efficiency model offering a surprising level of refinement. The *HB2*, *Pembroke*, *Lincoln 1/3* and *Carnival* comfortably hold to the good standards of their respective manufacturers. The *Diesis Solitaire* is a well finished newcomer offering a very competent sound, if a little pricey for the size.

## BEST BUYS: UNDER £285

There are four models here — the **Rogers LS7** (£280), the **Tannoy Venus** (£230), **JBL L46** (£240), **Spendor Prelude** (£220).

The current *LS7* stormed through the tests with its fine combination of engineering, finish, good sound, efficiency and bass extension. In vinyl finish, the *Prelude* is a close runner-up, with a useful saving in cost. The *Venus* was well liked and offers a competitive all round performance as does the *L46*, which is JBL's first Best buy in *Choice*, and one capable of near astonishing 'unforced' sound levels.

## RECOMMENDED: UNDER £285

This slightly larger group comprises the **B&W DM1200** (£230), **Celestion SL6** (£280), **Monitor audio R152** (£220), **Castle Pembroke** (£215) and **Spendor SA1** (£250).

The *DM1200* is an excellently finished high performance miniature — a sort of foil to the *SL6*. The latter is a well established and musical performer, offering exceptional treble and fine stereo. The *SA1* is another miniature with the remarkable Spendor bass and midrange, but sensitivity is rather low for this otherwise easy-to-drive model. The *R152* offers a superb finish with a wide range, neutral sound, and good stereo, and the *Pembroke* has a reliable tonal balance plus good sensitivity and power handling.

## RECOMMENDED: ABOVE £285

There are a surprisingly large number of models here — the **Celestion SL600** (£660), **JBL L86** (£375) **Mission 770 Freedom** (£399), **Rogers Studio One** (£385), **Spendor SP1** (£490), **Gale GS402A** (£480), **A&R Cambridge Arcam One**

(£299), **Meridian M2** (£905), **Spendor SA2** (£350), **Yamaha NS1000M** (£750), **JBL 150A** (£1,200), **Quad ESL63** (£1,250), and most expensive of all, the **Magneplanar MG3** (£2,500).

With the *SL600* performing even better this year than last, this exceptional miniature justifies the highest quality sources. Moving on to medium sized enclosures we have the *Arcam One*, arguably the best value and providing a highly revealing sound. Spendor's fine *SA2* design is likely to be supplanted in the near future by the *SP2*, with a polypropylene bass driver, a model which should be worth investigating. The Rogers *Studio One* also improved on its earlier performance, and offers monitor-class accuracy, with a decent sensitivity and extended bass. Mission's *770F* is designed for wall mounting and provides an explicit sound; it helps bridge the gap between the wall-mounted and the free-standing types. Spendor's refined *SP1* is highly neutral with excellent all round performance.

Powerful bass as well as unusual styling is a hallmark of the *GS402a* which can be used either vertically or horizontally depending on preference. The Yamaha *NS1000* is still in production — a unique design, compact yet powerful as well as being superbly engineered. JBL's *L150a* is rather like an extended-bass version of the *NS1000* and also performed well in previous tests.

The *Quad 63* set its own unique high standards for accuracy and low coloration but needs careful siting and system matching. The *MG3* is perhaps in a class of its own, establishing as it does new high standards for wide-range effortless sound quality, albeit at a price!

Although we were unable to include it in this issue, I have also very recently tested the *Acoustat 2+2* and this version performed much better than the model *2* reviewed in an earlier *Hi-Fi Choice*; at £2,500 it now sets a high standard.

As the Proac *Studio* is supplied mainly for export, the manufacturer did not think it appropriate to offer us review samples; but we believe this to be a fine loudspeaker, while its baby brother the *Tablette* has certainly given a good account of itself in other tests. Harbeth's *HL1* is currently under revision to become the *HL1 Mk IV*, and potentially, if the *III's* performance standard is maintained, as well as a continuing competitive price, it should also qualify for recommendation.

# OVERALL COMPARISON CHART

	Dimensions (cm)			Bass enclosure internal volume (litres)	Max sound level in at 2m/ pair	Lab sens at 1m 2.83V input	Low freq. rolloff (-6dB)	Suggested min/max amplifier power	Overall frequency Response	Dispersion/ Distribution
	H	W	D							
Acoustic Research AR48LS*	64	35.5	28	38	105dB	88dB	40Hz	15-100W	good	good
Arcam One*	47	27	33	30	104dB	88dB	55Hz	15-150W	v. good	good
Audiostatic ES200	129.5	53	23	—	94dB	81dB	45Hz	100W	good	average +
B&W DM110	49	26	25	22	107dB	89.5dB	56Hz	10-200W	v. good	good
B&W DM220	68	29	34	50	108dB	90dB	52Hz	10-200W	v. good	v. good
B&W LM1*	24	15.5	20	2.5	101dB	86.5dB	80Hz	15-100W	average +	good
B&W 1200	36	22	28	11	101dB	86dB	60Hz	15-100W	good +	good +
B&W 1400	60	25.5	30	30	105dB	86.5dB	50Hz	20-200W	good +	average +
BBC LS3/5A**	30	18.5	16	5.5	93.5dB	81.5dB	57Hz	30-50W	average +	v. good
Bose 301	43	27	23	15	102dB	87dB	50Hz	15-100W	good	good
Bose 901	32	53.5	33	—	110dB	93dB	§30Hz	50-200W	§average -	good
Boston A40*	34	21	18	8	100dB	88dB	65Hz	10-50W	average +	average
Castle Clyde*	37	21.5	22	9.8	102dB	89.5dB	64Hz	10-50W	v. good	excellent
Castle Trent	33.5	19.5	21	9	101dB	89dB	73Hz	10-50W	good	excellent
Castle Tyne	44	25	24	17	103dB	88.5dB	55Hz	12-100W	good +	v. good
Castle Lincoln*	44	22	27	15	100dB	88dB	53Hz	15-50W	v. good	good
Castle Pembroke*	35	25.75	30.5	32	103dB	88dB	46Hz	10-100W	v. good	v. good
Celestion 100*	33	21	18.5	7	100dB	88dB	76Hz	15-50W	average	v. good
Celestion SL6**	37	20	25.5	12	98dB	82.5dB	55Hz	30-150W	good +	excellent
Celestion SL600**	37	20	25.5	12	99dB	83dB	55Hz	30-150W	v. good	excellent
Diesis Solitaire	35	26	20	12	100dB	85dB	57Hz	20-100W	average +	average +
Gale GS402A**	33.5	61	28	40	106dB	88dB	48Hz	25-200W	average +	average +
Goodmans Mezzo*	60	32	26	37	104dB	88dB	46Hz	12-100W	average -	average
Harbeth ML*	34.5	21.5	19.5	9	96dB	84dB	70Hz	20-50W	average	good
Harbeth HL1 III*	63.5	32.5	30.5	50	102dB	87.5dB	46Hz	15-100W	good	v. good
Harman T3000	56	27	23	25	105dB	94dB	76Hz	10-50W	average	poor
Heybrook HB1*	47	29	23	22	104dB	90dB	55Hz	10-80W	average	good
Heybrook HB2*	41	23	23	12	99dB	84dB	60Hz	30-100W	average +	good
IAS 808	33	20	22	9	99dB	87dB	86Hz	15-50W	average -	average +
JBL L46	52.5	32	29	35	105dB	87dB	48Hz	15-150W	v. good	good
JBL L86	54	33	27	37	106dB	87.5dB	40Hz	15-200W	good +	good
JBL L96*	60	36	30	40	107dB	89dB	40Hz	10-200W	average +	average
JBL L150A*	105.5	43	33	110	111dB	89dB	40Hz	10-500W	v. good	v. good
JPW J31	44	26	26.5	18	105dB	90dB	60Hz	10-100W	good +	good
Keesonic Kub*	29	18	21	7	99dB	85dB	63Hz	20-75W	average +	average +
Kef Chorale III	37	22	18.5	9.5	98dB	86.5dB	66Hz	15-50W	good +	excellent
Kef Coda III**	47	28	21	19	103dB	88dB	55Hz	15-150W	v. good	v. good
Kef 103/2	50.5	26.5	25	19	104dB	86dB	46Hz	20-200W	v. good	v. good
Kef 104/2	90	28	41.5	50	110dB	92dB	50Hz	10-200W	v. good	v. good
Linn Kan*	30.5	19	16.5	5.2	103dB	87dB	70Hz	15-100W	average	v. good
Linn Sara*	43	34	24	20	103dB	87.5dB	42Hz	25-100W	good	v. good
Magneplanar MG3	180	62	38	—	106dB	85dB	35Hz	25-300W	good +	v. good
Marantz LD20	36.5	23	25.5	16	102dB	87.5dB	60Hz	15-100W	good	good
Marantz LD30 II*	42	27	28	23	100dB	85.5dB	47Hz	20-100W	good	good
Marantz LD50	42	26	29	23	101dB	86dB	43Hz	15-100W	good +	v. good
Meridian M2*	50	18	38	17	102dB	active	45Hz	active	good	v. good
Mission 70 II	35	21	21	13	104dB	89dB	68Hz	10-100W	good +	v. good
Mission 770 Freedom	61	27	30	35	107dB	91dB	55Hz	10-150W	average +	v. good
Monitor Audio R252/R252V**	47	25	24	17	102dB	89dB	62Hz	10-75W	good	good
Monitor Audio R352	64	25	32	36	105dB	90dB	50Hz	10-100W	average +	average
Monitor Audio R152*	51	20	28	20	101dB	85.5dB	55Hz	15-150W	average +	average +
Monitor Audio R552	51	20	28	20	103dB	86dB	65Hz	15-150W	good	good
Mordaunt Shorti MS20*	42	25	20	14	102dB	87dB	55Hz	15-75W	good	good
Mordaunt Shorti MS40	92	25.5	24	22	105dB	86.5dB	50Hz	15-200W	good +	v. good
Quad ESL-63**	92	66	27	—	99dB	84dB	34Hz	25-100W	excellent	average -
Rogers LS1	35.5	19	16	8	103dB	85.5dB	65Hz	15-200W	good +	v. good
Rogers LS7**	56	27	28	30	106dB	88dB	48Hz	10-200W	v. good	v. good
Rogers Studio One*	63.5	30.5	30.5	43	106dB	87.5dB	35Hz	15-200W	v. good	v. good
Rotel RL850	44	25	25	20	103dB	87dB	52Hz	15-150W	good	good
SD Acoustics SD2	55	38.5	35	50	108dB	90dB	55Hz	10-200W	average	good
Sony APM22ES	51.5	29	30	30	106dB	88.5dB	46Hz	15-200W	v. good	v. good
Spendor SA1*	30.5	22.5	21.5	9	96dB	81dB	52Hz	30-100W	v. good	v. good
Spendor Prelude*	50	26	28	28	105dB	88dB	48Hz	15-200W	good	v. good
Spendor SP1*	63.5	29.5	30.5	44	104dB	87dB	41Hz	12-150W	v. good	v. good
Spendor SA3*	85	38	46	120	107dB	89dB	32Hz	10-200W	v. good	good
Tannoy Mercury**	48	26.5	23	19	103dB	88dB	52Hz	12-200W	good	good
Tannoy Venus	53.5	30.5	27	30	106dB	86.5dB	47Hz	15-300W	good +	excellent
Tannoy Dover	55.5	31	28.5	33	107dB	88dB	49Hz	15-300W	average	excellent
Wharfedale Diamond	24	18.5	20.5	5.2	98dB	86dB	74Hz	15-50W	average -	average +
Wharfedale Laser 90B	47.5	26.5	24	17	104dB	89dB	60Hz	10-150W	v. good	v. good
Wharfedale TON102.2 TC	42	18.5	22	9.5	101dB	84dB	60Hz	25-100W	good +	excellent
Yamaha NS1000*	67.5	37.5	32.5	55	108dB	90dB	40Hz	10-200W	v. good	v. good
Yorkshire 1/3	37	23	18.5	11	100dB	88dB	60Hz	12-100W	good	average +

\* = revised & reprinted \*\* = reassessed § = dependent on equaliser settings

# OVERALL COMPARISON CHART

Coloration	Amplifier loading impedance	Peak distortion per 100W performance	Swept distortion per 96dB performance	Overall subjective quality	Stereo image quality	Typical price (stands)	Value judgement	
good	average	v. good	good	good	good	£200	Recommended	Acoustic Research AR48LS
v. good	v. good	average +	average	v. good	v. good	£299	Recommended	Arcam One
excellent	good	good	good +	good	v. good	£1397	Worth considering	Audiostatic ES200
good +	v. good	good	v. good	good +	v. good	£105	Best Buy	B&W DM110
average +	good	good	good	good +	v. good	£188	Recommended	B&W DM220
good +	excellent	good	good	average	average	£200	Worth considering	B&W LM1
good	v. good	v. good	good +	good +	v. good	£230	Recommended	B&W 1200
average +	excellent	average -	average +	average	good +	£190	Recommended	B&W 1400
average +	difficult	good	average +	average	average +	£225	Worth considering	BBC LS3/5A
poor	average -	good	average	average	average	£1250	—	Bose 301
average -	good	average	average	average	average	£99	Best Buy	Bose 901
average +	good	poor	average +	average +	average +	£110	Worth considering	Boston A40
good	v. good	poor	average +	average	average	£130	—	Castle Clyde
average +	v. good	good	good	average	average +	£165	Worth considering	Castle Trent
average	v. good	good	good	good	good	£215	Recommended	Castle Tyne
good +	average	good	average	average	good	£80	Recommended	Castle Pembroke
good +	average +	average +	average	good +	v. good	£280	Recommended	Celestion 100
excellent	average +	average +	average +	v. good	excellent (inc)	£660	Recommended	Celestion SL6
good	v. good	good +	average	good	good +	£220	Recommended	Celestion SL600
good	average -	v. good	good	good +	good	£480	Recommended	Diesis Solitaire
average +	good	good	v. good	average +	average +	£135	Recommended	Gale GS402A
average +	v. good	average	average	average	average +	£199	—	Goodmans Mezzo
v. good	good	average -	v. good	good +	good	£343	Recommended	Harbeth ML
poor	good	poor	average	poor	poor	£80	—	Harbeth HL113
good	average +	good	average +	v. good	v. good	£140	Best Buy	Harman T3000
good	average +	average -	good	good	good	£190	Recommended	Heybrook HB1
poor	v. good	average -	average -	average -	average -	£199	—	Heybrook HB2
good +	good	v. good	average +	v. good	v. good	£240	Best Buy	IAS 808
good	v. good	good	average +	v. good	v. good	£375	Recommended	JBL L146
average	good	v. good	excellent	average +	average +	£699	—	JBL L86
good	average	v. good	excellent	v. good	good	£1350	Recommended	JBL L96
average +	v. good	good +	average +	good	average +	£90	Recommended	JBL L150A
average +	good	average +	average	average +	average +	£90	Recommended	JPW JP1
good	v. good	average -	average -	good	good +	£85	Best Buy	Keesonic Kub
good +	v. good	v. good	average +	good +	v. good	£105	Best Buy	Kef Chorale III
good +	v. good	good +	good +	good +	v. good	£299	Worth considering	Kef Coda II
v. good	average -	excellent	v. good	average -	good +	£599	—	Kel 103/2
average	average	good	average +	average	average +	£196	—	Kel 104/2
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excellent	average -	excellent	v. good	excellent	v. good	£2500	Recommended	Linn Sara
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good	good	good	average	good +	good +	£99	Best Buy	Meridian M2
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good	v. good	good	v. good	good	good	£145	Best Buy	Monitor Audio R252/R252V
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**ABR:** Auxiliary bass radiator; a reflex type bass-loading for loudspeaker systems, which uses a speaker-like 'cone' without motor, instead of a port.

**Active:** Speaker systems which contain electronic crossovers and where the drive units are connected directly to power amplifiers.

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

**Anechoic:** Without echo; a special room or 'chamber' with thick sound absorbing materials on all surfaces to prevent reflections.

**Balance:** 1) The overall relative loudness perceived at different frequencies (eg bass, treble) 2) the accuracy of the match between the two channels of a stereo transducer (eg cartridge or headphone).

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

**Bass:** Lower part of the frequency spectrum, typically below 150Hz.

**Bextrene:** A plastics material frequently used for bass and midrange cones.

**Binaural:** Closed system recording/replay technique using headphones and 'dummy head' microphones.

**Bituminous damping:** A cabinet damping technique whereby heavy impregnated felt pads are attached to the internal cabinet surfaces.

**Capacitance:** An element of electrical impedance that is particularly important when matching pickup cartridge, arm leads and amplifier input characteristics to achieve a flat frequency response from discs.

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

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

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

**Crossover:** An electrical circuit which uses combinations of inductors, capacitors and resistors to divide the signal from the power amp into the required frequency bands and with

any necessary equalisation for feeding to the individual drive-units of the speaker system.

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

**Damping:** A means of controlling resonances by means of a resistive medium (electrical, mechanical, or acoustic depending on situation).

**Decibel (dB):** A logarithmic unit that is convenient for expressing ratios that span a wide range on a linear scale. For simplicity it can be regarded as a measure of relative loudness.

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

**Doping:** A technique involving the application of damping to a loudspeaker driver cone in order to assist in controlling resonances.

**Drive unit (Driver):** The term used to distinguish the loudspeaker unit itself, be it bass, midrange, treble or fullrange in application, from the complete loudspeaker system which combines drive units, cabinet and crossover into a total design.

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

**Electrostatic:** A principle employed in some headphone transducers using static electricity effects to set up a polarising field within which the modulated transducer medium moves.

**Equalisation: (general)** The deliberate modification of frequency response, usually in response to some engineering limitation or deficiency.

**Farad:** Measure of capacitance.

**Ferro-fluid:** A magnetic fluid which is introduced into the voice-coil gap to provide damping and/or improved cooling.

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

**Frequency range or spectrum:** Can refer to any particular group of frequencies, but commonly applied to the audible band from 20 to 20,000 cycles per second (Hz), extending from the deepest bass to the highest audible harmonics.

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

**HF:** High frequency.

**Hz (Hertz):** 1 Hz = 1 cycle per second and is a measure of frequency which corresponds to

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musical pitch (the higher the frequency the higher the pitch.)

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

**Harmonic distortion:** The addition of unwanted harmonics to a signal.

**Impedance:** Measure of resistance (and reactance) in alternating (ie audio) signals; this is of some importance in the compatibility of both cartridges and headphones with amplifiers. For convenience's sake is measured in ohms.

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

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

**Kilo (k):** prefix meaning one thousand.

**LED:** Light Emitting Diode; an indicator light.

**LF:** Low frequency.

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

**Load or loading:** The impedance (including resistive and reactive components, ie ohms, mH, pF) seen by one component looking back to its interconnected component; of importance in compatibility of cartridge/amp, and amp/headphone.

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

**Microseconds ( $\mu$ s):** The time constant of a resistor capacitor combination involving a frequency reponse change (equalisation).

**Midrange, Midband:** The central part of the audible frequency range where the ear is most sensitive.

**Modulation:** The audio signal is 'stored' by means of modulations within a medium, eg the 'wiggles' in the groove of a plastic disc, or the magnetic coding on a tape.

**Moving-coil:** A transducer (eg cartridge or headphone) where the signal is generated by the movement of a coil within a magnetic field.

**Noise:** Random unwanted low level signals.

**Octave:** Two-to-one ratio of pitch or frequency.

**Ohm:** Unit of electrical impedance (including

reactance) or resistance; also kohm, where 1 kohm = 1,000 ohms.

**Passive:** The most common type of system, where drivers and crossover are driven from a single power amplifier.

**Port:** An opening in a cabinet which is tuned to characteristics of the bass driver and the enclosure volume to provide reflex type bass-loading.

**Power amplifier:** The part of an amplifier that provides power to drive the loudspeakers; usually integrated, it is sometimes a separate component.

**Pre-amplifier:** The part of an amplifier that accepts the input signals, sorts them, applies any necessary equalisation, and then passes the signal to the (normally integral) power amplifiers.

**Presence:** A quality of forwardness or immediacy in a sound balance, generally related to an upper-middle frequency response boost.

**Q:** A measure of the magnitude and shape of a resonance; the higher the Q, the sharper and more severe in amplitude the resonance.

**Reflex:** A system of bass loading (using port or ABR) which offers improved efficiency and bass power handling at the expense of subsonic control compared to a sealed box.

**Sensitivity:** The volume of sound output for a specific electrical voltage input.

**Separation:** As between the two channels of a stereo pickup; see *crossstalk*.

**Signal-to-noise, signal/noise, S/N:** The difference in total output when an applied signal is removed.

**Subsonic:** Below the audible range, ie below 20Hz.

**THD:** Total harmonic distortion.

**Transient:** Signal of very short duration.

**Transmission line:** Complex in construction and hence fairly uncommon, this bass-loading technique has much in common with reflexing.

**Treble:** Upper part of frequency spectrum, typically above about 3kHz.

**Tweeter:** A small drive unit designed to operate over the high frequency range.

**Ultrasonic:** Frequencies above audibility, ie greater than 20kHz; also *supersonic*.

**Weighting:** A factor or function that is applied to a measurement to increase its relevance and usefulness; eg the weighting curves applied to headphone frequency response measurements to take account of head, ear, and other related effects.

**Woofer:** A drive unit that operates over the bass portion of the audio range.

# Protection is better than cure



Loudspeaker drive unit damage is a problem that some of you must have experienced in the past and those that have, will be aware of the cost and inconvenience involved.

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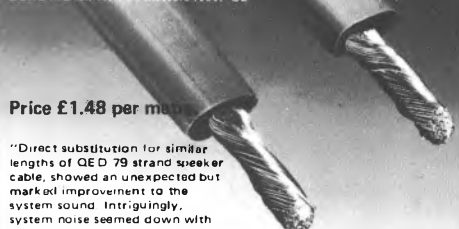
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