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THE BOOK OF LINN



IN the beginning is the performer.
2 And as he singeth or stroketh his instrument, so shall ye hear his song and know that it is good.
3 And all who hear his song may attest to the wonder of his music.
4 But in the days before the coming of high fidelity, though they that would hear the performer came in multitudes, even so his song could not carry beyond the ears of the anointed.
5 Therefore did the prophet Edison come forth from the Land of Ohio and create a disc which would transcribe the performer's song and multiply it a thousandfold. And in this manner did the performer make his song known even unto the ends of the earth.
6 Now in the time of Edi-

son the disc was but a pale reflection of the performer's song. But it came to pass, in the generations after him, that the art of the transcriber was increased greatly.
7 Yet all who would listen were not blessed with a joyful sound for there dwelt in the land false prophets who would distort the song and confound its progress from the record to the ear.
8 And there came then a manufacturer who looked upon this sore affliction and saith, Behold, there is a chain of reproduction and unless this chain be rendered faithfully, it shall not profit ye to listen. And though each link save the first be of the finest metal, nevertheless shall the result be without honour.
9 Thus was the law given by the manufacturer who was called Linn.

HI-FI CHOICE No 31
Loudspeakers

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by Martin Colloms

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HOW TO USE THIS BOOK

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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EDITORIAL INTRODUCTION

With this edition we have tried to cover the best recent speaker designs, from some increasingly sophisticated 'budget' models to the larger types which can claim to be true studio monitors. There are also some old favourites which just could not be left out!

It seems true to say that loudspeaker design has advanced on all fronts since the publication of the last *Choice* edition on the subject. In general the advances have been the result of a myriad of cumulative refinements rather than of technological 'quantum leaps' — with many firms succeeding in applying the 'fine tuning' and attention to detail, which makes the difference between an average speaker and a truly pleasing one, to relatively inexpensive models. All this has been spurred by fierce competition among the ranks of UK manufacturers, many of whom now produce quite amazingly good speakers at low prices.

One result of the general improvement in standards is that our expectations of performance-versus-price have been raised since the last issue, and accordingly we have had to revise the level at which we have made 'Recommended' and 'Best Buy' judgements. Some models which we recommended last time are therefore not recommended this time, though of course this does *not* mean that in absolute terms we no longer consider them worthy products. It is just that we feel that many of this year's models do represent even better value for money.

Another effect of recent design developments is that the performance obtained from a small to medium sized speaker is now such as to make a large enclosure less of a necessity for even quite ambitious hi-fi systems. It has long been a truism to say that at a given price the biggest box is unlikely to give the best sound, because the price of the woodwork implies cost-cutting on the components and constructional quality. Now, logically enough, there seems to be market acceptance for relatively expensive speakers which offer high build quality and good sound rather than impressively monolithic cabinets. Leading the field here are Celestion with the *SL6* and the 'no compromise' *SL600* variant, some Spendor models and the perhaps more specialised Linn *Sara*. The question of size-versus-sound-quality is discussed at length in later sections.

Much of the musical material now available on disc is mastered using digital recording equipment, but it is only with the arrival of Compact Disc that true digital reproduction has become available for domestic use. At the time of writing there is still strong controversy over

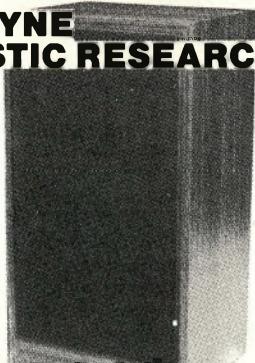
the possible subjective effects of the distortion of very low level signals which is characteristic of CD systems, but whatever the subtler problems, there is no doubt that Compact Disc is free from the inherent problems of analogue tape or disc replay (see *Hi-Fi Choice* No 30, *Turntables and Tonearms*). This in itself has important implications for loudspeakers, as the inclusion of digital master tape and CD programme material (theoretically identical to the master) in the *HFC* listening tests showed. Digital and analogue sources often appeared to highlight different strengths and weaknesses in speaker performance, which is perhaps not surprising as the refinement of speaker design referred to earlier has generally aimed at producing the most musically-satisfying results from a good conventional disc-playing system, and of course for most people this will be the most relevant requirement of a loudspeaker. So our reviews in this edition have attempted to comment constructively on each model's abilities on both analogue and digital input, and readers should look carefully at this aspect of the findings, which is also discussed fully in the *Conclusions* section. Suffice it to add here that we felt that ideally a speaker should acquit itself well on both kinds of programme and this is reflected in the recommendations in this edition.

Within the time and space available it is never possible to include quite all the models we would like. Though in this issue we have, I think, represented just about all the major manufacturers, some interesting products have had to be left out. We have sacrificed some of the largest and most esoteric systems in order to include more realistically-priced models, and I hope that most readers will approve of this!

While there is no shortage of new speaker models on the market, some successful designs have survived changes of fashion, and we felt that it was important to represent these. Examples are the Spendor *BC1*, a seminal design first introduced in 1969, with only relatively minor modifications since, the Yamaha *NS1000* which was introduced to the UK and first reviewed by *Choice* in 1976, and at the other end of the size spectrum, the Keesonic *Kub*, introduced about the same time and still selling very well at very little more than its original price! Some of the older designs have

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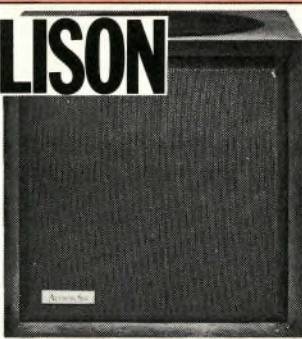
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EDITORIAL INTRODUCTION

done extremely well, suggesting perhaps that the traditional speaker virtues including flat frequency response and low coloration can still count for a lot as ancillary equipment and programme quality improves.

One or two manufacturers were in the midst of model changes or mods at the time of our deadline, and in these cases samples provided for review would have not represented the product available at the time of publication. Other omissions are the products of a number of smaller companies, who, although often successful, have a limited scale of production and distribute through a very small number of dealers. Some of these were not too anxious to be included anyway, and we feel that readers who discover these models at a specialist dealer will have the opportunity to compare them with generally-accepted 'yardstick' models. We must stress that omission of any model does not mean to imply that we regard it as inferior!

Every link in the hi-fi chain presents its own problems from the reviewer's point of view. Speakers present perhaps the most funda-

mental difficulty, in that the sound they produce is influenced in very complex ways by the acoustic character and size of the room they are used in. They are also dependent on the ability of the power amplifier to drive them correctly, and indeed the subjective results will vary dramatically according to the overall contribution of all the other parts of the replay system. In our review programme, we obviously cannot conduct listening tests in every variety of living room — however, the room used for HFC tests is one whose characteristics are now well understood, and which come close to the IEC standard dimensions and reverberation specification for audio analysis. This allows a fair prediction of room interactions, although of course ultimately only a home trial will predict exactly how a given pair of speakers will sound in your own listening room.

As usual, though, I must end 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 own mind!

Steve Harris

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CONSUMER INTRODUCTION

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 LOUDSPEAKER 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

CONSUMER INTRODUCTION

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

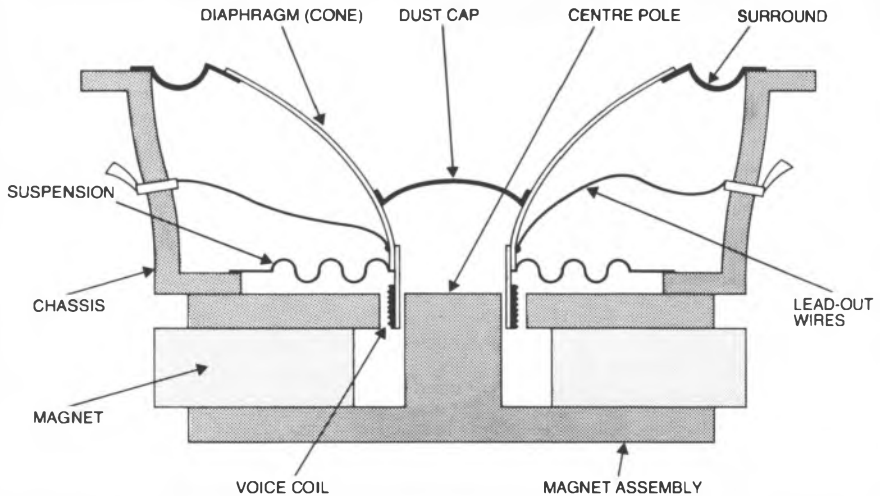
The very simplest form of crossover consists of a single capacitor, which acts as a high-pass filter to prevent low frequency signals from reaching the tweeter and burning it out. This

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



Moving-coil drive unit components. This diagram shows a typical bass/mid driver.

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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

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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).*

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.

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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

locations of colorants, 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 trial 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 'deaden' 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.

Paradox.

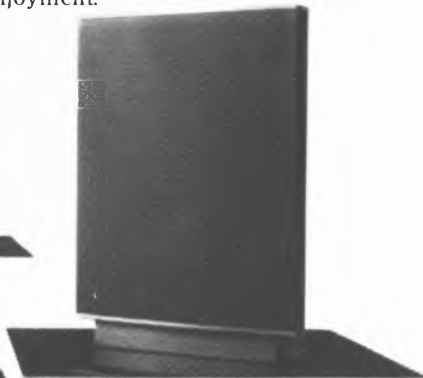
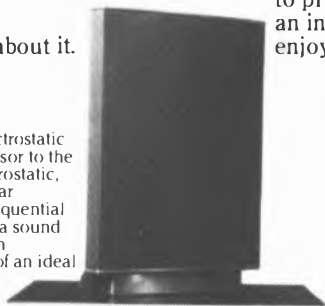
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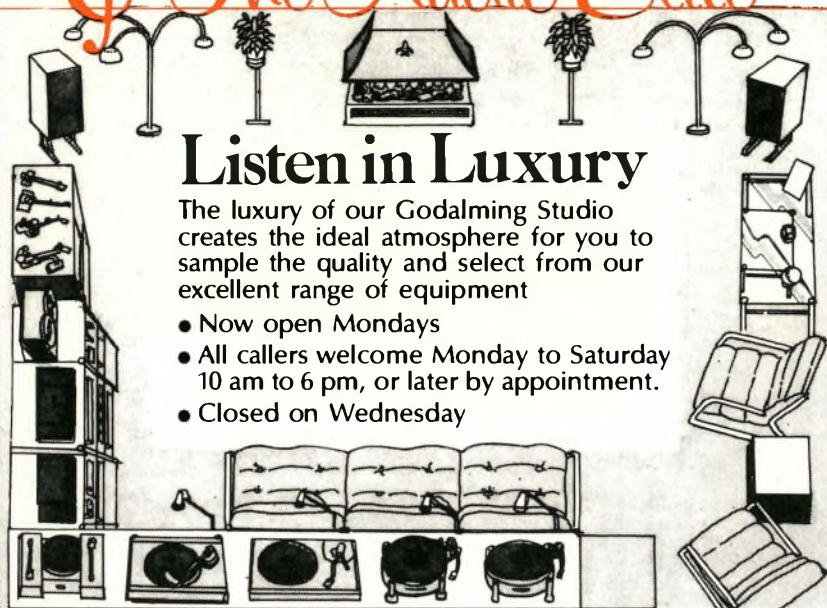
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TECHNICAL INTRODUCTION

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 Spendor *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

TECHNICAL INTRODUCTION

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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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.)

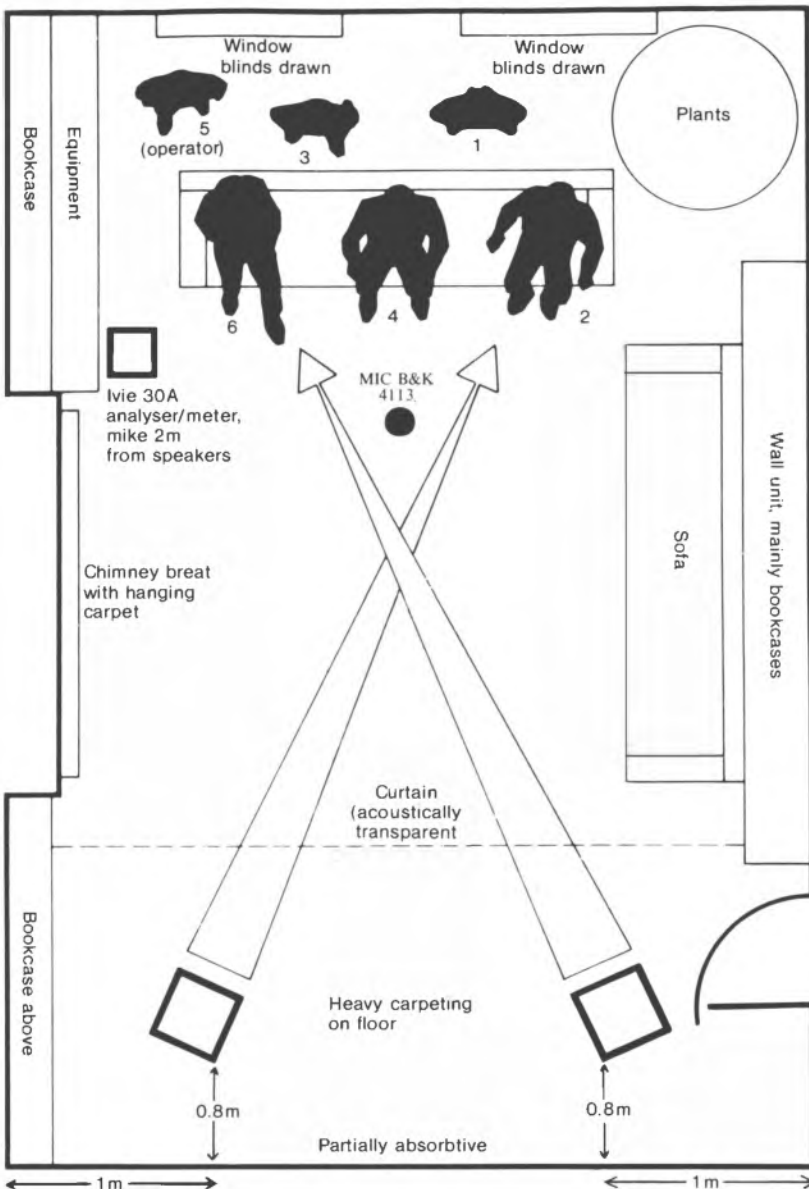
Recent research indicates that the perceived spectral balance of a loudspeaker is the result of a complex integration of the first group of sounds arriving within some 10-20mS. This period is in fact long enough to include reflected energy from adjacent boundaries — floor, rear and side walls. The character 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 $+1-3$ 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



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 \pm 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 loudspeaker reflecting, wall behind listening panel mainly absorbive. Dominant absorbive furniture, two large Chesterfield sofas.



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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) for 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 $\frac{1}{3}$ -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. The two prime examples in this issue are the Quad 63 and the Acoustat; in neither case can the room averaged response be taken as an accurate indication of the resulting sound. The Quad was particularly interesting, since it would appear that the low frequency radiation characteristics severely interact with the room modes even though the bipolar theory of radiation for the model suggest that it should interact less than the conventional and near omni-directional box type speaker. Subjectively, the Quad bass was comparatively uniform and extended, so perhaps further investigation is still required here!

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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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 reprinted 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 50 new reviews in this 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.

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.

In fact, a surprisingly large number of systems did produce spurious noises on clean low frequency signals. Their causes ranged from inadequately secured crossover components and boards, poorly fitted rear terminal assemblies, and frail driver mountings, with in some instances no real attempt made to seal either the panels of the cabinet itself, or the drive units to the front baffle.

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 Spendor *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-

cluded, 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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TECHNICAL INTRODUCTION

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 ± 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

The listening panel members included John Atkinson, Martin Colloms, Tony Faulkner, Steve Harris, Derek Hughes, David Inman, Peter Mapp, Robin Marshall, Adrian Orlowski and David Prkel. Others who took part in previous panel tests were Caroline Atkinson, Alan Harris, Tony Lockwood, Alan McGechan, Evelyn McDermott and Damien Pullen.

Location

Measurements were conducted at a new audio laboratory in Cambridge for this edition and (earlier reviews) at GEC Hirst Research Centre, Wembley. Listening tests carried out in the author's calibrated and near-IEC Standard room (note that this is an appreciably 'dry' room, with an unusually even reverberation over the frequency range. In practice most 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

Revox B77 HS IEC open-reel deck
Dolby A361 (x 2) 'A' processors
Linn LP12 (Nirvana/Valhalla) turntable
Linn Ittok tonearm
Alphason HR100S tonearm
Linn Asak, Koetsu Black and Technics EPC205 IIL cartridges
Lucas ILV and QED C38 speaker cable
Quad 34, 44 and Sony Esprit 901 pre-amplifiers
Mission 777, A&R SA200, Carver M400 power amplifiers.
Sony PCM-F1 digital recorder
Sony CD101P CD player (slightly modified, but no queries will be answered!)
Toshiba CD player
B&K 2203 sound level meter
Various speaker stands including coupled Sara stands
Ivie 30A precision analyser
Classical acoustic guitar, Paiste cymbal, flute, side drum, wood block zylophone, male voice

Programme material

Here 'AD' indicates Analogue Disc, '(CD)' indicates Compact Disc:

1. Cantate Domine; cathedral choir, ATR 002 (AD)
2. Shumann Piano Concerto, crossed-pair recording (master tape)
3. Tiden Bara Gar; Opus 3, Opus 7900 (AD)
4. The B52, ILPS 9580 (AD)
5. The Sheffield Drum Record (Direct-cut, AD)
6. The Sheffield 'Track' record (Direct-cut, AD)
7. Pictures at an exhibition, Arthur Wills, Ely Cathedral, crossed-pair recording (master tape)
8. Love Over Gold, Dire Straits, Vertigo 800 08-2 (CD)
9. The Visitors, Abba, 800 011-2 (CD)
10. Schubert Piano Sonata, Michelangeli, 400-043-2 (CD)
11. Matinée Musicale, Britten, (PCM digital master)
12. Castiliano Violin Concerto, and orchestra (PCM digital master)

Lab test equipment

B&K 2010 generator/analyser
B&K 1901 harmonic controller
Nicolet 100kHz FFT analyser
B&K 4133, 4165 precision 12.5 mm condenser microphones
B&K 1623 tracking $\frac{1}{3}$ octave analyser
B&K 2307 high speed level recorder
B&K phase meter
Ivie 30A real time $\frac{1}{3}$ octave analyser
Rion LR04 level recorder
Hitachi 550 oscilloscope
Baxendall sweep oscillator
Shackman scope camera
Hewlett-Packard HP3582A computing Fourier analyser
Hewlett Packard 89826A computer
Mission 777 power amplifier

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 dogsbody; 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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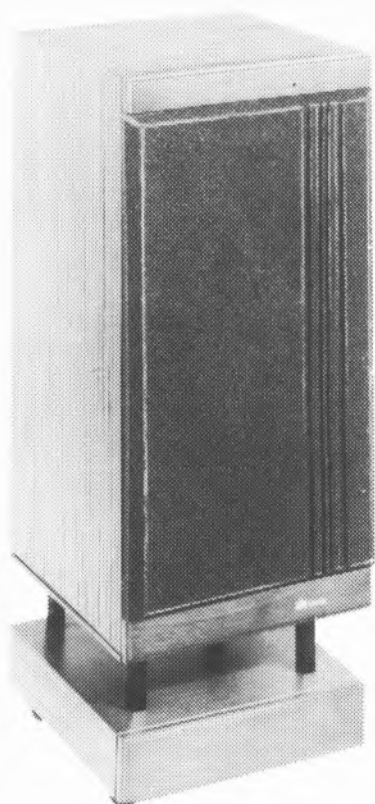
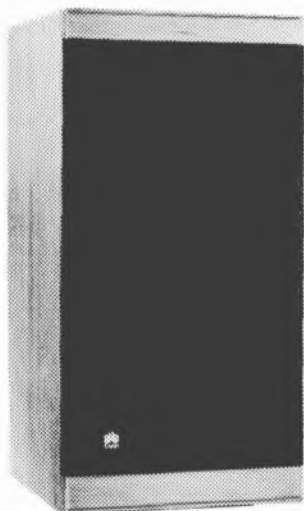
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Acoustic Research AR8LS

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



While AR do make a true miniature model, the *AR8LS* is the smallest speaker in their conventional series. It is a new introduction costing under £80 a pair – a price level where it would seem hard to make a hi-fi speaker at all!

In the AR tradition, the *8LS* is a sealed box, ('acoustic suspension' in AR's terminology) using a 165mm bass/mid driver. This has a fairly long throw suspension but it is quite stiff, presumably to give a good bass power handling, but in consequence the system resonance is also quite high at 79Hz. The driver uses a normal felted pulp cone with a standard motor system built on a pressed steel frame, and, as with the *28LS*, an acoustic crossover is employed, with only a single electrical component (a capacitor) present to protect the tweeter. This is a 32mm pulp cone unit, ferrofluid damped and cooled, and also built by AR themselves.

Well finished, the enclosure is trimmed by a new and apparently costly grille frame covered with good quality stretch woven fabric. The 12mm chipboard cabinet is covered in a walnut-effect, but the interior is undamped, save for a generous wadding filling for the 9litre internal volume.

External connection is via spring clips which replace the preferable binding posts that AR used to employ.

Sound quality

The listening panel did not favour the *AR8LS*, finding it to be distinctly coloured, with a shouty, 'megaphonic' and 'loud' quality. Low bass was absent, and the system was felt to be thin- and forward-sounding. It excelled on drum percussion, particularly rim shots, but its aggressive balance suited little else.

Considering the price its rating was not a complete disaster, but unfortunately it was much poorer than a number of other similarly priced models. Perhaps AR should stay out of this fiercely competitive area until a better product is available.

Lab results

Analysing the reference 1metre responses, pair matching was quite good, and the grille also appeared to be quite good in acoustic terms. Sensitivity was high at 90dB, and despite a sensible maximum limit of 50W, decently loud 105dBA sound levels will be possible. This model will also make the most of smaller amplifiers, though its impedance was somewhat lower than the 8ohm standard specified, with a dip below 5ohms noted at 7kHz and a mean value nearer to 6ohms. The –6dB bass rolloff point was difficult to judge due to the upper frequency response plateau – say between 80 and 100Hz.

From the 2metre position measurement the audible forward characteristic may be observed. The entire mid-treble range was excessively elevated by 4-5dB above the fundamental range – more than is required for wall mounting. The response was quite lumpy although its consistency over the various axes was considered to be quite good.

Room-averaged, the response illustrated a clear pattern in the mid/treble range, with a suckout around 200Hz. Subjectively, this robs the tonal balance of warmth. The bass was not extended, and plotted as an isolated hump around 90Hz.

Measured at 96dB, second harmonic distort-

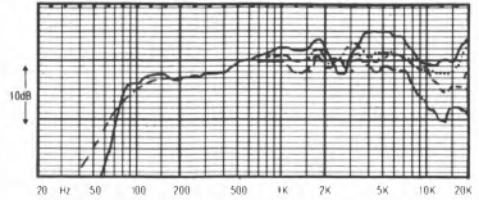
tion held below 2%, falling at higher frequencies, while third harmonic was higher than average, nearing 1% over much of the midrange – quite good results.

Summary

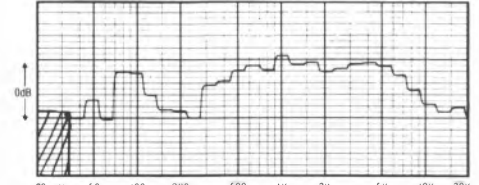
Standards are now so high that an ordinary small box even costing under £80 a pair will not succeed without the rudiments of a clean midrange and an attempt to produce a reasonable tonal balance. As far as *Choice* is concerned, the *AR8LS* does not come up to these requirements, and is therefore unlisted. However, like the *Boston A40*, I suspect it offers better value for money in the USA.

GENERAL DATA

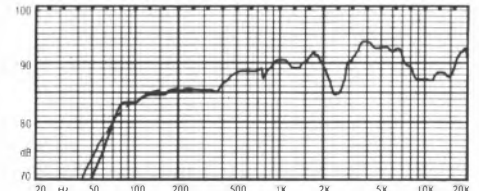
Size (height x width x depth)	35.5 x 23 x 18cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(10) – 50W
Recommended placement	shelf
Frequency response, within ± 3 dB, at 2 metres ..	400Hz to 20kHz
Low frequency rolloff (– 6dB point) at 1 metre	80-100Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre	90dB/W
Approximate maximum sound level (pair) at 2 metres ..	102dB
Impedance characteristic (ease of drive)	good
Forward response uniformly	fairly good
Typical price per pair, inc VAT	£75



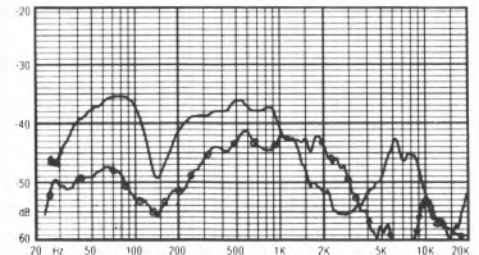
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



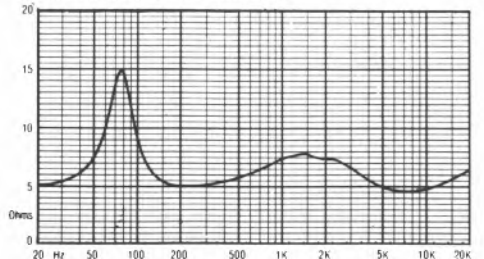
Averaged forward characteristic response in room at listening position.



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



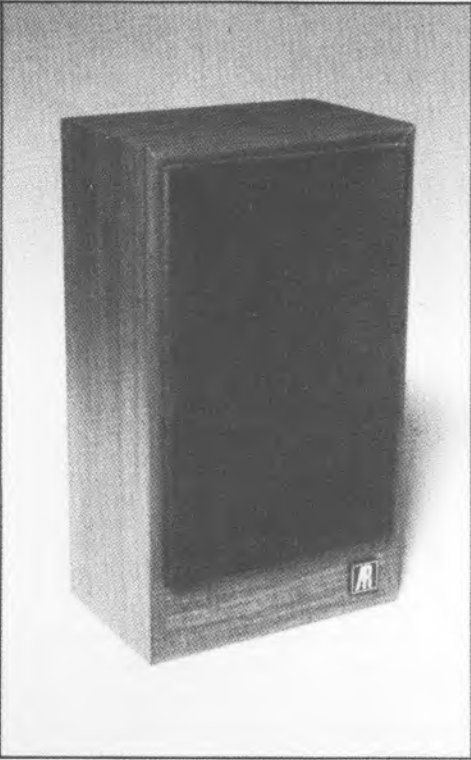
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Acoustic Research AR18S/AR18LS

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



a 12dB/octave rolloff slope below resonance which gives 18dB/octave with the single electrical component. I suspect that these mechanical filters may be rather less accurate and consistent than electrical components, although they nonetheless prove useful.

Possessing an internal volume of just under 10 litres, this is a shallow compact enclosure which might suit bookshelf mounting against a wall. The trend of forward responses certainly suggests that this is possible, though with a resulting increase in room coloration and a decline in stereo image quality. The system resonance lies at 62Hz which is average for the price, and the chipboard cabinet is finished in a synthetic dark walnut veneer. The grille is acoustically imperfect, comprising as it does a 14mm thick panel devoid of rebate or chamfer. Rated as 8 ohms, the signal input is *via* small screw terminals suitable only for bare wires.

Lab performance

The reference response at low frequencies has a dotted addition which indicates the sort of effects which would be produced by wall mounting, and also demonstrates the deleterious effect of the grille above 500Hz. The solid line is taken with the grille removed, showing the improvement but still retaining the obvious peaky tendency at 900Hz, 1.7kHz, 6kHz and 15kHz. The speaker's uneven characteristic was clearly delineated by the forward response, whose good integration suggested effective crossover control but an unbalanced result. If anything, the 30° off-axis response (short dashed) represented an improvement, and I would suggest using the speakers at an angle of 20–25° off-axis, with the pair directed so that axes cross well in front of the listener.

With the grille removed the '78 just met +/-3dB limits from 80Hz to 16kHz, with a modest -6dB low frequency point at 60Hz. At almost 90dB/watt it proved quite sensitive, and was capable of high sound levels of around 107dBA when fed with up to 75W per channel; 10W was sufficient to produce healthy volumes. The impedance characteristic averaged around 7ohms, briefly dipping to an acceptable 5.2 ohms at 9kHz, and it should not give rise to any amplifier problems.

As is often the case with higher sensitivity models, the distortion results were good, even at the higher 96dB sound level. This was particularly true of the low frequencies, measuring 1–2% both 2nd and 3rd order harmonic from 50 to 200Hz. Above this frequency third order was a little

AR's classic compact AR7 of a decade ago comprised a two-way sealed-box system using a 200mm pulp cone bass/mid driver and a 32mm HF dome. This lineup is repeated for their new AR18, and its cost is similar to its predecessor despite interim inflation. However, the new model does incorporate a number of evolutionary changes and improvements, including greater sensitivity and power handling, with the application of ferro-fluid cooling to the high frequency unit.

The crossover consists of a single capacitor to the high frequency unit and while at first glance this might appear a trifle primitive, in fact there is more to it than meets the eye. AR's work on driver frequency response has enabled them to build a mechanical 12dB/octave crossover filter slope into the low frequency driver, thereby removing the need for electrical components for that section; furthermore the ferro fluid plays a damping role in the treble unit, also contributing

higher (around 1.8%), and did not improve significantly with the level reduced to 90dB. Distortion was also present in the upper treble 6–15kHz, with 1%, 96dB and 0.5%, 90dB. Fed 100W pulses, the 5kHz tone showed only a slight compression, with 2nd harmonic 0.08%, and third 3.0%. But 500Hz proved taxing, and generated 0.5dB of compression, plus 10.0% 2nd order and 3.0% third order distortion. In consequence, 75W seems a safe peak power rating.

On stands the room response illustrates the upper mid dominance, and while wall mounting could be expected to augment the 150–500Hz range by 2–3dB, some 6dB would be required to match the midrange plateau.

Sound quality

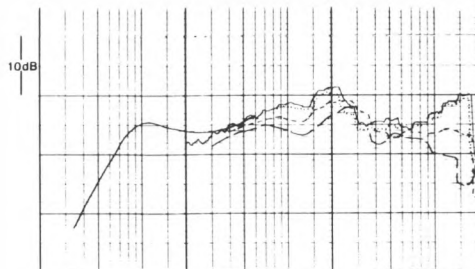
A 'peaky' 'forward' quality characterised the sound of this speaker, sufficiently so, in fact, to mask much of the expected improvement resulting from removing the grille. Wall mounting helped, but did not completely solve the frequency balance problem, namely the upper-mid prominence in the 'hard' region, followed by a 'dim' recessed presence range and a 'peaky' extreme top on axis. The sound was superficially detailed but showed little transparency, while both 'boxy' and 'hard' colorations were noted by the panel, who felt that the sound was 'shut in' or enclosed. Deep bass was absent with normal bass recessed and too dry, while stereo images were not well focused and showed little depth. On the live sound comparison, however, its 'forward' character apparently helped the results where the programme contained a high content of percussive sounds.

Summary

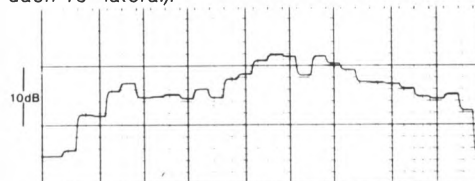
We have been informed that the new 18LS is very similar to the previous 18 except for the use of a new deep-look moulded grille offering a superior acoustic performance. Suited to wall mounting, the 18LS remains worth considering as an inexpensive book-case model, offering a good sensitivity and decent maximum sound level.

GENERAL DATA

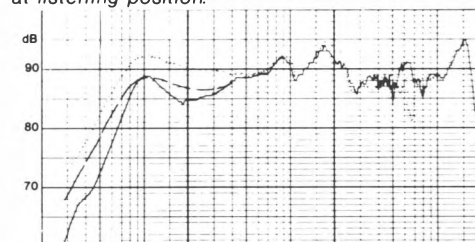
Size (h x w x d)	42 x 24.5 x 17cm
Weight	5.9kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–75W
Recommended placement	open shelf, near wall
Frequency response within ± 3 dB (2m)	80Hz to 16kHz
Low frequency rolloff (–6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, i.e. 1 watt in 8 ohms) at 1m	89.5dB/W
Approximate maximum sound level (pair at 2m)	107dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	below average
Typical price per pair inc VAT	£80



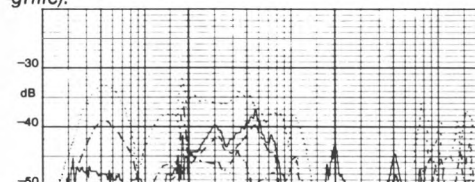
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



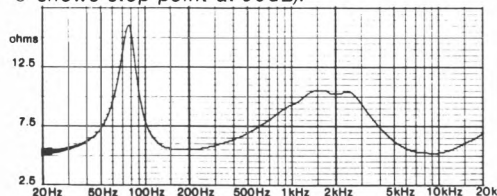
Averaged forward characteristic response in room at listening position.



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).

Acoustic Research AR28LS

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



Acoustic Research have adapted one or two older models and added a number of new ones to produce their latest *LS* range of speakers, these as a whole designed with specific reference to different mounting conditions.

In the case of the *28LS*, which is a small two-way system, shelf mounting adjacent to a rear wall is recommended, and accordingly this was adopted for our tests in addition to an open stand trial.

Designed in the USA and built here at the company's Houghton Regis plant, this model is a sealed box system of 20 litres internal volume and damped by a loose wadding fill. It is built along the lines suggested in an earlier technical paper by an AR engineer, the drive units so designed that they provide intrinsic natural rolloff rates at the intended crossover frequency. No electrical crossover should theoretically then be required, although in the

case of the *28* a capacitor is placed in series with the treble unit to remove the low frequency power from it, as otherwise this would burn it out. Bass and midrange frequencies are handled by a steel-framed driver with a large motor coil and straight-sided pulp cone. The diaphragm material was specially developed by AR and is a soft impregnated felt with a high loss factor. ARs established 32mm dome/cone paper diaphragm tweeter, here ferro-fluid cooled, completes the line-up.

The enclosure is built from plain 18mm chipboard, possessing a good finish in walnut effect vinyl. A substantial deep grille assembly is used, built on a costly plastic moulding of good acoustic properties, and rear connection is made via spring cable clips.

Sound quality

There was some dissent among panel members concerning the sound quality of this model, but the overall scoring indicated a below average rating. Although this was disappointing it nonetheless just attained a 'worth considering' classification on the grounds of its low price. It was felt to have a good attack with an open, clear presence range while it was lively with good bass definition but not much bass extension.

Stereo depth was restricted, and the treble occasionally sounded a little grainy and fizzy. However its main problem was undoubtedly plain coloration, as the mid band appeared 'shouty', forward and 'clangy' on piano. Vocals showed a hollow and nasal quality, with a 'cardboard' effect, while the lower treble could sound metallic and squeaky. Several listeners also complained of a mild feeling of fatigue.

Lab results

From the reference sinewave response the speaker can be seen to be tailored for wall mounting, evidenced by the rise in output above 500Hz. In the lower range the bass rolloff was estimated at 55Hz, which is typical for the type. Sensitivity was above average, at 89dB allowing substantial sound levels of up to 104dBA in a room with the speaker's response characteristic making it seem even louder. The axial response was quite tidy, if mildly lumpy.

Turning to the forward response, the mechanical crossover can be seen to be effective, reflected by the tidy grouping of off-axis outputs. The acoustic output was consistent and well controlled here, though still a trifle lumpy, and this, together with the design being

tailored for wall mounting, restricted the numeric frequency response limits to 300Hz – 20kHz, $\pm 3\text{dB}$ at 2 metres.

Impedance fell to 5ohms in several places, but the speaker's only mildly reactive nature meant that it still qualified as a reasonably good amplifier load.

Assessed by room averaging, the 28LS was tested both for stand and wall placement. The former was smoother and the latter better balanced, but with both the midrange was dominant around 700Hz, this associated with the thin, hard quality heard on audition.

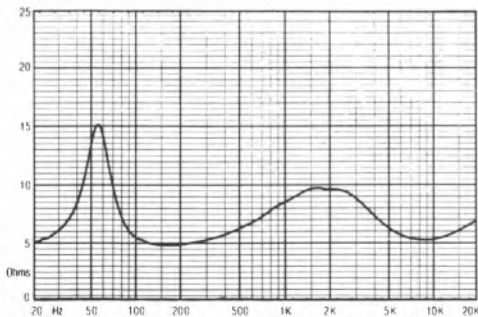
At 86dB, distortion was held to a satisfactory level, below 1%, aside from a small second harmonic peak at 10kHz. Good results were also measured at 96dB where figures below 2% were obtained for second harmonic throughout the bass-mid region, with third at less than 1%.

Summary

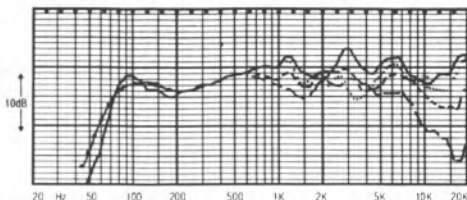
If AR are to succeed in this price area, their designers must pay greater heed to the standards of purity and tonal balance offered by certain of their competitors. The 28LS sounds quite hard and colored in a way which is becoming increasingly unacceptable to British ears, and while it performed satisfactorily on a technical basis and had a good forward integration, this was just not sufficient to lift it into the recommended category.

GENERAL DATA

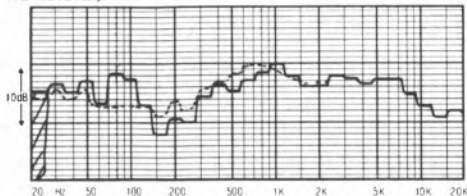
Size (height x width x depth)	51 x 28 x 22cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres)	(10) — 75W
Recommended placement	shelf/wall mounting
Frequency response, within $\pm 3\text{dB}$, a 2 metres	300Hz to 20kHz
Low frequency rolloff (-6dB point) at 1 metre	55Hz
Voltage sensitivity (ref. 2.83V, or 1W 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	good
Typical price per pair, inc VAT	£120



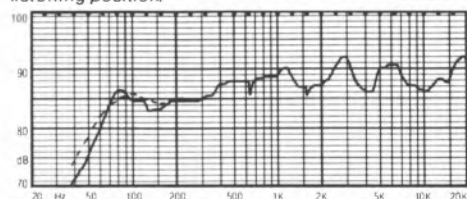
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



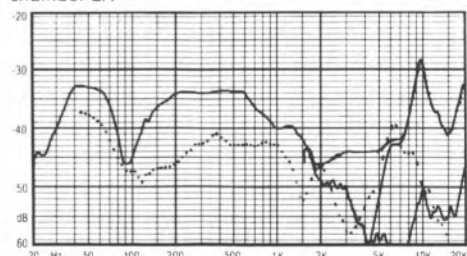
Forward characteristic response ($1/3$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



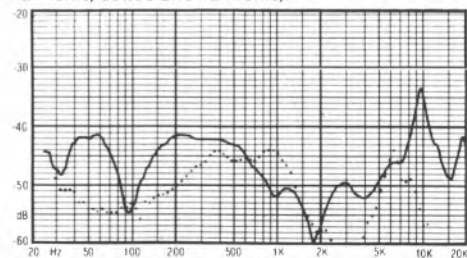
Averaged forward characteristic response in room at listening position.



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



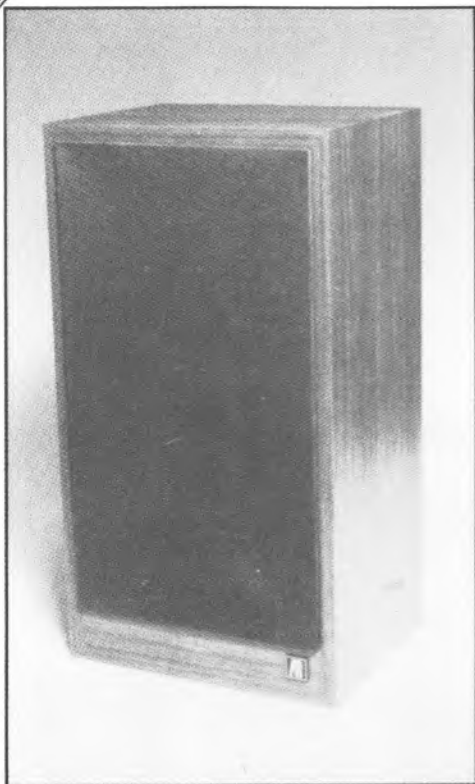
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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 400Hz-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, 700Hz (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, 500Hz. 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–1kHz 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.

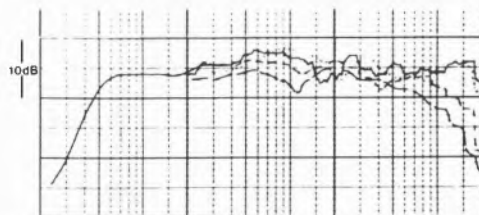
This picture was similar for the stereo sessions also, with the speaker sounding a trifle 'old fashioned' in terms of coloration levels, but at the same time considered easy on the ears. Lateral stereo presentation was to a good standard, although some loss of depth and 'see-through' ambience was experienced 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

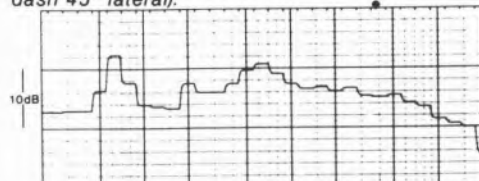
We were pretty keen on the 48S and the new LS version carries a dual improvement, namely a welcome price reduction and an improved grille. As such its 'Best Buy' rating is continued. A fine allrounder, suited to stand mounting, we still regard it as one of AR's most civilised speakers in the popular price range.

GENERAL DATA

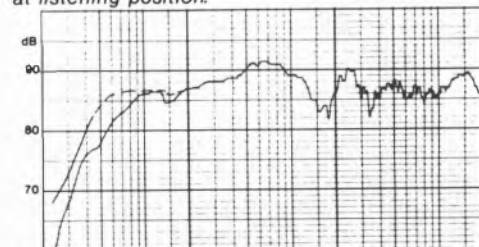
Size (h x w x d)	64 x 35.5 x 28cm
Weight	17.2kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)–100W
Recommended placement	stand
Frequency response within ± 3 dB (2m)	50Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt 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 £200



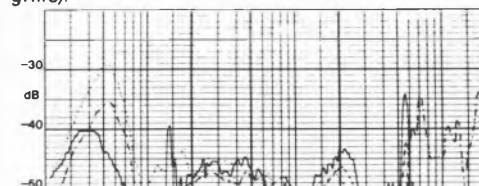
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



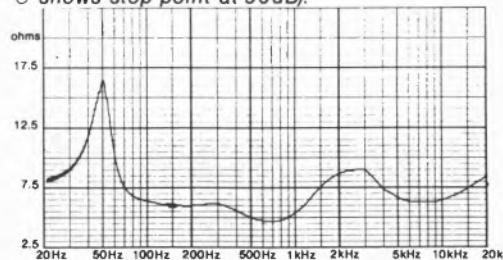
Averaged forward characteristic response in room at listening position.



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).

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 actually a modified VIFA 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, one metre, 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.

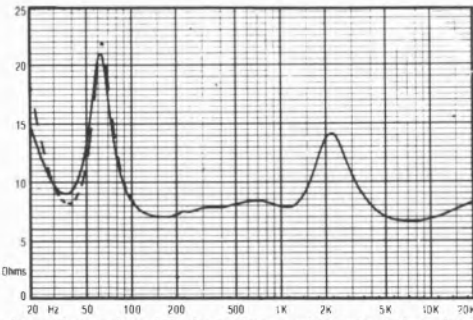
Summary

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.

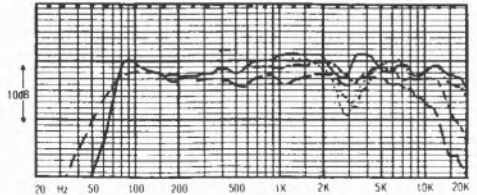
With A&R's acknowledged electronic expertise the active version could sound even better. To conclude, the Arcam *One* happily justifies its price tag.

GENERAL DATA

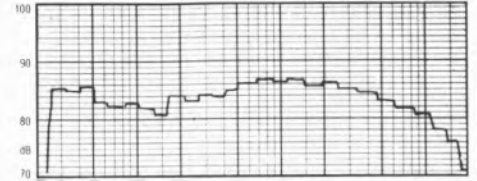
- Size (height x width x depth) 47 x 27 x 33cm
- Recommended amplifier power per channel
(for 96dBA minimum per pair at 2 metres) (15)—150W
- Recommended placement open stands
- Frequency response, within ±3dB, at 2 metres 60Hz to 20kHz
- Low frequency rolloff (-6dB point) at 1 metre 55Hz
- Voltage sensitivity
(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



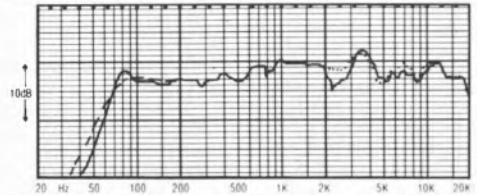
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



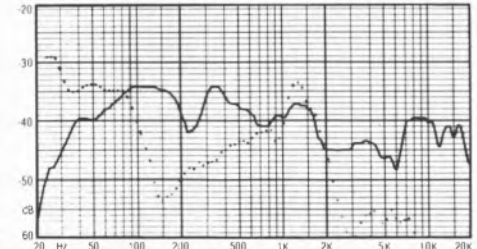
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



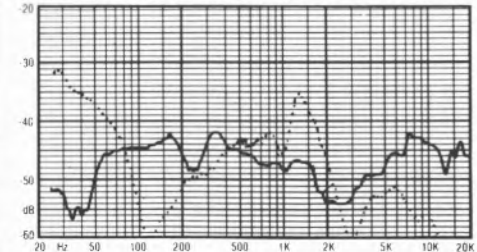
Averaged forward characteristic response in room at listening position.



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).

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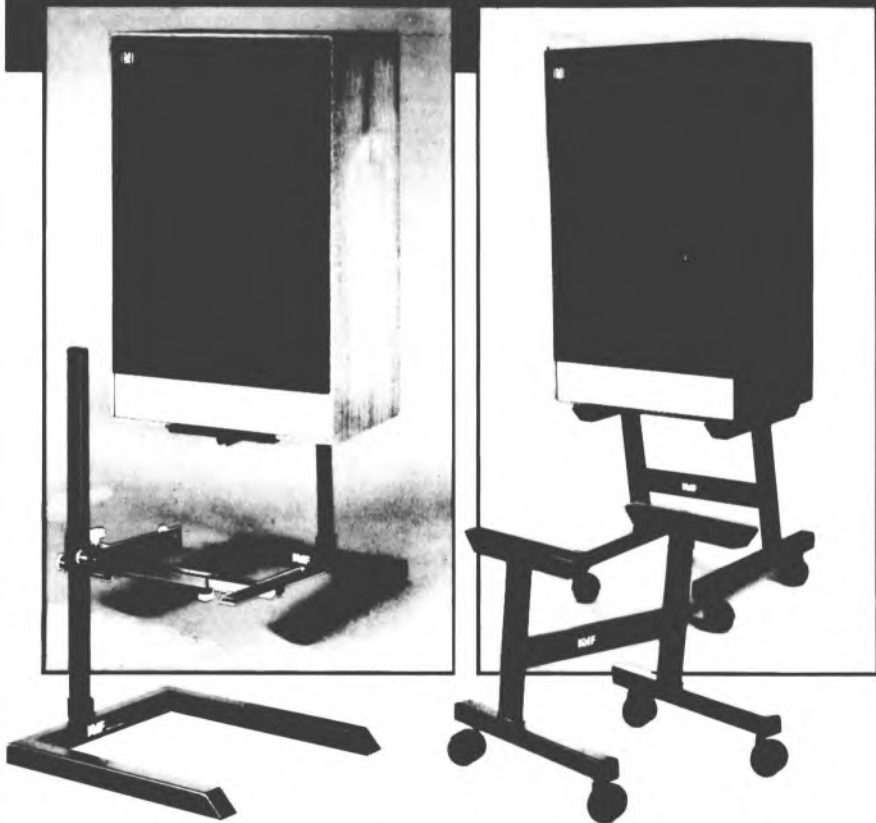
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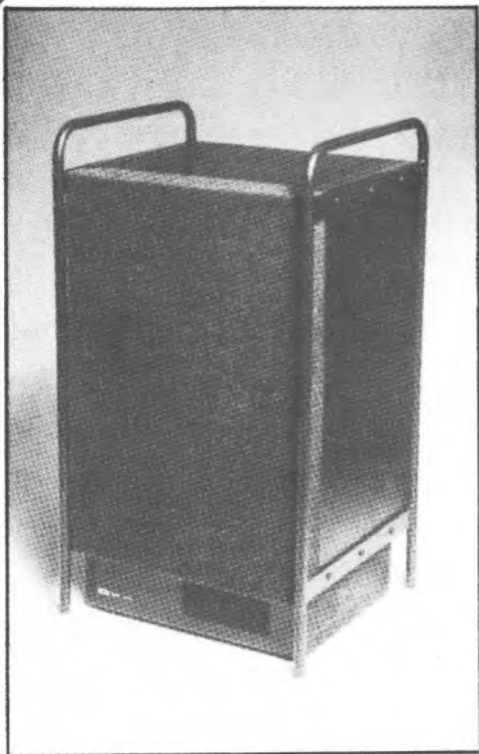
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Audio Pro 4-14

Audio Pro, Spye Copse, Pound Close, Loxwood, Sussex RH14 0SQ. Tel Loxwood 753055



The A414 is a compact speaker which sports a number of interesting and useful facilities, made available by the intelligent application of electronic theory to the design. Made in Sweden, it is finished in a high quality black oak veneer, and is equipped with optional side panels for professional use – the handles shown in the photo.

At £750.00 per pair, it is worth remembering that the complete package includes the following: treble and room boundary alignment control; two stereo power amplifiers; a high power subwoofer; system overload protection; a pair of three-way bi-amplified speaker enclosures, and the ability to play at astonishing sound levels, considering the enclosure volumes involved. £400.00 would not be an excessive price to pay for the amplifiers and electronics alone, so objectively the system stands or falls on its ability to compete acoustically with other high class full-range models in the £300.00 to £400.00 price bracket.

Using the Stahl 'Ace Bass' principle, the small 18 litre enclosure is 6th-order reflex-loaded by a complex moulded duct system beneath the driver panel, which also forms a damped cavity to back-load the 11 cm pulp cone Philips midrange driver. The bass units comprise 12 cm long throw drivers operating in push pull mode to provide optimum linearity.

The electronics are built on a single panel beneath the enclosure, and are of excellent quality. Low frequency contouring is available via a control marked in units of π (or acoustic space), these ranging from greater than 4π (free field plus bass lift) to $\frac{1}{2}\pi$, the latter corresponding to a corner position on the floor. While it can be driven from a conventional power amplifier terminal, we obtained the best results when driven direct from a high quality pre-amp such as the Meridian or Hafler.

Lab performance

Set to free field or 4π the axial response was very promising, meeting ± 2.5 dB limits from 36 Hz to above 20 kHz. The low frequencies were also dramatically extended for the box size, reaching down to 29 Hz, -6 dB, which is better than many purpose-built subwoofers.

Three of the π settings are shown in the 2 m characteristic response measured in $\frac{1}{3}$ -octave bands, with 'm' corresponding to maximum bass and π to floor position against the wall. The main forward response was notably well maintained off-axis, showing excellent directivity and driver integration, while the trend exposed either a gentle presence band depression 2 dB deep from 4 to 8 kHz, or conversely a mild mid prominence (depending on your point of view).

Driven to a 96 dB SPL 3rd harmonic distortion was very low above 150 Hz, increasing to a satisfactory 10.0% at 35 Hz. At 90 dB 3rd harmonic lay around 0.8% except at 16 kHz, and distortion continued to decline with reducing sound level. It withstood pulses driven to its maximum sound level, which is equivalent to 100 W into an average speaker sensitivity, and demonstrated a mild 0.4 dB compression; 2nd harmonic was 2.8% at 500 Hz, with 3rd at 0.5%; at 5 kHz a mild expansion of 0.3 dB occurred, with 0.8% 2nd, and 0.4% 3rd order content.

Capable of 108 dB linear at 1 m, a stereo pair could produce 109 dBA, substantially loud in a listening room, and when set to $\frac{3}{4}\pi$ for a stand location, the bass power bandwidth was more than sufficient for all wide-band programme we tried, even driven 'flat out'.

The room average response showed the effect of a bass setting close to 4π or 'anechoic flat', and illustrates that in my room at least the extreme bass was excessive by some 3-4dB. Subjectively the best balance at the higher listening levels was achieved with a reduced bass setting of close on 2π , and while a slight mid plateau is evident, the overall averaged characteristic was close to ideal, with a normal and gentle slope rolloff above 2kHz to the extreme treble frequencies.

Sound quality

The 414 performed exceptionally well on the live sound comparisons. Scoring was very high despite mild criticisms of a mid 'forwardness' with a residual 'speakerish' quality on voice. Transients and percussion were handled very well, and the depth and power on electric bass guitar set new standards for the size. The bass was quite neutral in terms of coloration, and could play loud enough to shake most of the house with only one cabinet energised!

On recorded programme the ranking was not quite as high but was nonetheless very respectable. Plus points included exceptional clarity and smoothness coupled with a lively, open and airy character. The bass depth was again exceptional, yet the upper registers were free from the often encountered boom, overhang or 'chesty' effects. Frontal stereo was well defined, though some loss of depth and ambience was apparent by comparison with the finest examples. Although well controlled, the mid band could sound a trifle 'thin' on vocals with a shade of 'boxiness' apparent.

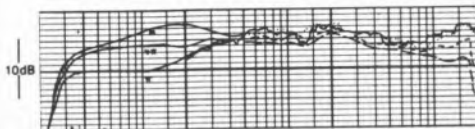
Summary

This is the first Swedish full range speaker to receive a virtually unqualified recommendation from *Choice*, and given the electronics/speaker cost relationship the system fully justifies its price. Its attributes include a smooth neutral balance, outstanding bass power and extension, high maximum sound level, low distortion, compact size, bass/treble adjustability, plus superb constructional quality and finish.

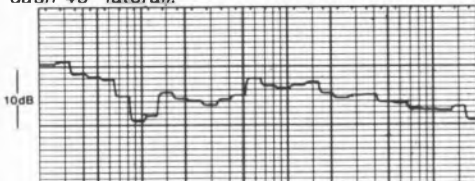
The performance belies its size, and while this system would be a prime choice for a bass enthusiast (organ, rock, etc.), it will also give high quality results on a wide range of other programmes. A warm recommendation is justified. *Note:* We have been informed that further development has taken place in the midrange driver, to improve its subjective characteristics.

GENERAL DATA

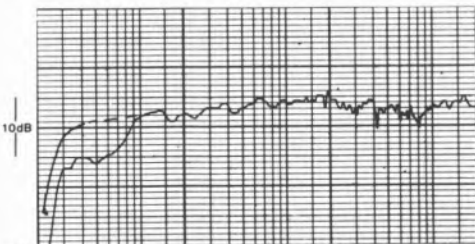
Size (h x w x d)	52 x 32 x 26cm
Weight	16kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	active
Recommended placement	versatile control adjustments
Frequency response within ± 3 dB (2m)	35Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	29Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	active, variable
Approximate maximum sound level (pair at 2m)	109dBa
Impedance characteristic (ease of drive)	N/A
Forward response uniformity	very good
Typical price per pair inc VAT	£750



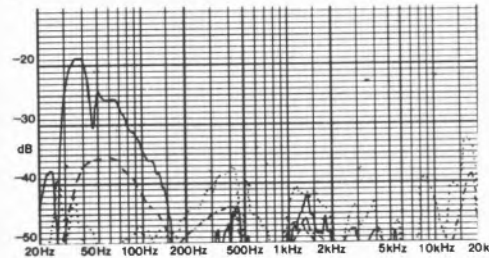
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



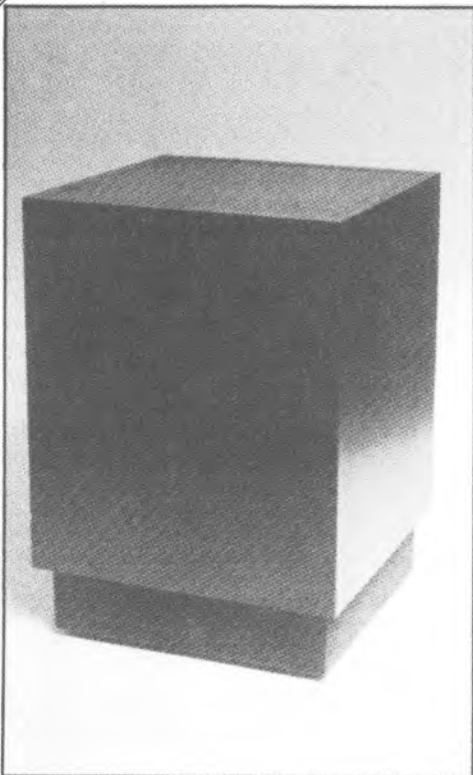
Reference sinewave response (1m on axis, dashing corrects for chamber LF).



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

Audio Pro B240 (sub)

Audio Pro, Spye Copse, Pound Close, Loxwood, Sussex RH14 0SQ. Tel Loxwood 753055



This subwoofer is a smaller and half price version of the *B250* reviewed by *Choice* two issues ago, and which possessed an almost unnecessarily extreme bass extension to an 18Hz -6dB point as well as being capable of a 100dB level in its upper range (see *Summary Reviews*). The *B240* sports many of the facilities of the '250, but with improved electronics to give greater subjective clarity on the upper band crossover, as well as a higher slew rate into the long return cables required for connection to the main amplifier. The sacrifice involved is a small one (some 9Hz) in terms of bass extension, giving 27Hz, -6dB. It will nonetheless raise a higher 105dBa at 100Hz and is thus capable of decent sound levels in conjunction with suitable satellite systems, one example of which is made by Audio Pro themselves.

The roughly cubic enclosure is veneered on all sides in fine black oak, with the acoustic output emanating from the base. The latter is a block

with recessed side grilles, and also contains the power amplifier and electronic crossovers. The bass loading is sixth order reflex on the *ACE Bass* principle, whereby special driver mechanical characteristics are simulated electronically and imposed on the acoustic system, thereby forcing it to the desired response and bandwidth. Two bass drivers operate in push pull within the enclosure, the latter vented by a large ducted port arranged so that the air flow cools the power amp heat sinks.

The crossover works on both the subwoofer and the satellite system and is variable between 50Hz and 200Hz, the printed graph showing the 140Hz setting. Since bass and satellite crossover frequencies may be chosen independently a useful degree of control is available for matching the bass register of the satellite to the subwoofer, and even the *LS3/5a* can be effectively accommodated.

Lab performance

Some doubts had been raised concerning the stability of the *ACE Bass* technique on theoretical grounds, especially after a sustained high power passage which results in heating of the driver motor coils and a change in their resistance. Accordingly the system was measured both before and after preconditioning with full power drive at 100Hz (c. 105dB) for ten minutes. No significant change was observed and the printed graph is in fact the post-heating result. The response in the passband is almost perfectly flat, showing an initial crossover rolloff of 12dB/octave increasing to a much greater slope (>35dB/octave) after a 'hiccough' at 340Hz.

Driven to 96dB at 100Hz with a 140Hz crossover setting an excellent distortion result was obtained (the distortion graph is of course only relevant below this frequency). Even at 25Hz the 2nd and 3rd harmonics were in good balance at around 5.0%, pretty harmless, and rapidly reducing with rising frequency (in contrast to the graphs these figures include chamber correction). By 50Hz the distortion was below 1.0% 96dB, an excellent result at such low frequencies, comparing well with the typical 3-5.0% distortion from other medium sized loudspeakers.

Summary

While the *B250* holds the honours for extremely wide low frequency performance, the *B240* nonetheless offers an octave more of extreme bass by comparison with most other highly ranked speakers in the £300-400 range. This is achieved at an effective price, with improved electronics, a

good standard of engineering, and a good acoustic performance.

The final results will of course depend on the settings chosen by the purchaser, his room, choice of satellite system and its amplification. But in this specialist sector of the market the B240 reigns supreme, and can be confidently recommended for those who can exploit its potential but for various reasons cannot accommodate larger full range speaker enclosures.

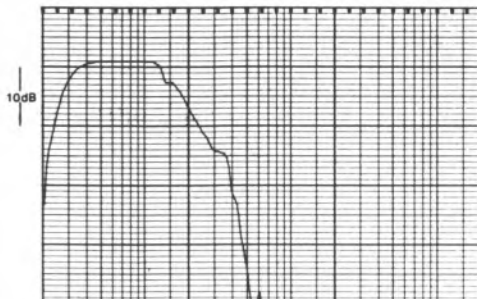
Summary

With the introduction of digital programme, the sub-woofer may in fact now take on increasing importance. On analogue programme, the worth of an extended output in the 20-40Hz low bass octave was questionable, but using digital, the story is different. On appropriate material using speakers of Celestion SL6/600 size and pedigree, a good subwoofer can make an appreciable improvement to the ambient weight and scale of the reproduction. When used, for example with the SL600, the upper B240 crossover was not employed, the SL600s driven direct from the main power amplifier. Instead the B240's crossover was set to 1v, 60Hz, located against the wall behind the stereo speakers and off-centre from the room median to reduce standing waves. It then provided a most reasonable bass enhancement, this improvement costing less than half the price of the main speaker pair.

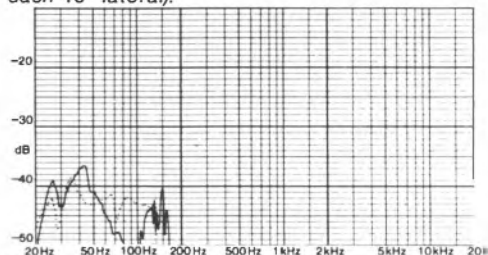
GENERAL DATA

Recommended placement: . . . floor, behind and between satellites
 Frequency response within ± 3 dB (2m) flat passband
 Low frequency rolloff (-6dB) at 1m 27Hz
 Voltage sensitivity
 (ref 2.83V, ie: 1 watt in 8 ohms) at 1m variable (active)
 Approximate maximum sound level (pair at 2m) 107 dBA*
 Impedance characteristic (ease of drive) N/A (active)
 Forward response uniformity N/A
 Typical price per pair inc VAT £250

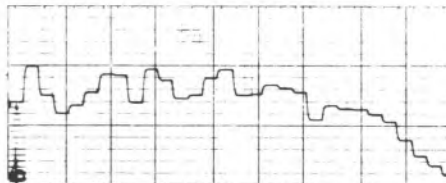
*with suitable satellites



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



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



Averaged forward response in room, with Celestion SL6

Bang & Olufsen S80 II

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



B&O remain one of Europe's largest and most successful hi-fi speaker manufacturers and yet their speakers consistently enjoy only limited success when reviewed by the UK press. I did not favour the earlier *S80*, and hoped for better things from this considerably revised Mark II version, developed using digital analysis of decay characteristics on pulsed input signals.

The *S80II* is a compact three way design, being a sealed box of around 25litres internal volume. It incorporates a measure of time delay compensation, by virtue of its designed radiating position, set by an adjustable screw on the matching stands, together with the special driver fixing on the massive sculpted structural front panel.

The 74mm dome midrange unit, previously made of polypropylene, is now formed from a fairly stiff doped fabric, and is back loaded via the hollow pole to a large moulded rear

chamber. A pulp cone 200mm bass unit covers the lower frequency range, built on a light pressed steel frame. A revised version of B&O's 25mm soft plastic dome tweeter completes the line-up, this slightly recessed in the elaborate front panel.

Slim metal-rimmed vestigial grille panels may be fitted or omitted as desired, while the plain 12mm chipboard cabinet is finely veneered in a natural rosewood, with no internal damping. Both 4mm binding posts and a DIN connector are both provided for connection convenience, and the simple crossover comprises seven elements plus six resistors, with a circuit-breaker trip overload protection built in.

Sound quality

The *S80II* scored a satisfactory 'average' mark for sound quality, which is about right for the price, but not highly competitive. Its performance in listening tests was variable, depending on the listener, his position and the programme. On occasion a strange 'suckout' effect was observed, this associated with a false depth or recession in some instrumental parts, while the upper treble could sound a little buzzy as well as sibilant. The bass was uninspiring, lacking attack, extension and detail, and some boxy as well as 'cuppy' colorations were also evident. Detail showed a veiled effect and the stereo focus was often rather vague as well as overwide. No particular difference was noted with analogue or digital programme.

Lab results

While the 1metre reference responses illustrated good pair matching for this system, the result was rather lumpy with a midrange recess. The speaker was quite axis-critical with its optimum angle (dotted response) around 10° below axis (see forward responses). Sensitivity was judged at a low 83dB for 1W, while the bass was underdamped with a boom at 80Hz and a -6dB point at approximately 55Hz. A minimum of 25W is suggested up to a maximum of 100W, this providing maximum sound levels of the order of 98dB from a pair in a typical room.

Examining the forward response group, it should be noted that the lateral response set were taken on the median axis and hence show the midband trough, while the better 15° vertical response was that taken below axis. The 15° above trace was rather worse. The response remains lumpy with a lower-mid trough, a bass hump and a treble prominence around 8kHz. Such changes in the response picture with the

measuring mic's position suggest poor driver phase integration.

The impedance characteristic showed little reactive content, and met the 8ohm standard, being considered an easy amplifier load.

Distortion was rather high with this speaker; at 96dB, second harmonic averaged 8% below 200Hz, with third around 2%, and only a moderate improvement was evident at 86dB. These results were rather worse than the norm.

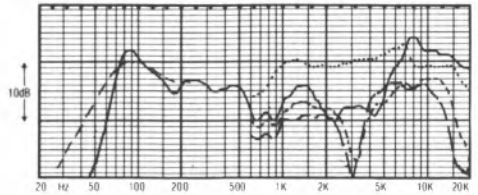
Room averaged, the speaker showed some attempt at better response integration, though a mildly lumpy characteristic remained.

Summary

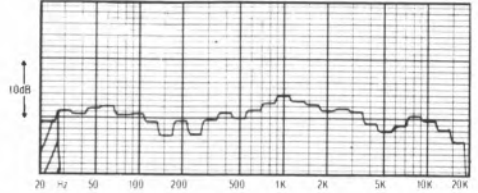
It is possible that with careful positioning and angling the *S80II*'s 'different' sound might appeal to some purchasers, particularly in conjunction with its elegant B&O 'house' styling and finish. However *Choice* panelists found it rather average with a confusing variability and phasiness of sound, a standard insufficient for recommendation.

GENERAL DATA

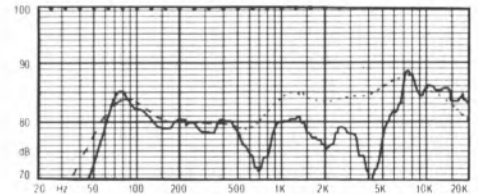
Size (height x width x depth).....	53 x 26.5 x 26cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(25)—100W
Recommended placement.....	open stands (optional B&O)
Frequency response, within ± 3 dB, a 2 metres.....	see text
Low frequency rolloff (-6 dB point) at 1 metre.....	see text
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	83dB/W
Approximate maximum sound level (pair) at 2 metres.....	98dB
Impedance characteristic (ease of drive).....	very good
Forward response uniformly.....	poor
Typical price per pair, inc VAT.....	£225



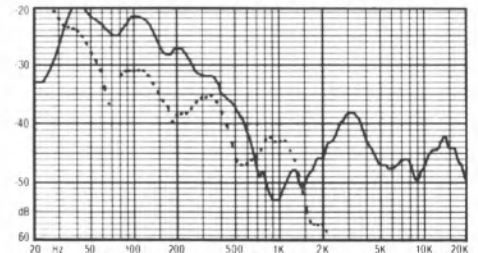
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



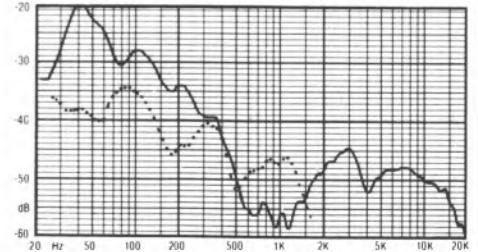
Averaged forward characteristic response in room at listening position.



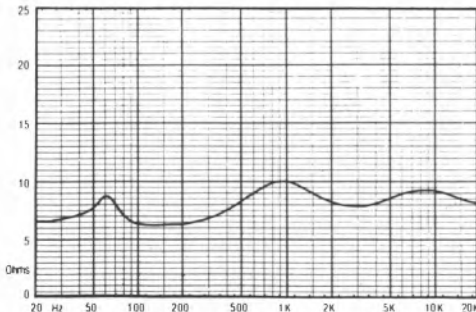
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



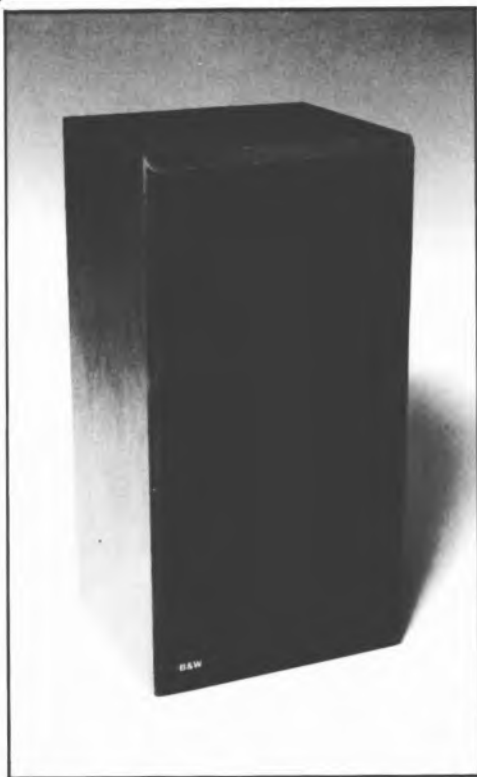
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

B&W DM10

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



After neglecting the market below £100.00 for some years, B&W have recently re-entered this highly competitive field with their new *DM10*. Utilising a die-cast alloy chassis from an earlier and highly successful model (the *DM4*), this time B&W have fitted a lightweight pulp cone of good flare with an applied surface coating for damping. The diaphragm assembly is fairly lightly suspended on a half roll surround, and the stiffness is appropriate for a reflexed enclosure such as this, as it can dramatically improve power handling (an aspect which was borne out on test).

The 25mm soft-dome treble unit is also of B&W's own manufacture, and the two drivers are integrated via a five-element crossover network (including one resistor). Reflex loaded by a small 5cm diameter/7cm deep port, the 19 litre enclosure is built from plain 12mm chipboard with no panel damping, which is understandable at the price; a foam lining helps to reduce internal resonances. Since the 12mm thick grille frame

has no rebate for the side-directed high frequency signals, this could contribute some diffraction irregularities. Although a modicum of driver decoupling is provided in the form of rubber grommets under the bass driver fixings, unfortunately on our samples at least the degree to which they were tightened was likely to reduce the effectiveness of this technique.

A synthetic walnut veneer covers the enclosure, which is fitted with the usual 4mm screw terminals suited to wire or banana plug connection. B&W offer a comprehensive and closely tolerated specification, and can also supply a matching base called the *STAV22* for floor standing use.

Lab performance

While the main axial response trace is uncorrected at low frequencies and applies with the grille on, the dashed trace shows the true low frequency response, while the dots illustrate the considerable improvement in smoothness resulting from removal of the grille. In the latter condition B&W's ± 3 dB limits were met from 68Hz to 20kHz. A suggestion of prominence at 100Hz in the bass and 15kHz in the treble was also given by the traces. We found a usefully high 88dB/W sensitivity, plus a moderately extended bass (55Hz, -6 dB).

Moving on to the forward characteristic responses, the 15° above axis curve showed some phase loss around the 3.5kHz crossover frequency, so the suggestion is for use close to or slightly above ear level. Another finding was that an off-axis listening position of about 20–25° resulted in a flatter treble characteristic, and the *DM10* was found to image well when over-angled inwards by this amount. Overall the forward responses were well integrated, though a bass prominence of 3dB or so at 100Hz was apparent.

Rated as an average amplifier load, the impedance dipped to almost 5ohms, 7kHz, but this should embarrass very few amplifiers these days. Distortion levels were very good at 96dB, but at 90dB some 0.8% of 3rd harmonic was present at 5kHz, together with an isolated 2.5% peak of 2nd harmonic at the secondary diaphragm resonance of 15kHz. Very good 3rd harmonic results were obtained on the 100W pulse tests, the system demonstrating a good power handling, so a comfortable 100W programme rating is suggested by the tests.

The averaged room responses illustrate a respectably uniform characteristic, only slightly marred by a mild mid prominence around 700Hz and a premature bass rolloff below 60Hz.

Sound quality

On the live sounds the *DM10* gave a good impression, and survived close comparison with several percussive sounds. The output was a trifle coloured, with comments of some 'boxiness' and 'nasality', and an 'edgy' quality in the upper treble. But on the plus side, it was also considered lively, clear and adequately 'sharp' on transients. Driven hard in the bass the lowest notes were absent, but the upper register was more even than the anechoic response would suggest. It withstood considerable bass inputs of up to 150W with only mild chuffing and buzzing.

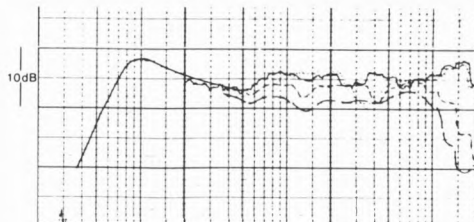
On the recorded sessions it was less well received, though the results were still creditable at the price. Coloration was again noticed, particularly of the 'wooden' and 'boxy' kind, while a clouding of detail linked with mild aggressive tendencies in the midrange gave an impression of reduced transparency as well as adversely affecting the impression of stereo image depth. However lateral imaging was very good, particularly with the grilles removed, and the overall balance was quite satisfactory despite the curtailed extension at low frequencies.

Summary

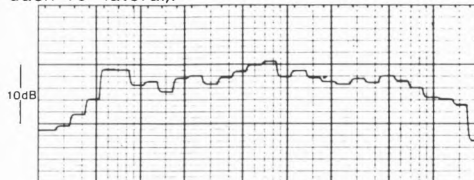
While not the best of the budget models in this issue, the *DM10* nonetheless sets a fine standard by offering a lively neutral frequency balance, a useful sensitivity, and good power handling, plus low distortion and fairly high maximum sound level at a competitive price. Such performance won a Best Buy rating in the last edition, but with tougher competition now we have had to reclassify this model as 'recommended' this time. It is worth auditioning the *DM10* to see if its particular blend of appearance and performance suits a proposed system. For the best results the grille should be removed and the speaker should be vertical (even though B&W suggest sideways bookshelf mounting as a viable option), and a cartridge used which has a 'kind' upper treble, such as the *ADC XLM* or a *Shure M97ED* or *HE*.

GENERAL DATA

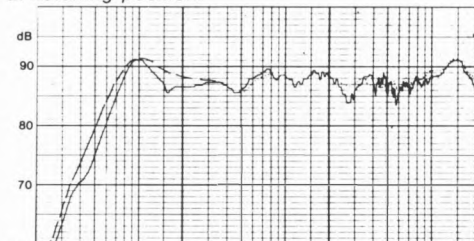
Size (h x w x d).....	48.5 x 25 x 23.5cm
Weight.....	6.6kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(15)-100W
Recommended placement.....	stand
Frequency response within ± 3 dB (2m).....	62Hz to 20kHz
Low frequency rolloff (-6dB) at 1m.....	55Hz
Voltage sensitivity (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.....	good
Typical price per pair inc VAT.....	£90 when reviewed, now £109



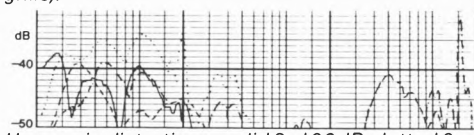
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



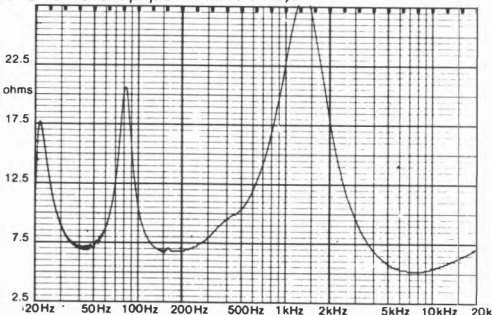
Averaged forward characteristic response in room at listening position.



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



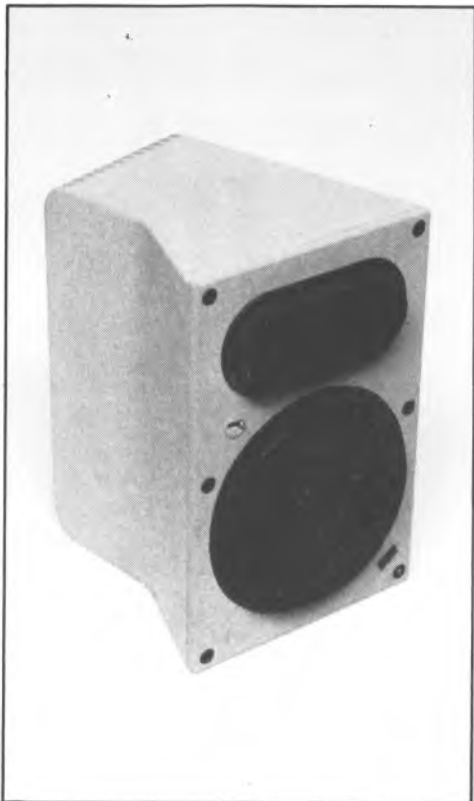
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, ○ shows stop point at 96dB).



Impedance (mod Z).

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.

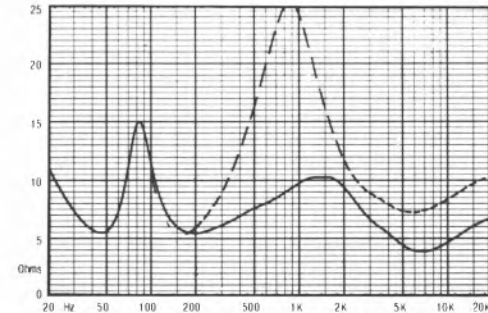
On '+' the impedance dipped to 5.4 ohms, 7kHz, but typically read 6 ohms – a reasonably good amplifier load. It was noticeably easier to drive on '0' but it then needed more power to fight the low sensitivity. The room-averaged curve confirmed the upper-mid plateau, and illustrated a smooth overall characteristic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

Summary

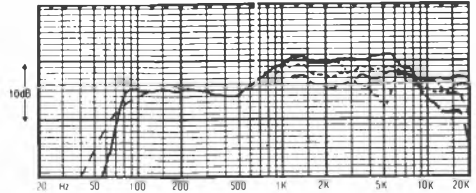
By basic *Choice* standards the *LM1* does not qualify for a recommendation. However, if its unique qualities of very small size, first-rate engineering content and finish, environmental tolerance and power capacity are all taken into account, the *LM1* becomes a special case well worth considering for 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

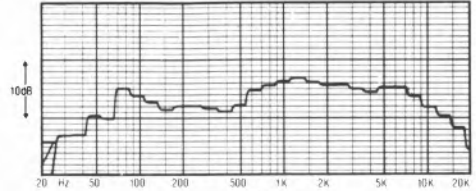
Size (height x width x depth) 24 x 15.5 x 20cm
 Recommended amplifier power per channel
 (for 96dB minimum per pair at 2 metres) (15)—100W
 Recommended placement shelf/wall mounting
 Frequency response, within ± 3 dB, a 2 metres see text
 Low frequency rolloff (-6 dB point) at 1 metre 80Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre) 86.5dB/W
 Approximate maximum sound level (pair) at 2 metres 101dB
 Impedance characteristic (ease of drive) satisfactory, see text
 Forward response uniformity good
 Typical price per pair, inc VAT £200



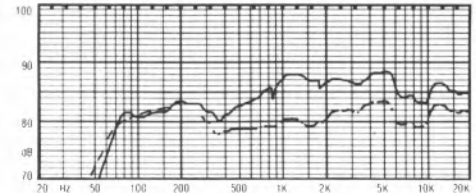
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



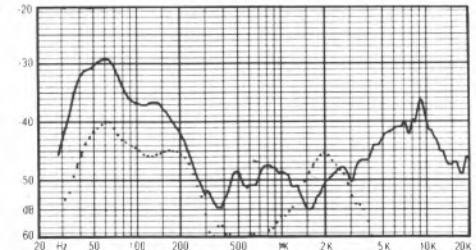
Forward characteristic response ($1/3$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



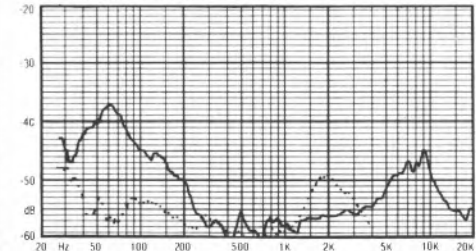
Averaged forward characteristic response in room at listening position.



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



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



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

B&W 802

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



An established floor-standing speaker of slim proportions, the *802* is in fact a smaller development of the massive *801* monitor. The head assembly is common to both models, but the bass section of the *802* employs a pair of matched 200mm drivers, using sealed box loading.

Around 45 litres in volume, the bass enclosure contains a long-fibre wool filling and extensive bracing, plus damping. The bass units use straight-sided Bextrene cones, and have a generous motor system built on a die-cast frame. The 100mm, heavily-doped woven-fibre midrange unit has its own separate enclosure, this an inert mineral-loaded moulding with special contouring to minimise diffraction irregularities. The 25mm soft-dome tweeter, is mounted above the midrange driver, has no baffle, again maximising the dispersion properties of this system.

The complex 24-element crossover is constructed of high quality, high power components, and in addition, it carries B&W's APOC electronic overload protection. Electrical connection is via 4mm socket/binding posts and overall the finish and engineering were both to the highest standards.

Sound quality

Price considerations aside the *802* produced an above average performance on the stereo listening tests with a significantly better result on analogue rather than digital programme. Using the former material, the results were in the 'good' class – the speaker portraying stereo images well with a pleasing precision and notable depth effects. Bass, mid and treble registers were all to a fine standard with moderate coloration and good definition.

On the more critical digital masters, the *802* did not however hold up so well. It was considered extremely smooth and civilised but several listeners commented on an overdamped 'bland' nature which diluted some of the air, ambience and depth on familiar recordings. Frontal information was good, but finer subtleties seemed masked, and the bass, while firm and extended, was a little excessive and did not have enough attack or specific detail. The treble could also sound a little brash and 'zitty' at times, especially at high listening levels; somehow part of that vital 'see through' quality was absent here.

Overall it demonstrated fine power handling, showing no mechanical or audible distress up to the 200W per channel limit we tried.

Lab results

Measured at 1metre for the reference sinewave response, the bass proved to be well extended with a -6dB reading at 37Hz, free of overhang. Sensitivity was just average at 85.5dB/W with an indicated minimum power of 15W. It demonstrated a 200W-plus protected maximum power handling, and a generous 105dBA should be possible from a stereo pair in a typical room. Pair matching was excellent, and the costly fabricated grilles had a negligible effect. The response was very uniform, just slightly down-tilted with rising frequency.

At 2metres the speaker met '2dB limits from 50Hz to 15kHz which is a fine result. Very good driver integration and dispersion were shown, these demonstrated by the smooth nature of the off-axis responses as well as their close correspondence to the axial result.

Assessed by room averaging, the output above 2kHz was flawless. Two features did however give rise to concern, notably the mild bass excess and the mid plateau centred on 900Hz, associated with the unusually good head assembly dispersion. Perhaps the subjective loss of 'air' is related to this.

Above 50Hz, third harmonic distortion was fine at a 96dB sound level, measuring under 0.3%, while second varied from 2% at low frequencies to 0.3% in the midrange. Some mild second harmonic content was evident in the treble register as well. At 86dB the trends were similar but with a mild improvement. In essentially meeting the 80hm specification, the 802 also rates as a good amplifier load.

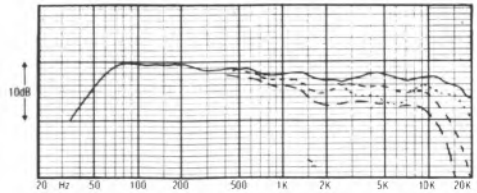
Summary

This relatively expensive speaker offered excellent engineering, a fine finish and a consistent well integrated sound which appeared to suit analogue programme well, particularly classical material. On the new digital sources however it was less impressive.

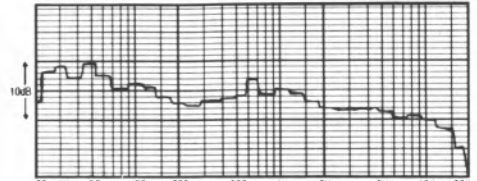
In view of this mixed reception we feel the 802 to be worthy of consideration but cannot place it in the recommended class. Had this model been included in the last issue I am sure it would have fared better – such is the pace of progress!

GENERAL DATA

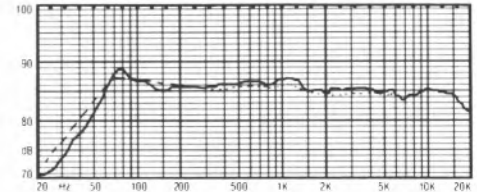
Size (height x width x depth)	104 x 37 x 30cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres)	(15)—200W
Recommended placement	floor, away from walls
Frequency response, within ± 3 dB, at 2 metres	46Hz to 20kHz
Low frequency rolloff (– 6dB point) at 1 metre	37Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre)	85 5dB/W
Approximate maximum sound level (pair) at 2 metres	105dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair, inc VAT	£650



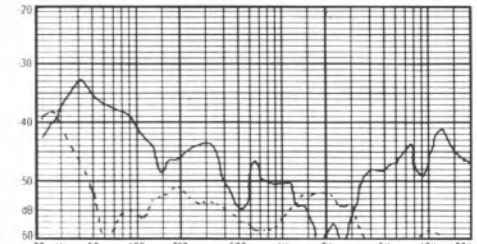
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



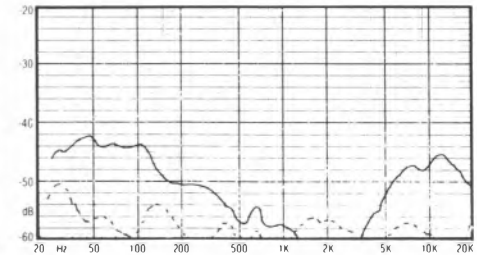
Averaged forward characteristic response in room at listening position.



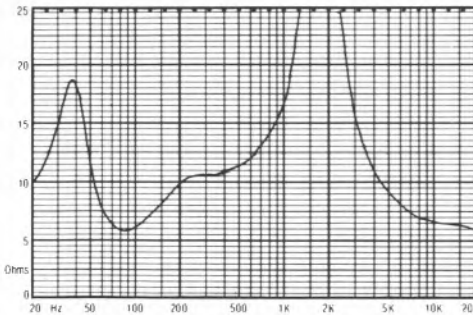
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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; Swissstone Ltd (Rogers); Spondor Audio Systems Ltd



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 multi-ply 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 96dB 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.

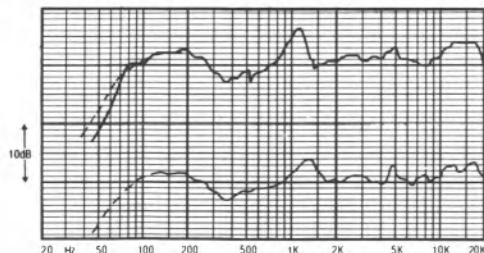
At 2metres the 1.2kHz prominence was rather obvious, and while the responses were clearly well integrated the speaker's 'lumpy' nature was evident. Computer averaged in the listening room, the low frequencies integrated well, but the mid prominence remained, and the upper treble was excessive. Measured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

Summary

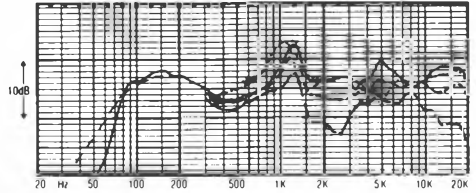
At risk of offending the BBC, I feel that the 3/5a is due for a revision; as a working broadcast tool it no doubt does its job, but as a piece of value engineering it is beginning to fall behind. Other speakers have shown a progressive reduction in price as well as an improvement in sound quality, but the LS3/5a has steadily increased in price more or less in line with inflation. In view of its new ratings and modest value for money, the LS3/5a must lose its position in the recommended listings, although we would still regard it as worthy of consideration.

GENERAL DATA

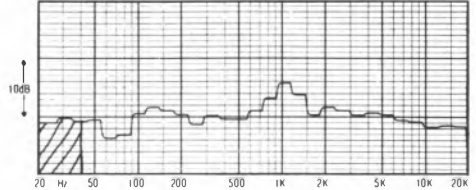
Size (height x width x depth)	30 x 18.5 x 16cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(30)—50W
Recommended placement	open stands
Frequency response, within ± 3 dB, at 2 metres	see text
Low frequency rolloff (-6dB point) at 1 metre	57Hz
Voltage sensitivity (ref. 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



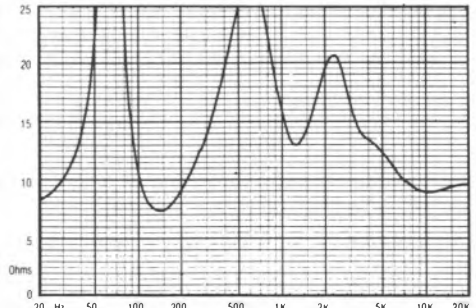
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



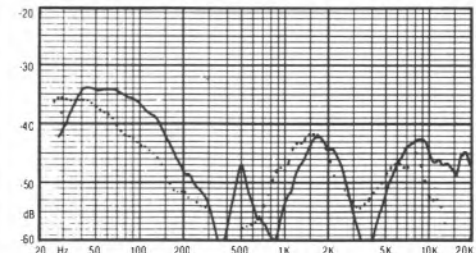
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



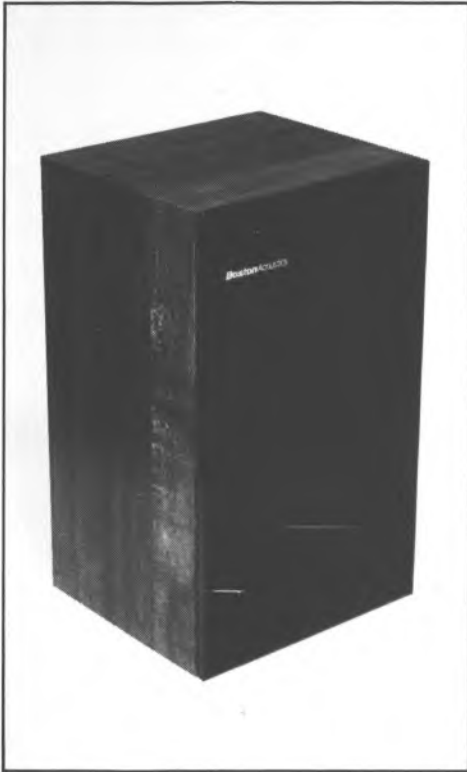
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



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.

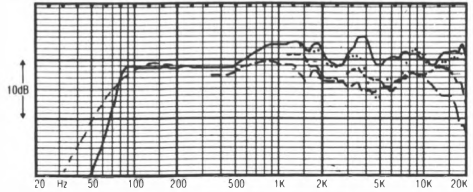
Impedance dipped to below 4.5ohms at 200Hz, this indicating a more difficult than average amplifier load. The room-averaged response shown is for stand mounting, and while the low frequency integration was fortuitously good, the balance was clearly mid-dominant and centred on 1kHz, which will not be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

Summary

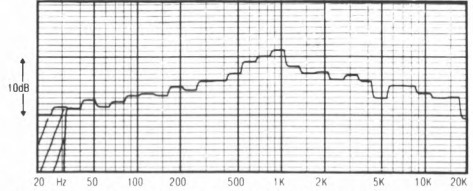
I suspect the A40 suffers from the cost of its transatlantic passage — the price here in pounds is probably close to the USA price in dollars. A simple, medium-power two-way design such as this must try hard to succeed in the competitive UK market, and from these results the A40 just does not make the grade. While satisfactory in most respects, the performance versus value for money equation is not in its favour. If it were available at some 30% less, we would have to revise our ratings.

GENERAL DATA

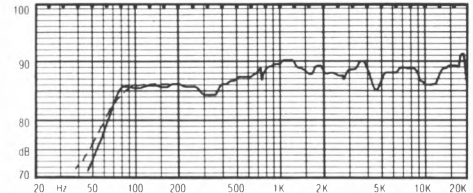
Size (height x width x depth).....	34 x 21 x 18cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(10)—50W
Recommended placement.....	stand or shelf
Frequency response, within ±3dB, at 2 metres.....	70Hz to 20kHz
Low frequency rolloff (−6dB point) at 1 metre.....	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



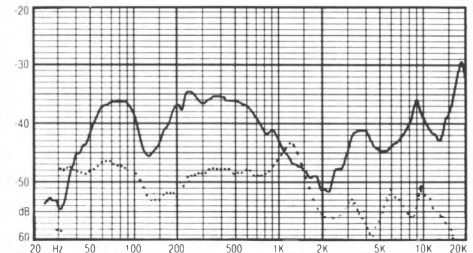
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



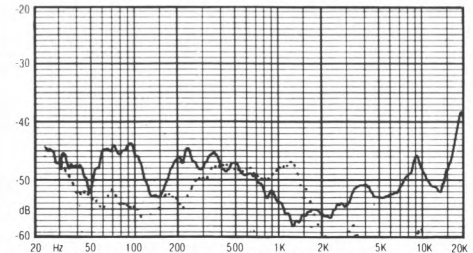
Averaged forward characteristic response in room at listening position.



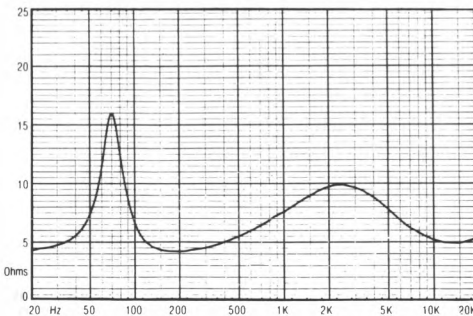
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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

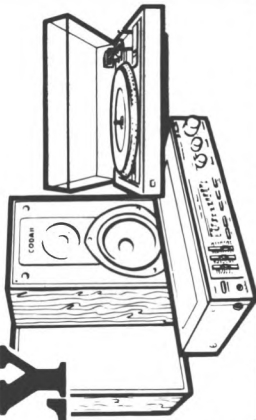


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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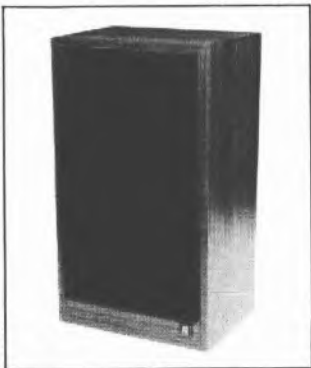
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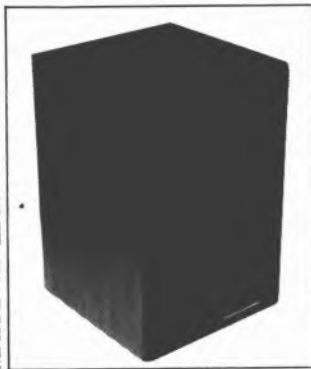
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Castle Clyde

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 ± 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 ± 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 102dBA 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

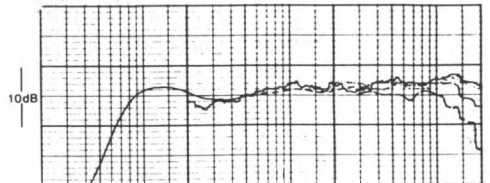
Once again we find a Castle speaker in the Best Buy category. This tidy little box packs a surprising 'punch' in terms of a clear even and lively sound, offering a high sensitivity, easy amplifier load, high dynamic range and moderate distortion, plus fine finish and engineering. At the price and size 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

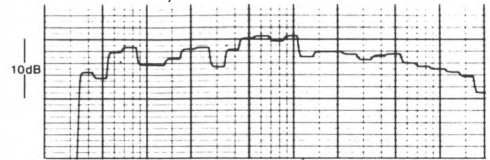
A new full length grille has now been fitted, dispensing with the alloy trim.

GENERAL DATA

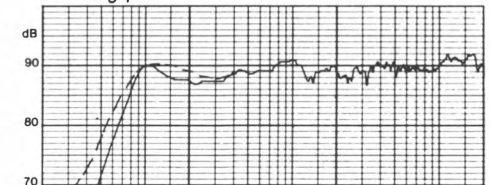
Size (h x w x d)	37 x 21.5 x 22cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)–50W
Recommended placement	open stand
Frequency response within ± 3 dB (2m)	75Hz to 20kHz
Low frequency rolloff (-6 dB) at 1m64Hz
Voltage sensitivity (ref 2.83V, i_e : 1 watt in 8 ohms) 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 £95



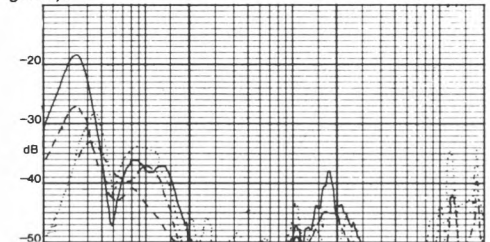
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



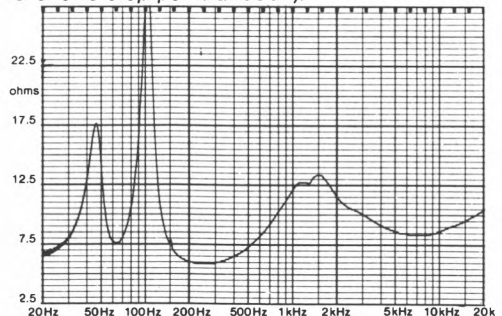
Averaged forward characteristic response in room at listening position.



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).

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 -6dB , 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.

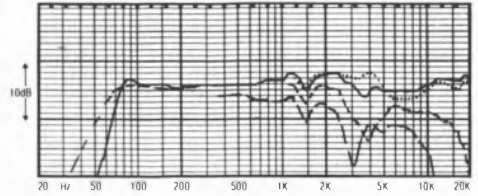
Assessed by room averaging, the *Lincoln* maintained its uniformity. The treble rolloff was nicely rounded, the mid smooth and the low frequency integration well controlled down to the 45Hz working limit.

Summary

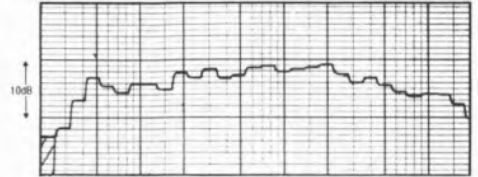
For some panelists the *Lincoln* did not quite 'gel' as a total sound but it remains a fine, well balanced, well designed and well constructed system, offering good value for money. Other attributes include an easy amplifier loading, and an above average sensitivity, and is certainly well worth hearing.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

GENERAL DATA

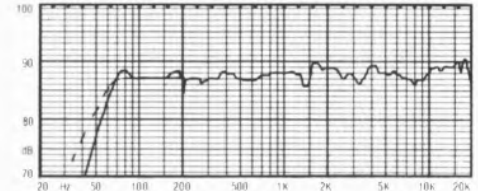
Size (height x width x depth)	44 x 22 x 27cm
Recommended amplifier power per channel (for 96dB/A minimum per pair at 2 metres)	(15)—50W
Recommended placement	open stands
Frequency response, within ± 3 dB, at 2 metres	60Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre	53Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre	86dB/W
Approximate maximum sound level (pair) at 2 metres	100dB/A
Impedance characteristic (ease of drive)	very good
Forward response uniformity	good
Typical price per pair, inc VAT	£135



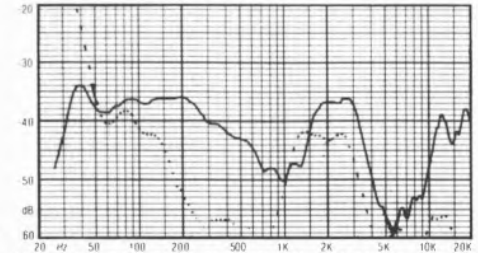
Forward characteristic response ($1/3$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



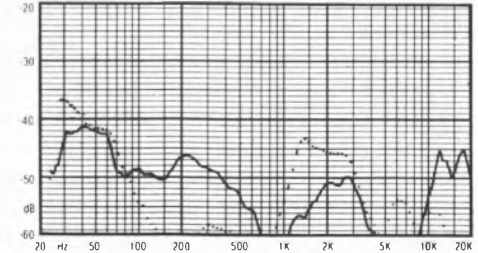
Averaged forward characteristic response in room at listening position.



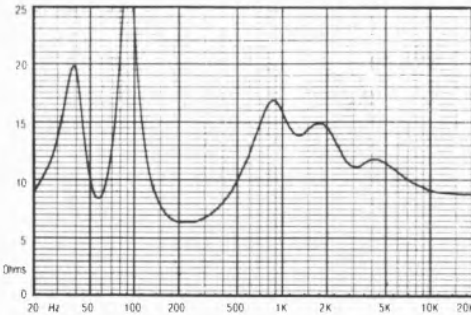
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



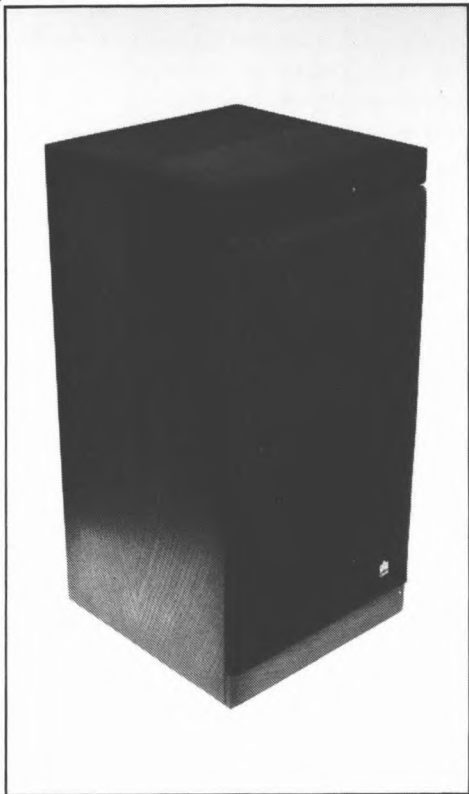
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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 103dBA, 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 ± 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 ± 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.

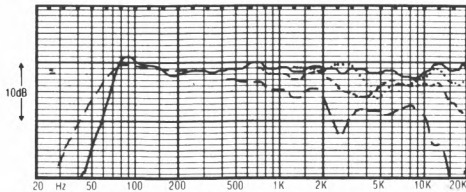
Impedance never fell below 6.4ohms, making it very easy to drive by any amp of good repute. The computer-averaged room response also looking very promising, with the low frequencies integrating well with the room, down to 40Hz. The mid register was also very smooth and while the lower treble seemed slightly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

Summary

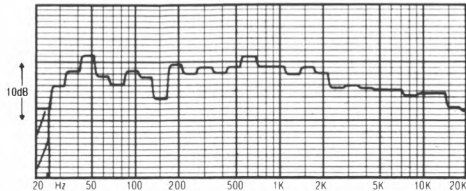
Comfortably 'recommended', this traditional-looking speaker offers a sweet, smooth sound with an excellent overall balance of engineering-based performance. For the size the bass is good, and the system will also play loud when required, being easy to drive. In fact some purchasers may prefer this speaker 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

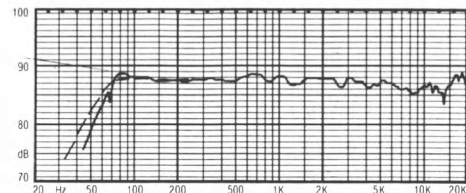
- Size (height x width x depth) 55 x 27.5 x 30.5cm
- Recommended amplifier power per channel
(for 96dBA minimum per pair at 2 metres) (10)–100W
- Recommended placement open stands
- Frequency response, within ±3dB, a 2 metres 50Hz to 20kHz
- Low frequency rolloff (–6dB point) at 1 metre 46Hz
- Voltage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



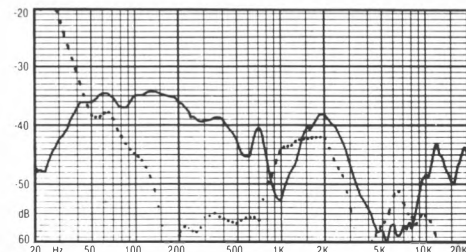
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



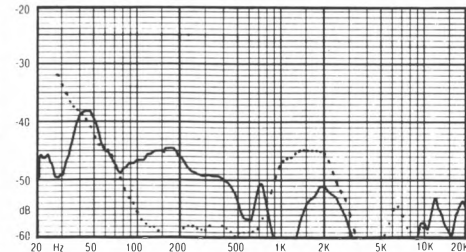
Averaged forward characteristic response in room at listening position.



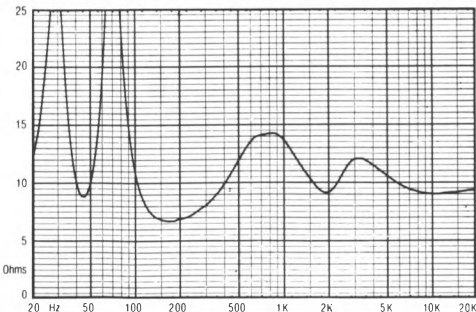
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



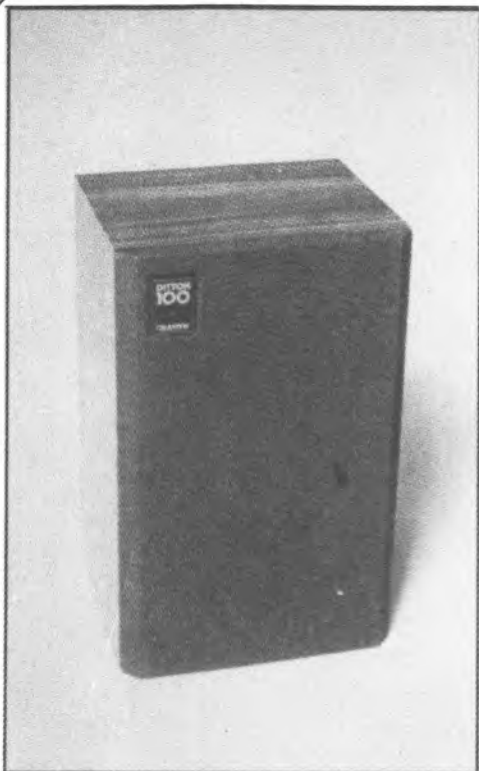
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Celestion 100

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



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 rebated 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 1 m 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 ± 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 500 Hz, 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.

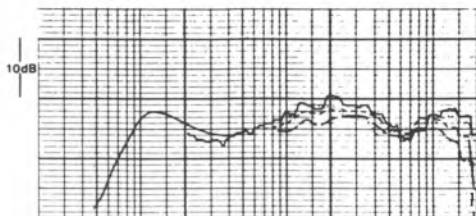
On the stereo sessions it was not so well regarded, although in view of its budget price the grading was reasonable. The upper treble was considered a trifle prominent, while the sound lacked 'weight'. Although it gave a reasonable impression of ambience, and the stereo presentation was quite good, it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

Summary

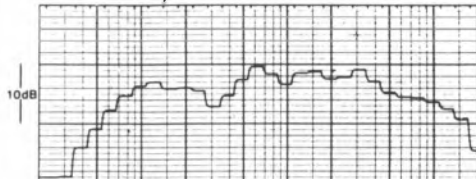
This small and inexpensive speaker is quite presentable, particularly when used without the grille. At £80.00 it justifies a recommendation on value grounds and is worth trying. On the debit side the frequency balance was none too even, distortion was poorer than average and the bass response was rather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

GENERAL DATA

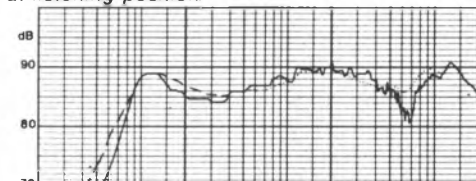
Size (h x w x d)	33 x 21 x 18.5cm
Weight	4.4kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(15)-50W
Recommended placement	open shelf
Frequency response within ± 3 dB (2m)	85Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	76Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt 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	£70



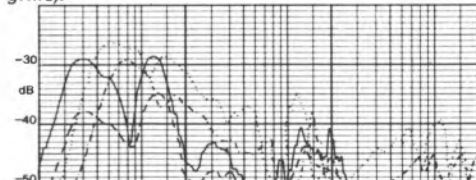
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



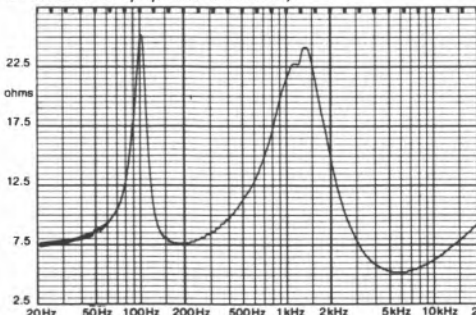
Averaged forward characteristic response in room at listening position.



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 110

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

COMMENDED



Well presented and inexpensive, the 110 could be regarded as Celestion's answer to the KEF *Coda*. A sealed box, two-way system, it incorporates a 200mm pulp cone bass/midrange unit plus a 25mm fabric-dome tweeter. Built on a steel frame, the bass unit has a decent-sized magnet on a 25mm pole, the diaphragm a flared design with a surface coating of pva. Crossover frequency is set at approximately 3kHz, and the network is essentially 12dB/octave using commercial quality components.

With an internal volume of 15litres, the enclosure is made of plain 12mm chipboard, clad externally in a vinyl walnut-effect material with a complementary black cloth grille. The grille frame is not bevelled and is 12mm thick – not conducive to good uniformity in the lower treble. No side wall damping is used inside the box, though the space is filled with some acoustic wadding. Connection is via spring

clips on the rear panel surface.

Sound quality

auditioned on open stands with the grilles in position, the 110 delivered a substantially above average performance on the listening tests, which is a fine result for the price.

An open punchy sound was heard, with a forward 'up front' presentation, and the bass, while not very extended was nonetheless considered to be relatively clean and articulate. Tonally it sounded light and the treble was slightly rough with reduced transparency, while in the midrange it could appear a little congested with a 'loud' effect. 'Tunnely' and boxy colorations were also audible in the lower midrange.

Stereo images showed a slight 'double mono' effect – that is, the central focus was not too clear and the impression of depth and ambience was curtailed. In fact, we found the treble improved and became a little smoother with better detail if the grilles were removed.

Lab results

Pair matching was fine up to 16kHz, beyond which some deviations were apparent. The dotted line on the reference 1metre trace shows the significant improvement obtained with the grille removed. Sensitivity averaged 88dB/W which was above average while the –6dB point was at 60Hz, about the group mean, and was also well damped. Overall the 110 showed quite a tidy reference response.

At 2metres the favourable aspects were retained with a well-integrated group of off-axis responses. Slight prominences were in evidence at 600Hz and 16kHz, but these were minor, and the output comfortably met ± 3 dB limits from 70Hz to 20kHz.

Only when the room averaged curve is assessed can the reason for the subjective comments of 'forwardness' be explained. The main bass register integrated well with the room, but the last couple of octaves were depressed relative to the midrange, while the mid/treble transition showed a 'corner' at 2kHz. The extreme treble was itself a little too extended, a gentle rolloff here correlating with a smother sounding top end.

Essentially an 8ohm system, the 110 dips a little below 5ohms at 7kHz, but the rating for the amplifier loading was still fairly good. System resonance lay at 73Hz, associated with the moderate bass depth measured.

Measured at 96dB, second harmonic distor-

tion averaged 1.5% even at low frequencies, with third a bit irregular at around 0.8%. A reduction in sound level to 86dB gave a worthwhile improvement, with midband second harmonic then around 0.2%, but higher towards the band extremes. Third harmonic did not change much however and averaged 0.6%.

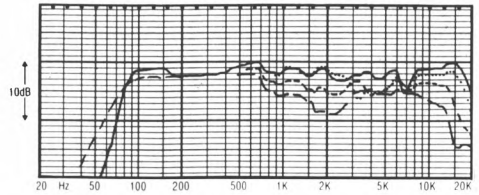
Summary

Well-made and finished, the 110 is reasonably easy to drive and it will reproduce decent sound levels, possessing an above average sensitivity. Its lightish tonal balance also suggests that it might suit wall mounting as well as the open stands used for our tests.

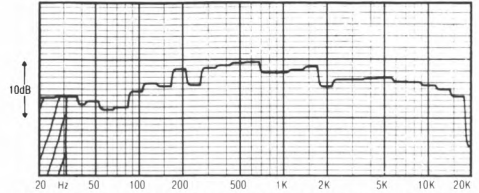
Celestion have a well behaved compact system in the 110. Value for money is good, and the commendable sound quality only fails the Best Buy category by a small margin.

GENERAL DATA

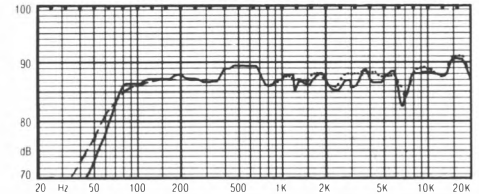
- Size (height x width x depth)..... 44 x 25 x 21cm
- Recommended amplifier power per channel
(for 96dBA minimum per pair at 2 metres) (10)—100W
- Recommended placement
- Frequency response, within ±3dB, a 2 metres 70Hz to 20kHz
- Low frequency rolloff (-6dB point) at 1 metre..... 60Hz
- Voltage sensitivity
(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)..... good
- Forward response uniformity..... very good
- Typical price per pair, inc VAT..... £99



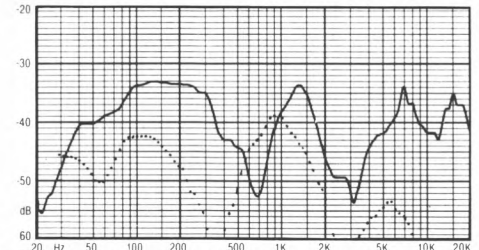
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



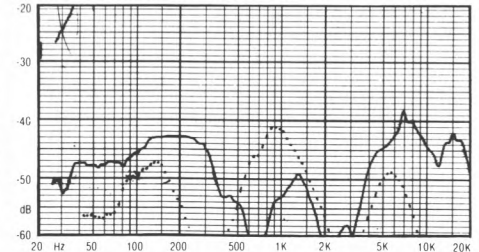
Averaged forward characteristic response in room at listening position.



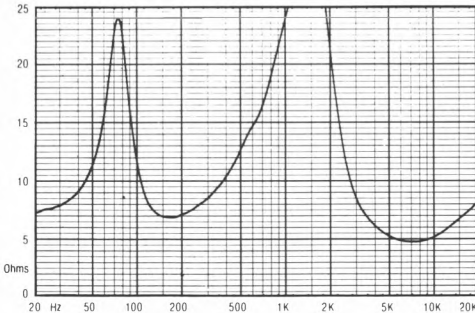
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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.

RECOMMENDED

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 unrebrated 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 96dB 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 midly rich treble balance and a smooth rolloff.

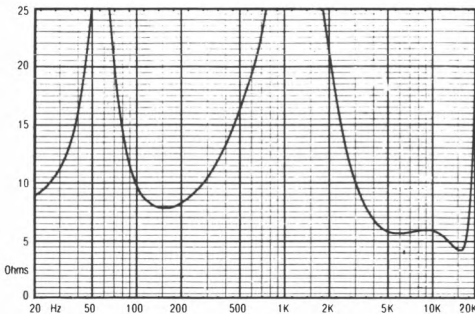
Summary

The SL6 is a remarkably musical if slightly colored performer for the price, offering a fine stereo performance albeit at a low sensitivity. It is recommended but its particular warm balance suggests an audition before purchase.

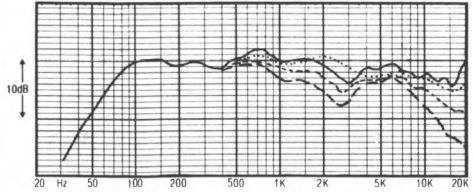
The SL600 is arguably one of the finest speakers of its size ever produced. Its stereo performance was revelatory, while its overall accuracy and natural scale belied its miniature dimensions. Apart from a moderately limited maximum level and the need for large amplifier, the SL600 can comfortably take on some of the world's finest speakers. At £600 a pair it can hardly be said to represent good value, but qualifies for a recommendation on sheer merit.

GENERAL DATA

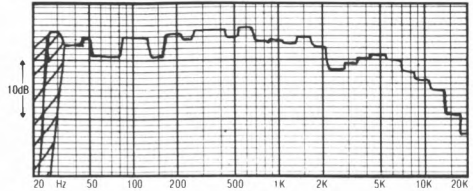
Size (height x width x depth)	37 x 20 x 25.5cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(30) – 150W
Recommended placement	open stands (Celestion)
Frequency response, within ±3dB, at 2 metres	60Hz to 20kHz
Low frequency rolloff (–6dB point) at 1 metre	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre)	82.5dB/W
Approximate maximum sound level (pair) at 2 metres	98dB
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



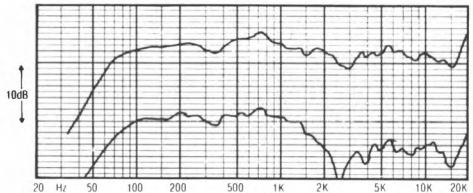
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



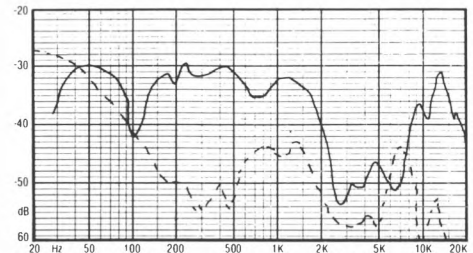
Forward characteristic response (1/3 octave at 2m, dotted 15° lateral, small dash 30° lateral, long dash 45° lateral).



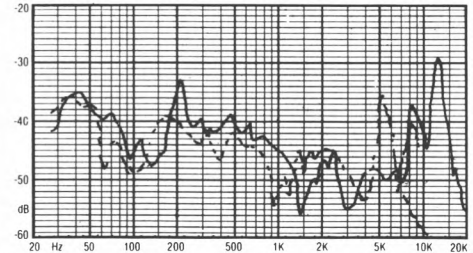
Averaged forward characteristic response in room at listening position.



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



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

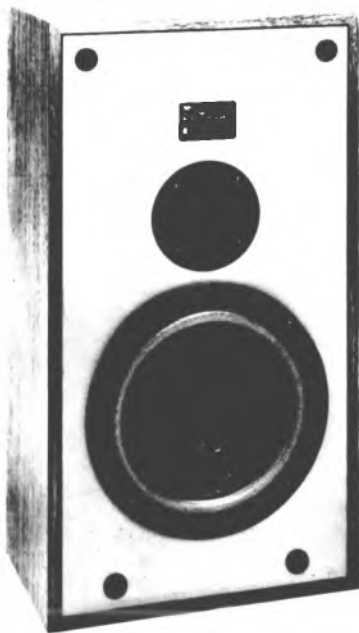


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

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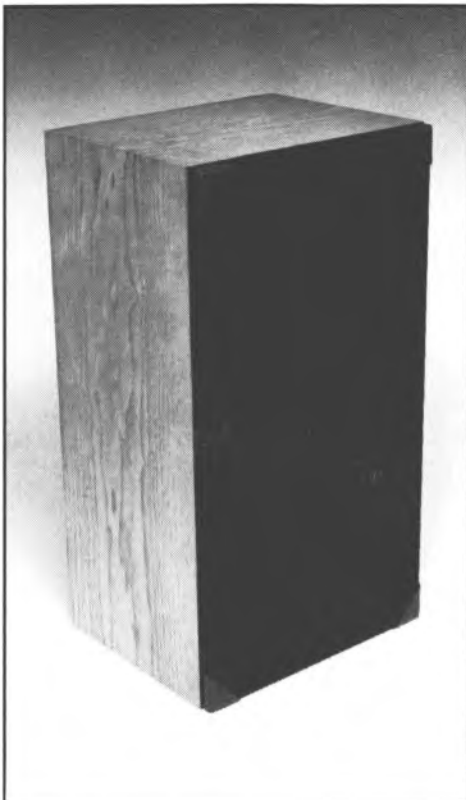
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51 FISHERGATE, PRESTON,
LANCS PR1 8BH
TEL 0772 53057**

Gale GS402

DW Labs Ltd, 88-90 Grays Inn Road, London WC1X 8AA
Tel 01-404 5140

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 40litres, 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.

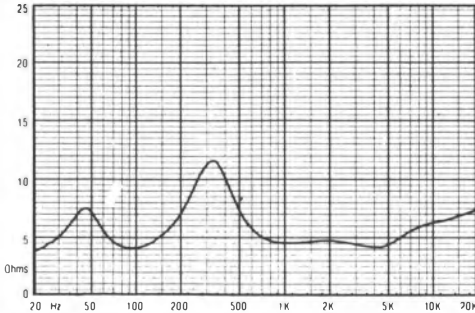
At 96dB the distortion was average on second harmonic above 500 Hz but below this frequency very good results were obtained. At 86dB the second harmonic improved greatly while third remained very low throughout — a fine performance here.

Summary

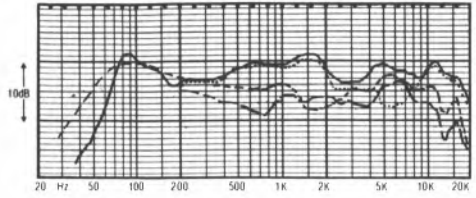
While the Gale needs a beefy amplifier to exploit it to the full, it has proved to be a well-ordered and good-sounding system. Power capacity was high, allowing sound levels of up to 106dBA, while the bass was clean and powerful, right up to the limit. Distortion was moderate and the sound pretty accurate as well as detailed. Constructional quality and performance justify the price, and so the new Gale qualifies for a recommendation. We hope that pair matching is improved in future.

GENERAL DATA

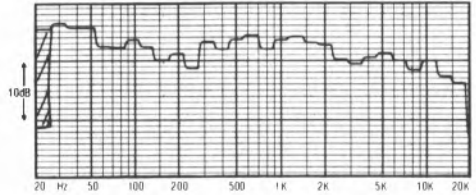
Size (height x width x depth)	33.5 x 61 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres)	(25)—200W
Recommended placement	on matching stands
Frequency response, within ±3dB, a 2 metres	50 Hz to 18kHz
Low frequency rolloff (-6dB point) at 1 metre	48Hz
Voltage sensitivity (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



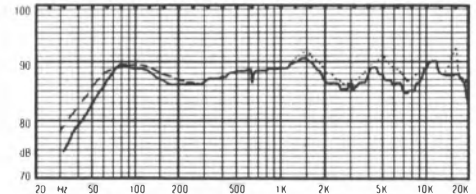
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



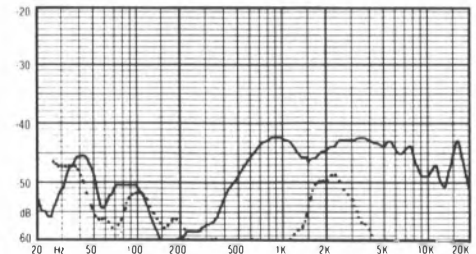
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



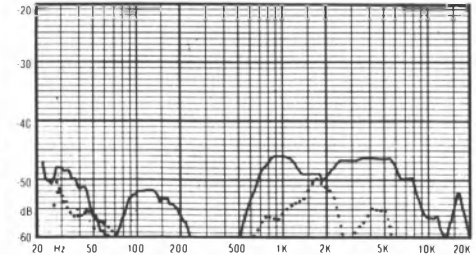
Averaged forward characteristic response in room at listening position.



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



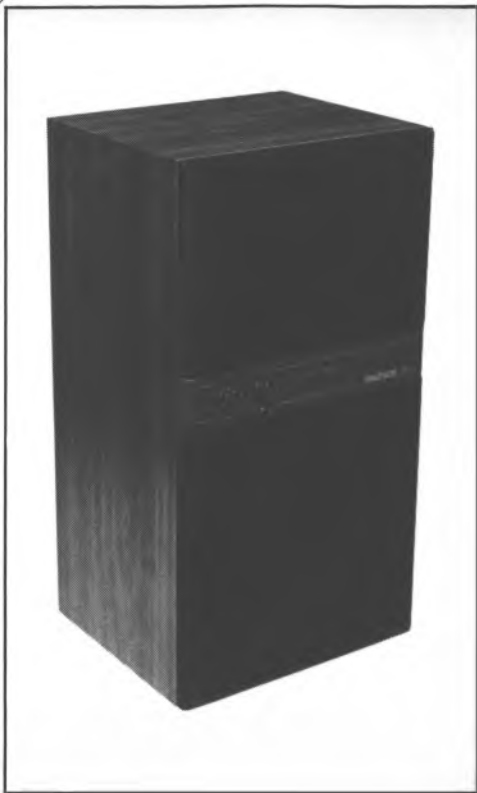
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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.

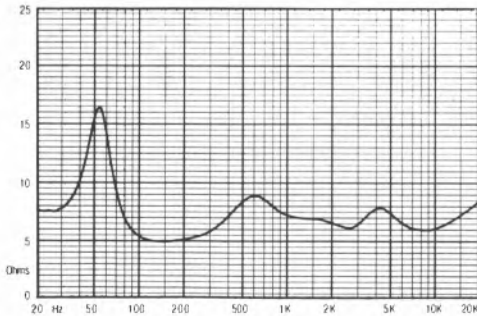
Failing to meet the 8ohms spec, the *Mezzo* showed an impedance dip to 5ohms, but it modest reactive content and average value of 7ohms meant that it remained quite easy to drive.

Summary

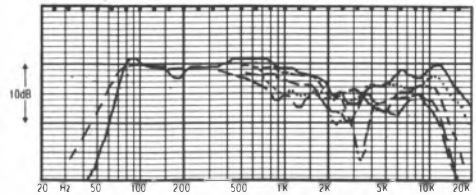
This larger-than-average speaker is good value for money, offering a pleasant, uncritical 'big' sound. The bass extended deeper than usual while high sound levels with low distortion were possible. If stereo precision is not too important then the *Mezzo* would be a strong contender, and in any case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

GENERAL DATA

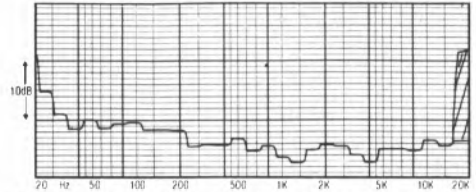
Size (height x width x depth)	60 x 32 x 26cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(12)—100W
Recommended placement	open stands
Frequency response, within ± 3 dB, at 2 metres	see text
Low frequency rolloff (—6dB point) at 1 metre	46Hz
Voltage sensitivity (ref.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



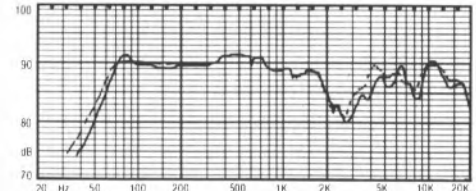
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



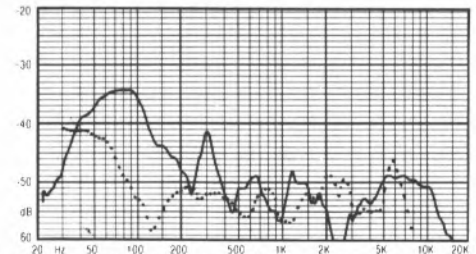
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



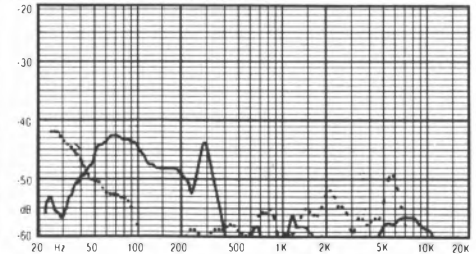
Averaged forward characteristic response in room at listening position.



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



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

Goodmans Graduate

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



Derived from the more expensive *Graduate Alpha*, the *Graduate* tested here is without the *Alpha* model's active bass pressure control system, to provide improved and more extended output at low frequencies. In other respects the systems are similar, and comprise a slim tall floor standing enclosure with three vertical in-line drivers.

The *Graduate* is fitted with a chamfered black grille and is finely veneered in good looking walnut. Rear connectors are 4mm socket/binding posts (incorrectly phased on our sample). The system is bass reflex loaded by a small 47mm diameter port, some 35mm deep, and the 18mm MDF enclosure is extensively braced, but left to damp itself by a volume filling.

A massive-framed 200mm Bextrene bass unit is used, this having the Hitachi-patented pleated cloth surround. The doped-cone 110mm diameter midrange unit is fitted in its own

loading box filled with absorbent long fibre wool but despite its large external dimensions, the *Graduate* bass enclosure volume is moderate, estimated as a little under 40litres. A 25mm soft fabric dome tweeter completes the lineup.

A high power but commercial quality crossover is fitted, comprising thirteen elements with three resistors, this assembly well spaced out and located within the hollow box forming the loudspeaker's plinth.

Sound quality

In the event the sound of the *Graduate* was distinctly disappointing, and in fact the blind listening test results indicated that the panel actually preferred the much cheaper *Mezzo* by a considerable margin.

On the plus side, it was smooth sounding as well as inoffensive but the kind comments were far outweighed by the negative ones. The bass sounded distinctly boxy, the mid 'cuppy' and hollow, while the top end could also be a touch metallic. The bass appeared 'slow' with impaired articulation, and stereo images lacked focus or perspective, with little depth shown. In the usual sense of the word, 'transparency' was felt to be reduced with this model, robbing the sound of detail as well as transient definition.

Lab results

Taken at 1metre on axis the output looked quite presentable. The bass had good extension, to -6dB at 38Hz, albeit with a mid 90Hz hump. While the mid was commendably uniform, it suffered a step at 3kHz to an attenuated treble. Pair matching was not brilliant with a further 1.5dB high frequency depression shown on the second system of the pair. The grille did not help matters - the dashed line showing the response with it removed illustrates a distinct improvement. Sensitivity was fractionally below average at 85.5dB/W, which, in conjunction with a 150W power capacity allows maximum levels of up to 102dB.

At a 96dB sound level the distortion was fine with both second and third harmonic averaging 0.3% above 100Hz, with pretty good figures below. The picture was stable at 86dB, but with a further improvement, to the 0.1% level, in the midband distortion.

Examining the forward responses, the 15° above-axis trace was distinctly poorer, suggesting that the best axis was on the mid unit. 15° below, it was fine - good for sitting on the floor! In other respects the forward response group showed good uniformity and dispersion,

with $\pm 3\text{dB}$ limits met from 42Hz top 16kHz. However, there was a mild mid range prominence.

Dipping to almost 5ohms at 150Hz, this speaker was nonetheless an easy amplifier load, and was rated good here.

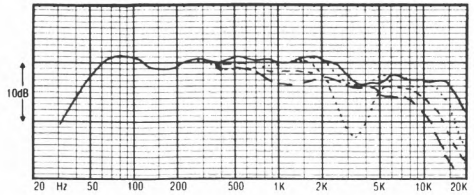
Room response gave a better idea of the sound as there was some room-coupled bass excess while the mid was noticeably prominent and the treble distinctly deficient throughout the range. A presence band loss can be seen at 3-4kHz, probably partially associated with the lack of transparency we heard.

Summary

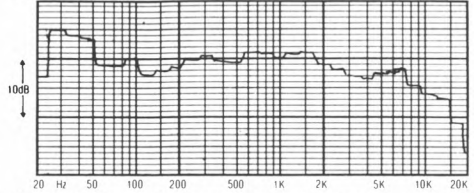
Unfortunately we found the new *Graduate* to be something of a disappointment. It is carefully made, finished and engineered, but just does not deliver the goods as regards sound quality. No recommendation is possible considering the high price, but if the responses were improved above 2kHz, with a better grille as well as more bass damping, the picture could well change. We shall just have to wait and see.

GENERAL DATA

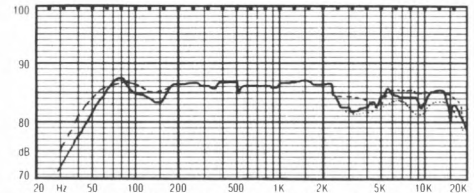
- Size (height x width x depth) 70 x 27 x 40cm
- Recommended amplifier power per channel (for 96dBa minimum per pair at 2 metres) (25)—150W
- Recommended placement floor standing
- Frequency response, within $\pm 3\text{dB}$, a 2 metres 42Hz to 16kHz
- Low frequency rolloff (- 6dB point) at 1 metre 38Hz
- Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre) 85.5dB/W
- Approximate maximum sound level (pair) at 2 metres 102dBa
- Impedance characteristic (ease of drive) good
- Forward response uniformity very good
- Typical price per pair, inc VAT £520



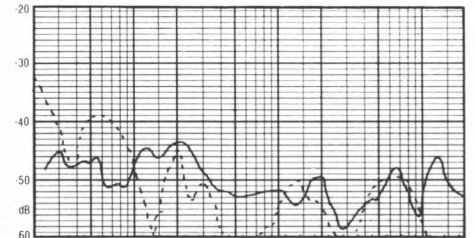
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



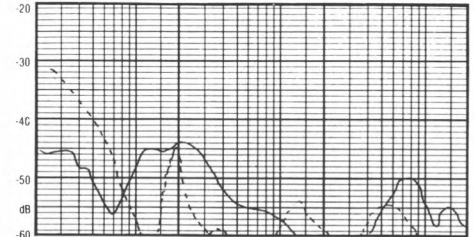
Averaged forward characteristic response in room at listening position.



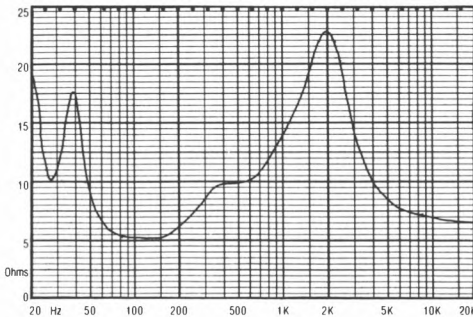
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



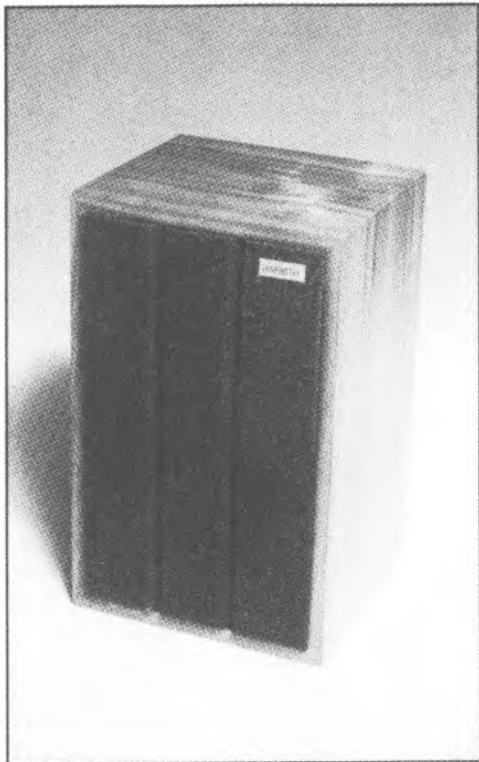
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Harbeth ML

Harbeth Acoustics, 2a Nova Road, West Croydon CRO 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 ± 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 85dB/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° 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.

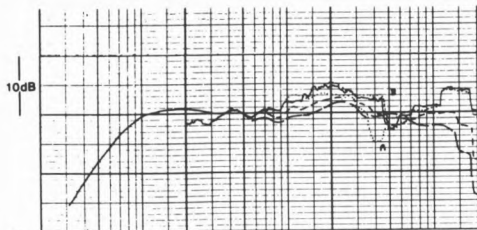
On the live comparisons the 'light' balance proved an advantage on the dominant percussive solo material, as is often the case. Nevertheless criticisms of a 'boxy' quality coupled with a 'zingy' treble were made, and the system often showed 'hardness' in the midrange.

Summary

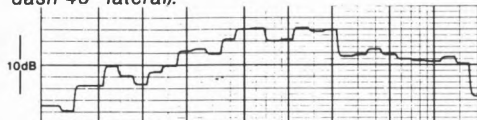
The performance of this new Harbeth does not justify recommendation. The system is comparatively expensive at £190.00 a pair, and does not compare favourably with the 3/5A, which is more accurate, and broadly comparable in terms of size, price, power handling and bandwidth.

GENERAL DATA

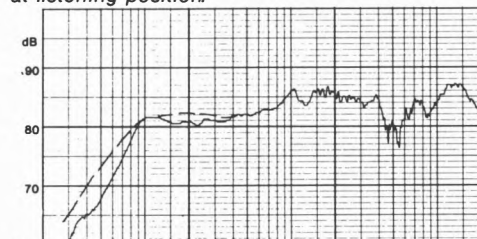
Size (h x w x d).....	34.5 x 21.5 x 19.5cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(20)–50W
Recommended placement	high stand or open shelf
Frequency response within ± 3 dB (2m)	90Hz to 20kHz
Low frequency rolloff (–6dB) at 1m	70Hz
Voltage sensitivity (ref 2.83V, ie: 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



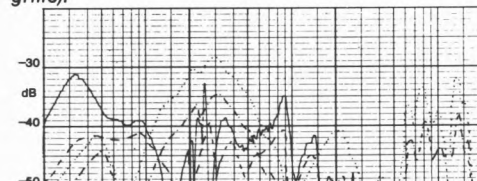
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



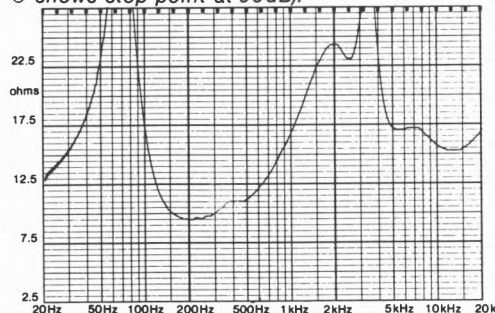
Averaged forward characteristic response in room at listening position.



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, O shows stop point at 96dB).

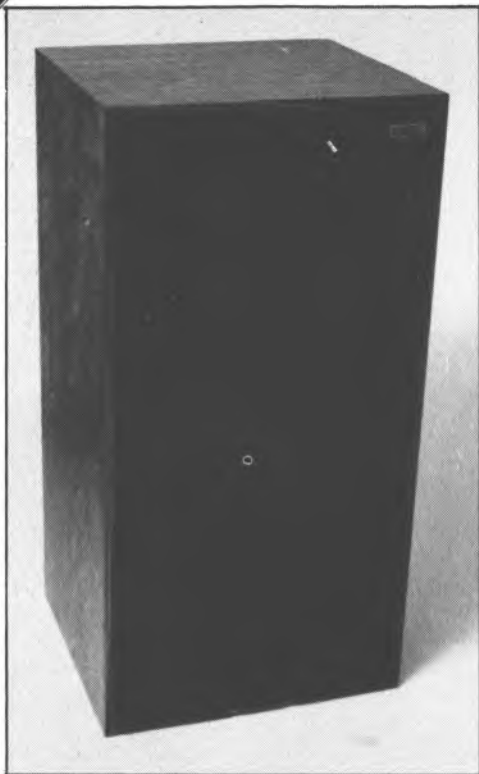


Impedance (mod Z).

Harbeth HL1 III

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

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 ± 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?

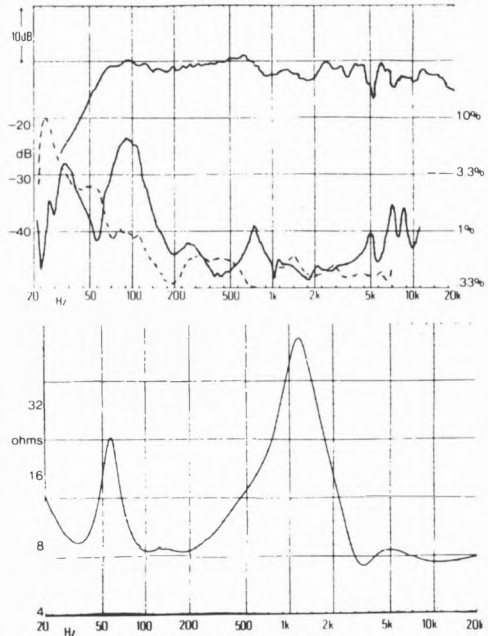
Top: Frequency response, 1m sine wave, plus 2nd (solid) and 3rd (dashed) harmonic distortion ($\approx 96\text{dB}$)

Middle: Impedance (modulus)

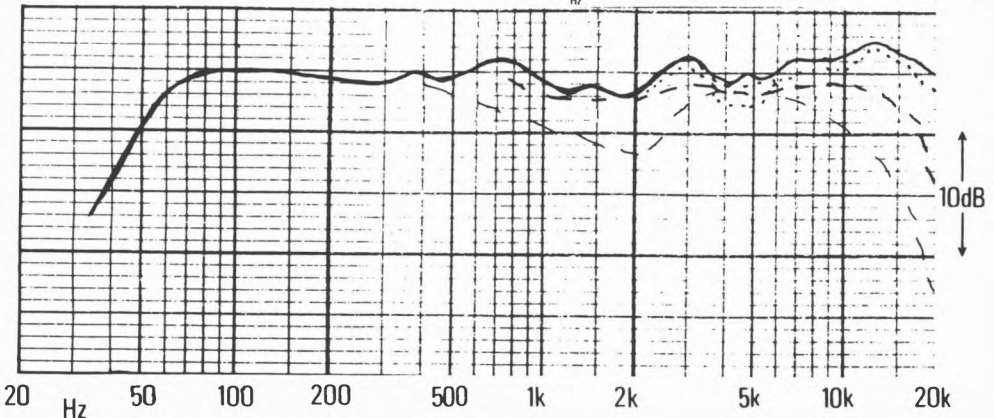
Bottom: Frequency response, 2m $\frac{1}{3}$ -octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal; dotted, 15° vertical).

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.



Size	63.5(2.5)	H: 32.5(1.3)	W: 30.5(1.2)	d: cm(inches)
Weight				13.5(3.0) kg(lbs)
Recommended amplifier power per channel (for 96dB/BA per pair at 2 metres minimum)				15-100W
Recommended placement				on stands away from walls
Frequency response within $\pm 3\text{dB}$ (2m)				6.3Hz to 18kHz
Low frequency rolloff (-6dB) at (1m)				46 Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)				87dB/W at 1m
Approximate maximum sound level (pair at 2 metres)				102dB/BA
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 £343
*Check text				



BEST BUY

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

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 ± 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 50hms, but it represents a simple amplifier load reactively and should prove fairly easy to drive. System resonance was noted as 65Hz.

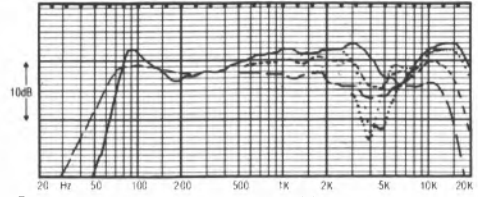
Room averaged, the bass was smooth but somewhat deficient, being a few dB down in the fundamental midrange. Consequently, the mid remained forward although the integrated treble works better than the axial responses might otherwise suggest.

Summary

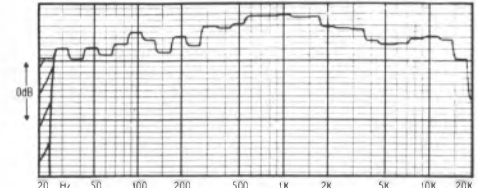
The *HB1* offers a distinctly bright character plus an above average build quality. Moderate distortion levels, high sensitivity as well as good maximum acoustic power are also all apparent, while the sound is strikingly clear with a fine transient performance. On the basis of its sound quality ratings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

GENERAL DATA

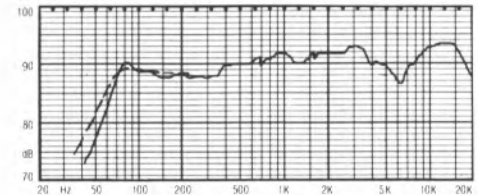
Size (height x width x depth).....	47 x 29 x 23cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—80W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, at 2 metres.....	65Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	55Hz
Voltage sensitivity (ref. 2.83V, or 1W into Bohms at 1 metre.....)	90dB/W
Approximate maximum sound level (pair) at 2 metres.....	104dBA
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	fairly good
Typical price per pair, inc VAT.....	£129



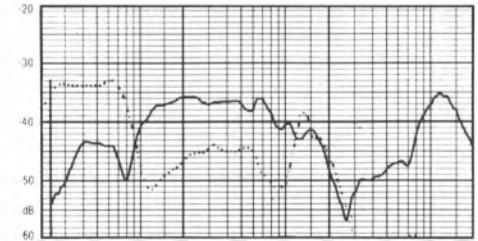
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



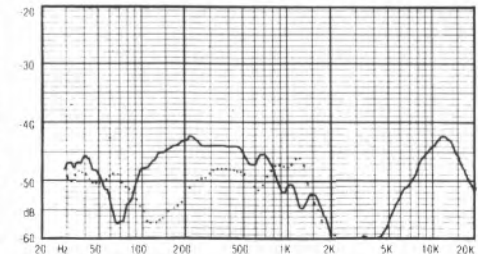
Averaged forward characteristic response in room at listening position.



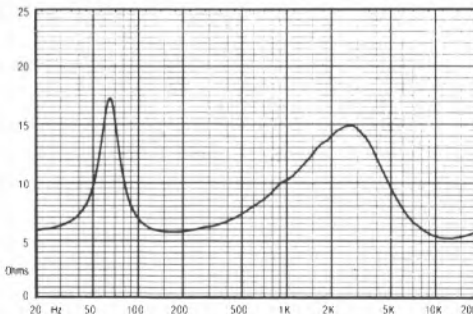
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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.

Heybrook HB2

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



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 ± 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.

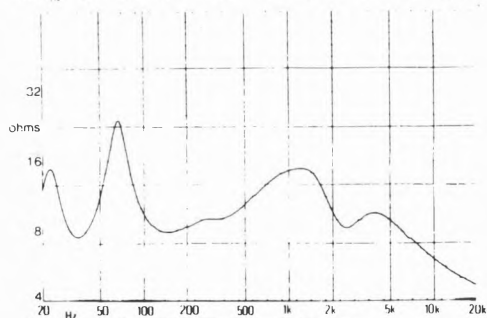
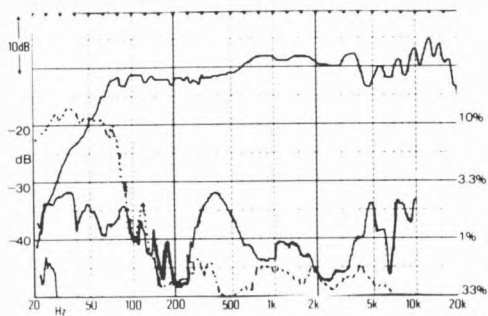
Summary

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 Heybook's first venture into the commercial world, and it represents a welcome addition to the market.

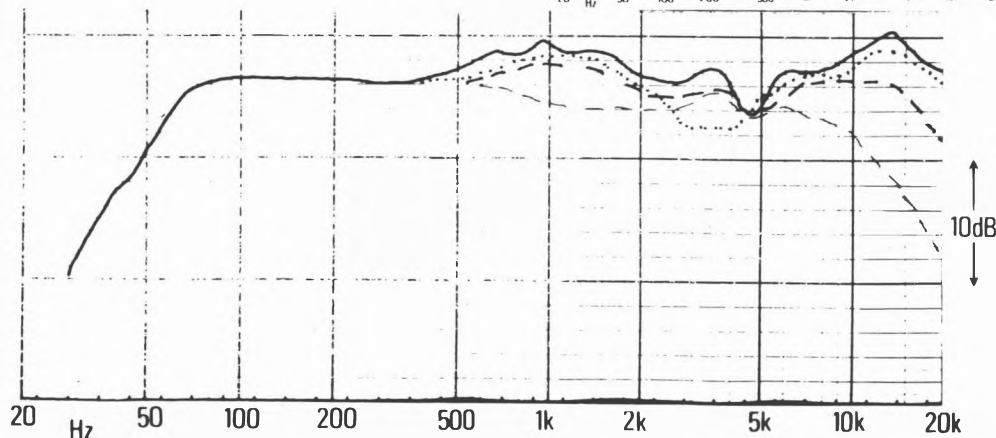
Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion (a 96dB

Middle: Impedance (modulus)

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

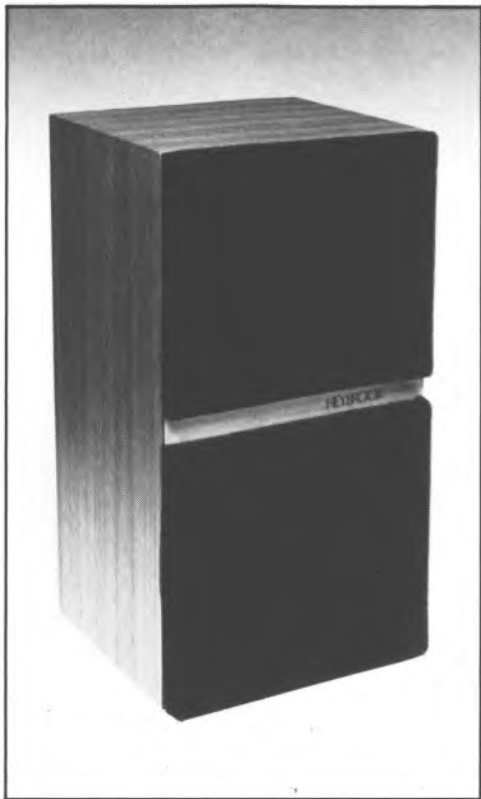


Size (H. W. D)	41. 23. 23 (16. 9. 9) cm (inches)
Weight	8 (18) kg (lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30-100W
Recommended placement	open shelf or stand
Frequency response within ± 3 dB (2m)	65Hz-20kHz
Low frequency rolloff (-6dB) at 1m	60Hz
Voltage sensitivity (ref 2.83V, ie: 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



Heybrook HB3 II

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



An earlier version of the *HB3* was assessed a couple of years ago, and this time round we have taken the opportunity to review the latest model.

A medium sized three-way speaker of some 37litres internal volume, the *HB3* is well engineered in all respects. The chipboard enclosure is substantially constructed with multiple bracing as well and a decent thickness of bituminous cladding to provide panel damping. The separate midrange chamber is also used internally to brace the main enclosure. Long-haired wool is used for mid absorption with acoustic foam for the main chamber.

The cabinet is superbly veneered on the outside and is fitted with a double grille of acoustically transparent foam, this minimising diffraction effects.

Bass is handled by a 250mm doped pulp cone

and fitted with a powerful motor system. A highly developed 100mm midrange driver is used, this also possessing a heavily doped pulp composition cone, but on a cast chassis this time. Finally a soft dome 19mm tweeter completes the line-up with a good quality crossover to integrate the outputs, electrical connection being made by binding posts at the rear.

A strong pair of stands were supplied for test which set the systems at the correct height with the median axis close to ear level. The *HB3* was auditioned both in its normally-recommended back-to-the-wall position and some 40cm away from the wall.

Sound quality

The *HB3* did not fare well on the new digital master programme, suffering from a number of coloration effects which were less obvious when the more veiled analogue material was played. Overall its rating was just average which was not impressive at the price. Stereo depth suffered some restriction, but the frontal focusing was reasonably good.

The numerous colorations observed included hissy, boxy, nasal, hollow brash and 'odd' effects, the latter often mentioned on vocal sections. The bass was unexceptional in articulation, and slightly boomy, though it was apparently of fairly good depth and low in distortion. One skilled panelist commented that it had a 'dated' sound overall.

In fact, I suspect that this latest *HB3* is better than the one we previously reviewed but that standards have improved so much over the intervening period that the improvement fails to register when up against the competition in our blind listening tests.

Lab results

Pair matching was fine up to 5kHz, beyond which frequency a 2dB mismatch was observed, the trace recorded being for the better sample (the other is shown in the 2metre response group). Heybrook have clearly put a lot of work into the new crossover assembly — sensitivity is now 88dB/W, which is well above average, with the -6dB bass rolloff at 44Hz. The power capacity of 200W suggested a high maximum sound level of 106dBA, while 15W amplifiers could produce quite good levels.

The troublesome impedance problems of the earlier model have been eliminated, and the new '3 now has textbook 8ohm, easy-to-drive characteristic.

At 2metres the output shows very good uniformity and integration, with a slightly elevated mid/treble range which seems to be a Heybrook characteristic.

Distortion levels were about average at 96dB, measuring a typical 2-3% at mid and low frequencies, although third harmonic was rather better than second. Third in fact remained unaltered at the lower 86dB sound level while second showed a good improvement, lying in the 0.3-1% range, and overall at this lower level the distortion was reasonably good.

Summary

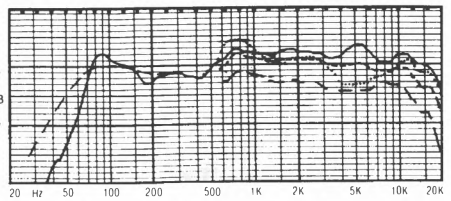
It must be said that the *HB3* has been significantly improved in several respects, particularly as regards response integration and impedance, but the overall sound quality has not been sufficiently advanced for it to become very competitive on today's UK market.

At well over £350, the *HB3* does not qualify for recommendation. However it may still be worth auditioning for analogue duty only, as its particular character appears to suit vinyl discs better than the Compact variety.

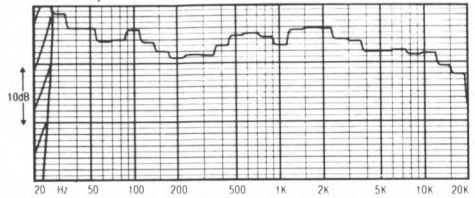
(Note: the manufacturers state that the HB3, as perhaps in the case of the Linn Sara, can be expected to give its intended optimum performance only when partnered by subjectively-compatible equipment — Ed).

GENERAL DATA

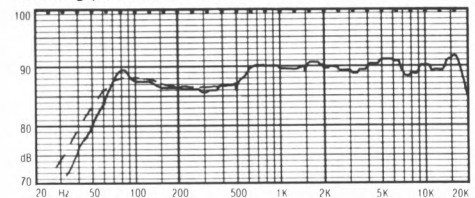
Size (height x width x depth) 62.5 x 33.5 x 28.5cm
 Recommended amplifier power per channel
 (for 96dB BA minimum per pair at 2 metres) (15)—200W
 Recommended placement
 on Heybrook stand, 1 metre or 0.2 metre from wall
 Frequency response, within ± 3 dB, at 2 metres 55Hz to 20kHz
 Low frequency rolloff (-6 dB point) at 1 metre 44Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre 89dB/W
 Approximate maximum sound level (pair) at 2 metres 106dB BA
 Impedance characteristic (ease of drive) very good
 Forward response uniformity very good
 Typical price per pair, inc VAT £425



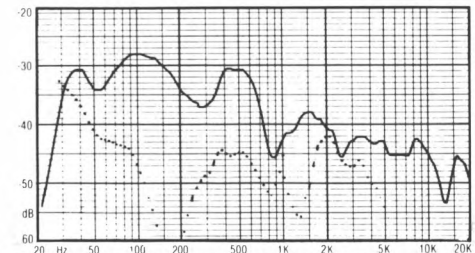
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



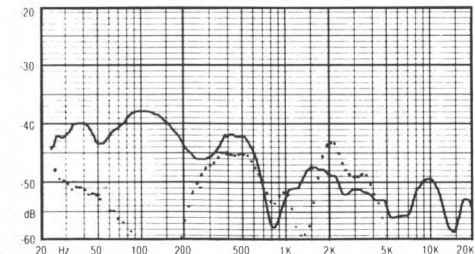
Averaged forward characteristic response in room at listening position.



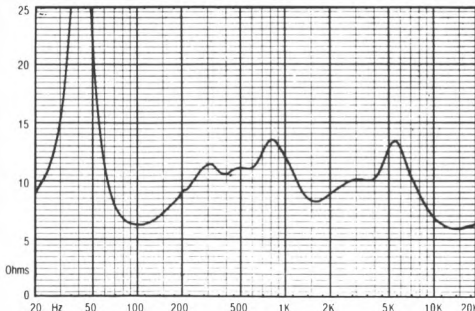
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



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

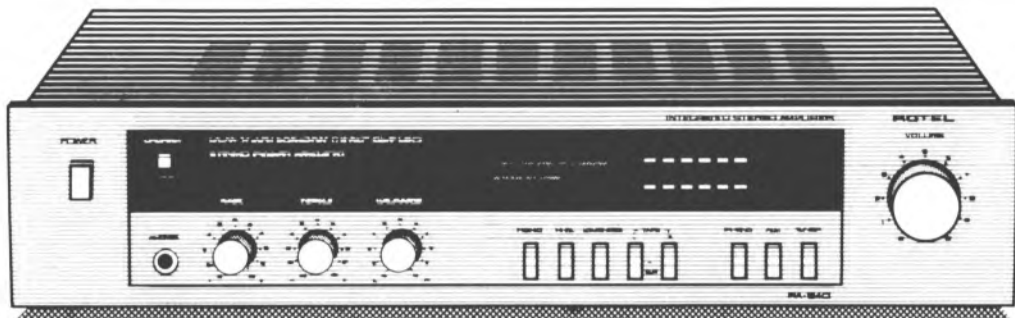


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

**By all means
listen to
the critics**

**even better
listen to the amp**





● "The Rotel RA-820 is a real winner. It has unbelievable punch and sharpness . . . At its price, I know of no amplifier to touch it." **Chris Thomas — Practical HiFi** ● "This Linn/Rotel/Monitor Audio combination is one of my personal favourite 'finds' of 1982." **Subjective Sounds** ● "But the thing which really grabbed me was the foot lapping rhythm. Every time I listened on the Rotel I ended up tapping my feet to the beat. It just seemed to have so much ability to maintain structure and keep the original patterns intact!" **Alan Mackay — Popular HiFi** ● "The Rotel RA-840 is probably as good an amplifier as you can expect to get at the price, for I know of no better amplifier on sale for £100 or less." **Stan Curtis — HiFi for Pleasure** ● "I am confident that Rotel have taken specific steps to develop a rewardingly auditioning, low price amplifier. . . The amplifier warrants a higher-than-average score for value. My judgement of value therefore, taking all things into account, resolves to 4.2 marks out of 5." **Gordon King — HiFi News & Record Review** ● "The 820 will provide tough competition for most amplifiers under £100, and may well be the best at its particular price point." **Subjective Sounds** ● "The most obvious ability of the Rotel is the way it allows the music to live and breath." **What HiFi** ● "The Rotel RA-820 looks better built, and its sound quality was as close to the NAD 3020 as anything I have encountered in the last couple of years." **Jonathan Kettle — Popular Hi-Fi** ● "The exciting new Rotel RA-820, an excellently made machine offering phenomenal value. . . It definitely sounds good and at the ridiculously modest price it allows your budget to stretch that bit further." **Jimmy Hughes — Practical HiFi** ● "I like these Rotel amplifiers a great deal. It seems perfectly clear that they are very nearly as good as can be bought for the price." **Avn Gold — HiFi News & Record Review**

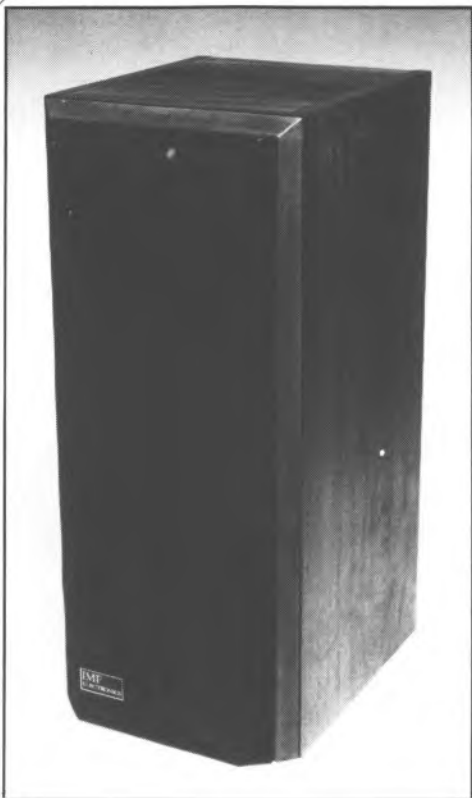
ROTEL *hi-fi*

ROTEL HI-FI LTD. 2-4 ERICA ROAD, STACEY BUSHES, MILTON KEYNES

RECOMMENDED

IMF HPCM

IMF Electronics Ltd, Westbourne Street, High Wycombe, Bucks HP11 2PZ
Tel (0494) 35576



A fairly tall looking speaker, the *HPCM* is in fact smaller than it looks. The enclosed volume of this three-way sealed-box system is estimated at 35litres, this large volume being partly devoted to a large triangular upper compartment used to backload the midrange unit located in the upper part of the front panel. An oval bass unit of approximately 230mm equivalent circular diameter is vertically aligned to allow a narrow front panel, which has bevelled edges and is fitted with a foam grille to minimise cabinet diffraction. If the drivers are good, very flat responses should result.

The bass unit has remarkable excursion capability of over 3.0cm peak-to-peak and employs a generous high-power motor system, founded on a rigid cast chassis. A fibreglass-reinforced polystyrene diaphragm is used.

The midrange unit has a specialised 100mm doped Bextrene cone, and a small grille-

protected plastic dome tweeter completes the lineup. All drivers are made by IMF themselves.

Substantially built from 20mm chipboard, the cabinet has some crossbracing and general reinforcement. Superb walnut veneer is used on the exterior with 4mm socket/binding posts used to connect the complex crossover, which includes six inductors, five electrolytic capacitors and four plastic film capacitors. Heavy duty wiring, fully soldered, is employed throughout.

Sound quality

The *HPCM* demonstrated a consistently good sound quality on all programmes, which did justice to its 'control monitor' title. Hallmarks were the moderate coloration, the extended 'air-moving' bass, and the open, lively character demonstrating fine musical detail. Stereo images were well staged showing satisfactory depth as well as good focus, while some instability in treble imaging was associated with a measured imbalance here (see results), and could well be better on other samples.

Tonal balance was well received attracting little criticism, and was felt to give a pleasing scale and weight to most programmes. Colorations were slight, with a little boxiness and nasality in the mid, plus a trace of 'lispingness' in the treble.

Lab results

Measured at 1metre, responses of both speakers were taken — the dotted line is that for the second enclosure and shows a 1-2dB treble imbalance. Bass was smooth and shelved down slightly with fine extension to 40Hz, -6dB, while the speaker was also remarkably flat elsewhere. Sensitivity was average at 86.5dB, which in conjunction with a 20 to 200W power capacity allows maximum levels of up to 105dBA, which is a pretty decent level.

Out at 2metres, an immaculate set of forward responses was taken, confirming the very low diffraction properties of the cabinet geometry. ± 1.5 dB limits were enough for a 55Hz to 20kHz range!

The impedance characteristic was however not so favourable, with dips in two areas to 4ohms and with some reactive content also present, this indicating a fairly difficult amplifier loading. System resonance was low at around 33Hz.

Room response showed an extended bass which did not rise above midband levels but was mildly deficient in the low hundreds of Hz. The

dispersed treble energy was less than anticipated, the speaker rolling gently away above 2kHz, this partially accounting for the smooth 'soft' nature described on test.

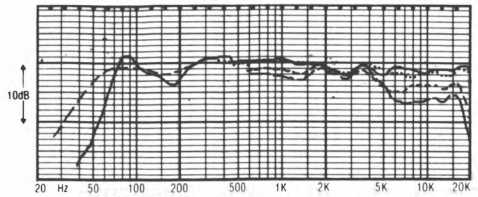
At 96dB the distortion was good at 0.3% third and 1% or better second harmonic, and at the reduced level of 86dB, it showed a general improvement to a more than satisfactory level especially at high frequencies. Considering the bass extension, the low frequencies were surprisingly linear.

Summary

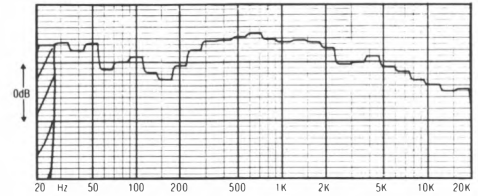
The HPCM has many good qualities — a fine consistent sound; extended bass from trim dimensions; a good dynamic range and a strong stereo performance. Of course at £550 a pair we would expect no less and a tough amplifier will be needed to drive this poorer-than-average load; nonetheless the system achieves a full recommendation.

GENERAL DATA

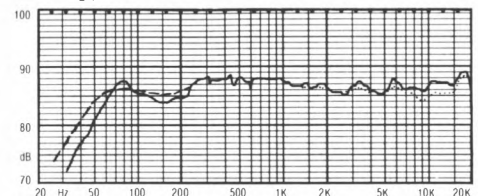
Size (height x width x depth).....	67 x 29 x 37cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(20)—200W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, a 2 metres.....	46Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	40Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre.....)	86.5dB/W
Approximate maximum sound level (pair) at 2 metres.....	105dBA
Impedance characteristic (ease of drive).....	fairly difficult
Forward response uniformity.....	excellent
Typical price per pair, inc VAT.....	£550



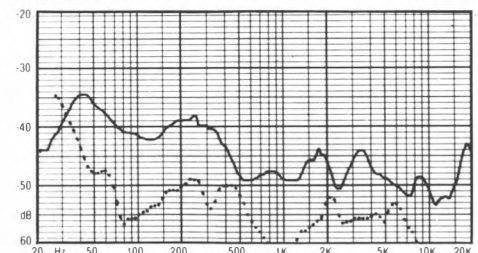
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



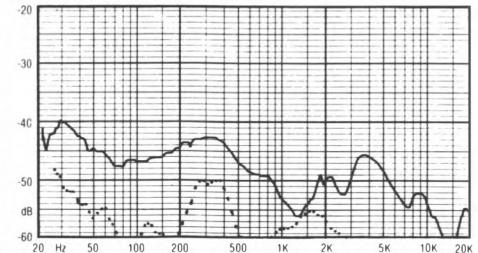
Averaged forward characteristic response in room at listening position.



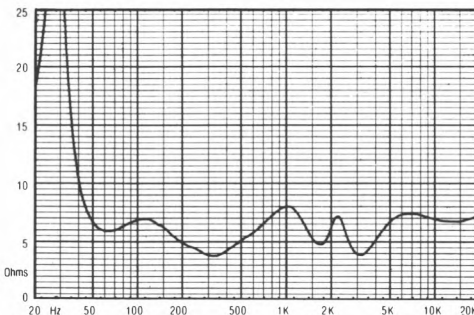
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



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



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

IMF Compact Monitor 3

IMF Electronics Ltd, Westbourne Street, High Wycombe, Bucks HP11 2PZ
Tel (0494) 35576



A compact three-way system, the *CM3* can be obtained with a distinctive veneer finish in which the colour is lightened towards the upper and lower edges. I personally did not particularly like this styling, but the *CM3* is also available with a conventional full walnut veneer. It is fitted with a black, acoustically-transparent foam grille.

Drivers are disposed vertically, for good lateral symmetry, with a 25mm soft fabric dome tweeter uppermost. This is followed by a 100mm midrange using a purpose-designed Bextrene cone and finally, a 200mm steel-framed Bextrene-coned bass unit, the latter fitted with a decent-sized magnet. A large triangular section of the enclosure back-loads the midrange, while the main volume (estimated at 25litres) is reflex-tuned by a large, strongly-overdamped rectangular aperture in the enclosure base. In fact this is so strongly damped that no trace of it can

be seen on the impedance graph!

The enclosure is well built from 18mm high density chipboard with a 12mm thick internal bituminous cladding plus foam absorption. The three drivers are electrically integrated by a good quality crossover network of eight elements, plus one resistor. The speaker is designed for mounting on open stands clear of room boundaries.

Sound quality

At an average price, the *CM3* scored a basically average rating on the blind listening tests. Some conflicting characteristics were described in the panel score sheets, namely a degree of hardness, wiriness and brightness in the mid treble coupled with a richer, thicker boxiness in the upper bass/lower-mid. There was also a tendency to slight sibilant exaggeration on vocal passages, while the bass lacked some of the definition and clarity associated with the better examples in this price range.

Stereo presentation was reasonably good with moderate depth and a fair representation of width as well as frontal focus. It suited analogue programme better than it did digital, tending to sound a little 'busy' on the latter, with a lack of ultimate 'see through' clarity.

Lab results

The *CM3* exhibited fine pair-matching, to better than $\pm 0.5\text{dB}$, and the grille was seen to exert a negligible influence on the acoustic output — a good point. Sensitivity was just average at 85.5dB/W and was also compromised to some degree by a lower-than-standard impedance. It remained below 5ohms over a considerable range, dipping to 4ohms around 200Hz, and as such represents a fairly difficult amplifier loading.

The reference curve suggested a mild 'lumpiness' in the axial response. This was confirmed at 2metres with the forward-response set, in a dip appearing at 4kHz, 15° off-axis so the speakers should be mounted at a decent height, with the mid/treble axis aimed at ear level. Bass was reasonably extended, to 48Hz, -6dB, with a slight overshoot at 90Hz and on the lateral axes good dispersion was demonstrated. The irregularities were mild enough to allow better than $\pm 3\text{dB}$ limits for a 50Hz to 19kHz range.

Assessed by computer room averaging, a mild bass hump existed at 86-100Hz, with a broad mid prominence 600Hz to 2kHz. The treble was also somewhat uneven above this point, with an isolated lump at 14kHz —

associated with some subjectively-assessed treble unevenness.

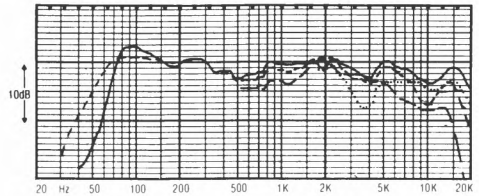
Distortion at 96dB was poorer than average at low frequencies, measuring around 5%, second harmonic with third at the 1% level. In the midrange the performance was better, reading 0.6% second and 0.4% third. The bass distortions improved by about 6-10dB at reduced level of 86dB, little improvement was shown elsewhere.

Summary

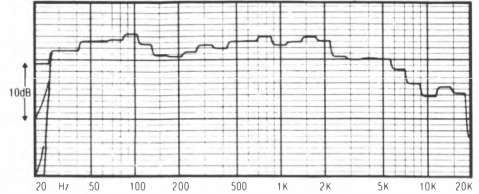
Offering an average sound quality at an average price it could be argued that the CM3 is reasonable value, and this is probably true enough where analogue material is involved. However, it proved less promising on digital material, and when set against the performance of some of its competitors in this edition, it does not qualify for recommendation. However, the CM3 remains worth auditioning.

GENERAL DATA

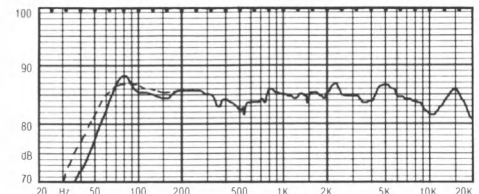
Size (height x width x depth).....	57 x 29 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(20)—100W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, at 2 metres.....	55Hz to 19kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	48Hz
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).....	fairly difficult
Forward response uniformity.....	very good
Typical price per pair, inc VAT.....	£275



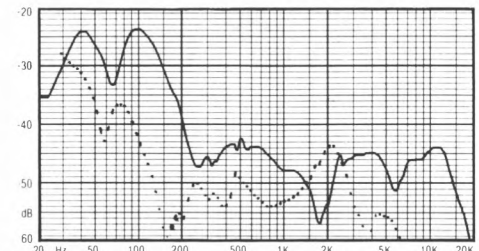
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



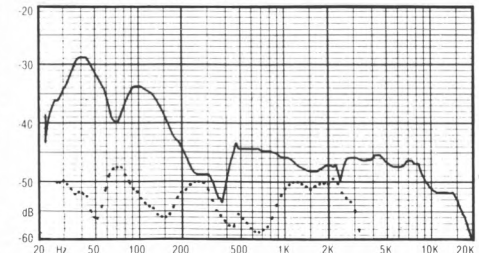
Averaged forward characteristic response in room at listening position.



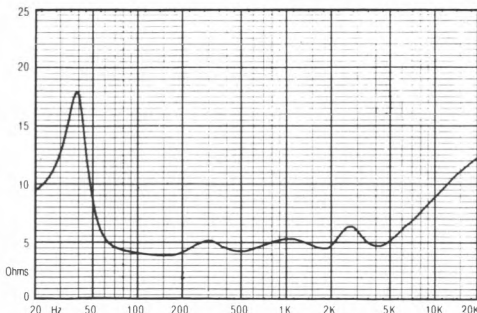
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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.

JBL L15

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



Exquisitely made, the 'miniature' JBL L15 model is fitted with one of the most substantially engineered bass/mid units available at the price. With a diminutive 10litres internal volume, the system is bass-reflex tuned by a port with a modest 50mm exit diameter, backed by a rather long 120mm duct, this likely to result in some airflow asymmetry at higher sound levels.

A 16mm unrebeated grille frame is fitted, not in my view a wise choice for a speaker of such small panel area as it is calculated to produce upper response anomalies. The carcass itself is a rigid construction in 20mm thick high density particle board, superbly veneered in walnut.

Built on a die-cast frame the 170mm bass unit is fitted with a rigid reinforced pulp cone and a decent magnet. The tweeter employs a hard dome with an aluminised surface, the assembly protected by a stainless steel mesh. Both drivers are made by JBL themselves. The

crossover network uses high quality, high power components and consists of six elements plus three resistors — more complex than usual for JBL.

Electrical connection is made via JBL's own type of screw-down binding posts, which are not suitable for the thicker sort of speaker cables. Bookshelf mounting is envisaged but we also tried the L15s on stands.

Sound quality

The listening panel did not like the L15, describing the sound as appearing to come from a small 'box', with inadequate bass weight and poor tonal balance, even in the upper bass registers — a region not necessarily ruled out to miniatures. It was also considered to possess considerable coloration, with boxy, hard, nasal, sibilant and breathy effects.

Tonally we felt it was balanced too thin, the sound lacking in ambient weight.

Stereo seemed to be localised near the boxes and failed to spread or focus sharply at the median position. Depth effects were also lacking, the stereo perspective seeming rather flat and compressed.

Lab results

The 1metre responses suggested a slight pair imbalance, the dotted curve being for the second unit which was more sensitive in the bass and slightly less sensitive in the treble. Mean sensitivity was 87dB/W, which was a little above average. The dotted response is that taken with the grille removed and shows that the grille had introduced 3-4dB suckouts at both 2.5 and 6kHz. A moderate bass response was recorded of 55Hz, -6dB.

Assessed at 2metres, the response was pretty uniform with a good set of lateral off-axis curves. At 15° above, the loss was mild, although broader than we expected.

However, the best correlation with subjective results was provided by the room response. Here the system was clearly mid-dominant, with an upper-presence hump at 3.5kHz, a treble 'corner' at 16kHz and an overdry bass which cannot be fully recovered by wall mounting.

Measured at 96dB the distortion at low frequencies was fine at below 1% over the working range, averaging around 0.4%. It improved greatly at 86dB, averaging a remarkably good 0.2% which was rather better than usual.

Impedance dipped to almost 4ohms at 200Hz and 4kHz and this does not make the L15 an

easy speaker to drive. 6ohms would be a fair nominal value.

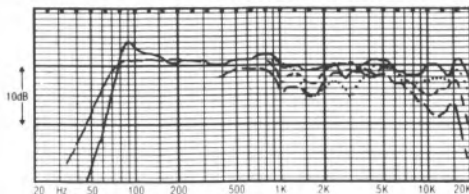
Maximum sound levels of 102dBa from a pair were typically possible using the 15 to 100W per channel suggested amplifier power range.

Summary

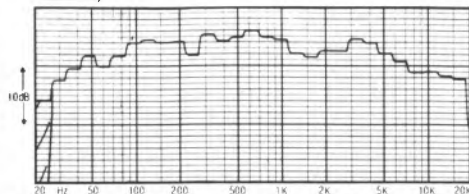
Superbly constructed and finished, this gutsy miniature was unfortunately to our ears too coloured and too mid-forward as well as too obviously curtailed in its bass extension for a recommendation to be possible. Current standards at the £200 price level dictate a better all round sound and good engineering alone is just not enough.

GENERAL DATA

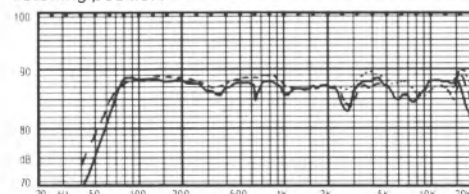
Size (height x width x depth) 37.5 x 24 x 20cm
 Recommended amplifier power per channel
 (for 96dBa minimum per pair at 2 metres) (15)—100W
 Recommended placement shelf or stands
 Frequency response, within ± 3 dB, at 2 metres 60Hz to 17kHz
 Low frequency rolloff (-6 dB point) at 1 metre 55Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre) 87dB/W
 Approximate maximum sound level (pair) at 2 metres 102dBa
 Impedance characteristic (ease of drive) fairly difficult
 Forward response uniformity very good
 Typical price per pair, inc VAT £210



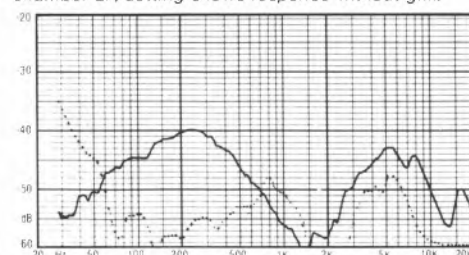
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



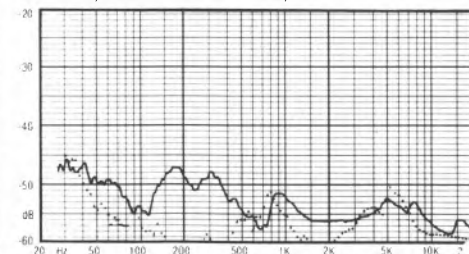
Averaged forward characteristic response in room at listening position.



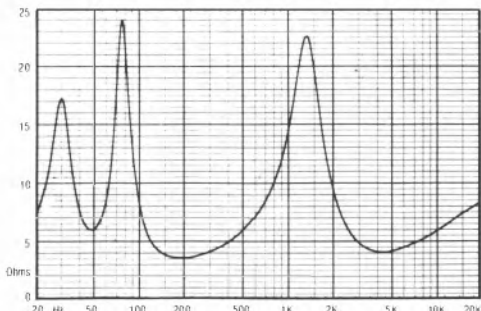
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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



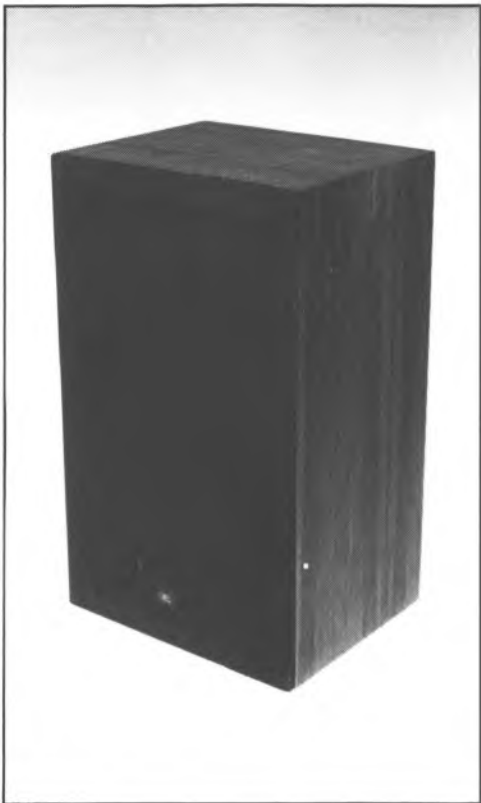
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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.

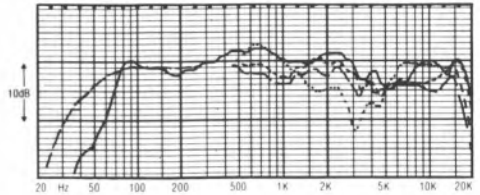
At a couple of points the impedance dipped to 5ohms, and demonstrated and average of 7ohms, a result below the 8ohm standard but still reasonably easy to drive.

Summary

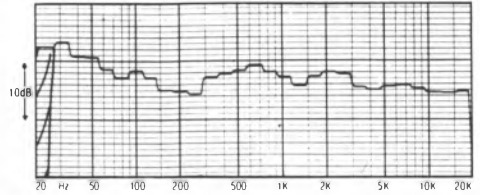
This is a speaker worthy of consideration on the basis of its reasonable scoring and the fact that some panelists favoured it quite strongly. It provides very low distortion, extended bass and a wide dynamic range plus a good transient performance especially on percussion. Stereo presentation is also 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

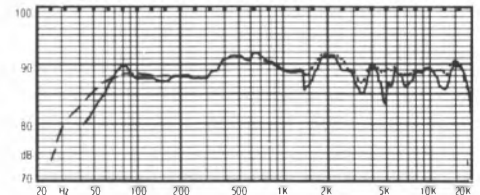
Size (height x width x depth).....	60 x 36 x 30cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(10)—200W
Recommended placement.....	open stands
Frequency response, within $\pm 3\text{dB}$, at 2 metres.....	see text
Low frequency rolloff (-6dB point) at 1 metre.....	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



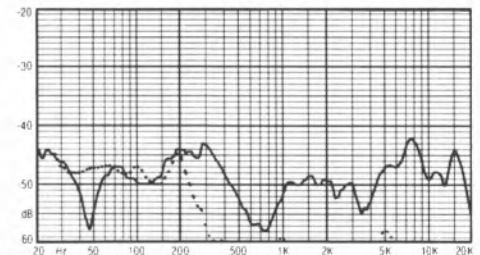
Forward characteristic response ($1/3$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



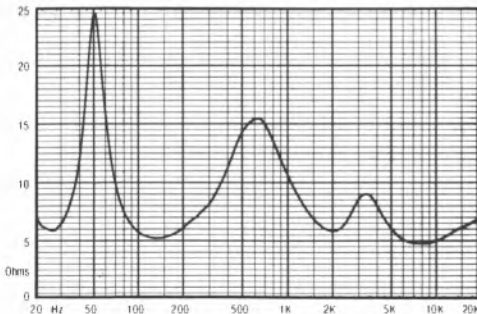
Averaged forward characteristic response in room at listening position.



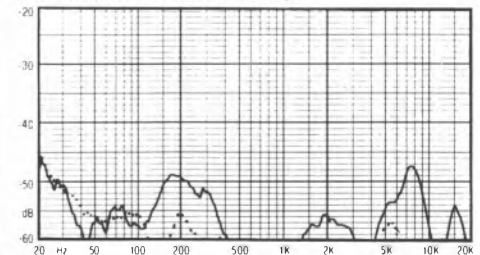
Reference sine wave response (1m on axis, 283V input shows sensitivity). Dashing corrects for chamber LF, dotted shows response without grill.



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



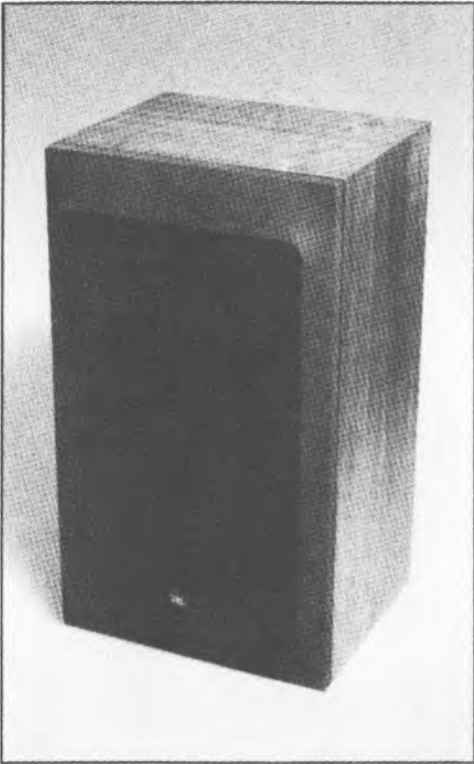
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



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

JBL L112

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



Two JBL systems, the 150A and the 112 share a number of common features, not least their driver lineup and most of their crossover networks. In fact, they are also close in terms of certain of their physical dimensions, namely their width and depth, and by simply leaving off the lower ABR section of the 150A, we would arrive at an approximate 112! There are of course differences between the two, the 112 possessing much smaller internal volume (43 litres) than the 150A, and comprising a reflexed system loaded by a 75mm diameter by 150mm deep duct. Inexplicably the lateral symmetry of the 150A has been abandoned in the 112, presumably so that the system can be used on its side in a large US bookcase or shelf location. These differences are obviously of great importance, judging from the markedly poorer subjective performance of the 112 compared with the 150A, a gap which not even the former's £300 lower price can justify.

As already mentioned the general construction

of the 112 parallels that of the 150A, with a 305mm heavy duty bass unit, a 100mm midrange pulp-cone driver and the new version of the 25mm bakelised linen phenolic aluminised soft-dome tweeter. The steel-grille frame was superbly crafted and finished, but was potentially suspect in placing a wide strip near the HF driver, while the large port was also close to the tweeter, neither feature conducive to the smoothest frequency response.

Both the 112 and 150A use a special JBL terminal whereby the bared speaker leads are clamped by a strong screw locking mechanism. Open shelf positions are possible for the 112, but in average UK rooms stand mounting is most likely, and this is how they were used for the test programme.

Lab performance

The sensitivity was marginally lower than for the 150 at 88dB/W, with a reasonably extended bass response to 43Hz, -6dB. Limits of +/-4.5dB were required to contain the axial reference response, largely due to a depression at 6kHz and some "peakiness" at 15kHz. The grille did affect this result a little, but not sufficiently to merit a separate response with it removed.

Moving to the 2m characteristic response, this speaker's problems were readily apparent. Taking the dotted 15° vertical response first, severe phase problems were evident, dictating a listening position with the axis well up to ear level. Supplied as stereo pairs, the 30° lateral short-dashed response was measured in both directions, 'in' and 'out', showing the marked asymmetry of the output in the lateral plane. Overall the system did not demonstrate good forward uniformity.

The distortion results were however exemplary at all powers and levels, with that shown at 96dB in the treble comprising comparatively harmless 2nd harmonic. The distortion averaged 0.3% or less and 100W pulses were equally well dealt with, showing negligible compression and low distortion (500Hz, 0.15% 2nd and 0.18% 3rd, 5kHz, 1.5% of 2nd and 0.8% of 3rd).

Possessing excellent power handling, the system could produce high sound levels of 109dBA in the listening room, yet would give satisfactory levels on a little as 15W per channel. It rated as reasonably easy to drive, possessing an 'average' impedance.

The room response showed evidence of energy peaks at 60Hz and 16kHz, with a drop at 160Hz, all rather different from the 150A. The output fell quickly below 50Hz, reinforcing the effect of the room's 60Hz lift.

Sound quality

The results for the 112 were none too promising at the price. Compared with live sounds the treble found little favour, while the mid appeared forward with significant coloration including 'hardness' and 'thinness'. Acoustic guitar appeared significantly inferior to the 150A, and only in the bass did the 112 show signs of its pedigree, where the power handling and 'attack' were excellent. The bass register was fairly extended and very clean but showed some excess 'richness'; it could have been 'leaner' to advantage.

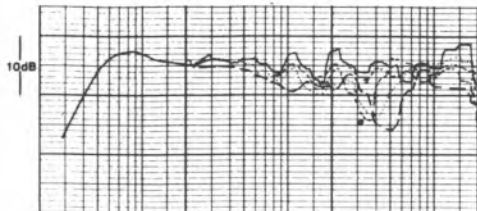
The panel was more impressed during the recorded sessions, awarding fairly good scores. The sound was liked for some measure of 'impact', clarity and overall balance, but was less well received than the 150, particularly as regards stereo stability, precision and depth. The bass was also marginally more colored than the 150, though it was nonetheless well above average, and it excelled on the rock sections – an area where the stereo performance is arguably less important.

Summary

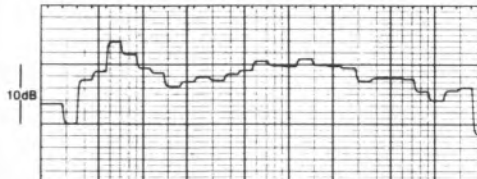
This is a finely made speaker offering a high dynamic range and above average bass, plus good sensitivity and fine sound on rock programme. However the overall quality suffers from directivity and moderate coloration problems, and cannot be recommended at the relatively high asking price. The L112 is not a 150A on the cheap or small and devotees of the new JBL sound must I am afraid stick to the more expensive and massive 150A. Wouldn't it be nice if JBL could scale down the 150A and produce a 112 without its present defects?

GENERAL DATA

Size (h x w x d)	62 x 33 x 34cm
Weight	approx 22kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(15)–400W
Recommended placement	open stand, clear of walls
Frequency response within ± 3 dB (2m)	45Hz to 16kHz
Low frequency rolloff (–6dB) at 1m	43Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	88dB/W
Approximate maximum sound level (pair at 2m)	109dBa
Impedance characteristic (ease of drive)	average
Forward response uniformity	average
Typical price per pair inc VAT	£700



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



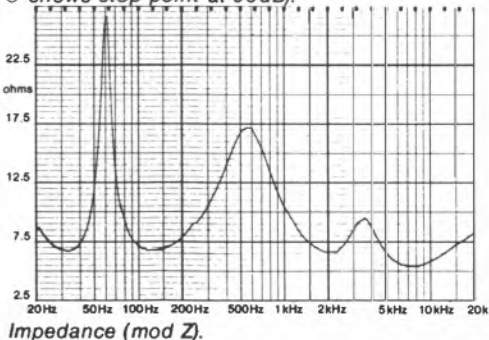
Averaged forward characteristic response in room at listening position.



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



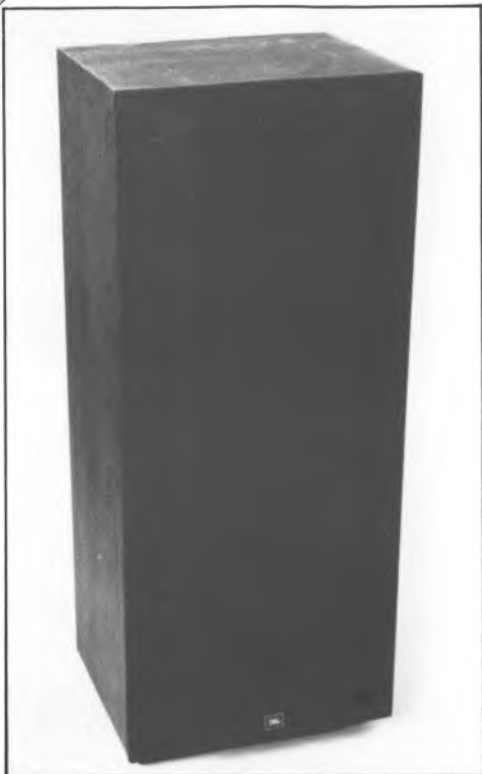
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, O shows stop point at 96dB).



Impedance (mod Z).

JBL L150A

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



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 32Hz, 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 hall-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.

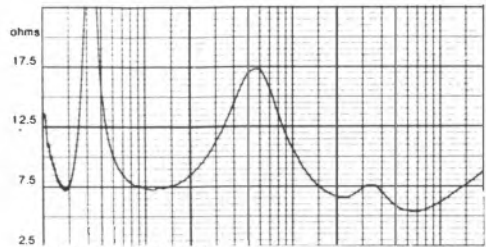
On stereo programme the speaker gave a 'big' sound, partly as a result of its physical height and its wide bandwidth. The bass was superbly clear and unusually extended, if slightly excessive, while 1000W of electric bass guitar was handled without knocking or distortion. Stereo imaging was to a good 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

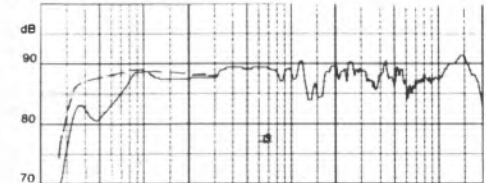
Continued refinements have helped to maintain the competitiveness of this model, and despite its high UK price it provides a sufficiently good standard of sound quality to deserve continued recommendation. Its particular merits include low distortion, a wide dynamic range and exceptional power handling, 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.

GENERAL DATA

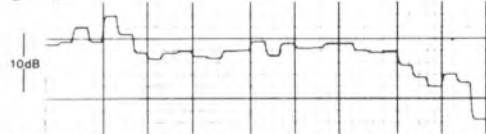
Size (h x w x d)	105.4 x 43 x 33cm
Weight	36kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(10)-500W
Recommended placement	on floor clear of walls
Frequency response within ± 3 dB (2m)	35Hz to 18kHz
Low frequency rolloff (-6dB) at 1m	32Hz
Voltage sensitivity (ref 2.83V, i.e. 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 £1250



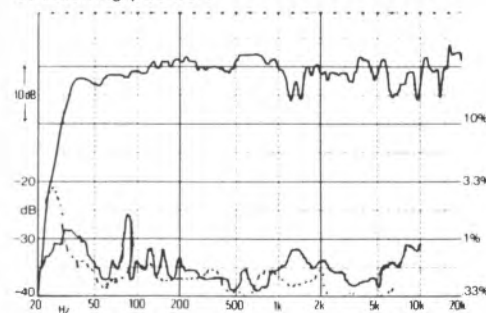
Impedance (mod Z).



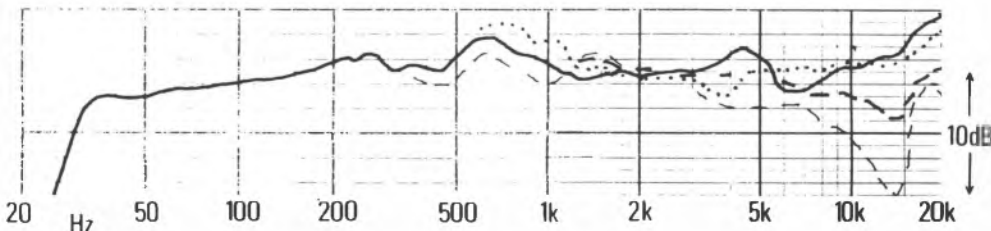
Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Averaged forward characteristic response in room at listening position.



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



Forward characteristic response ($\frac{1}{3}$ -octave @ 2m, solid axial, thick-dash 30° horiz, thin dash 45° horiz, dotted 15° vert).

BEST BUY

Keesonic Kub

Keesonic Audio Developments Ltd, Halldore Hill, Cookham, Maidenhead, Berks
Tel (06285) 22726



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.

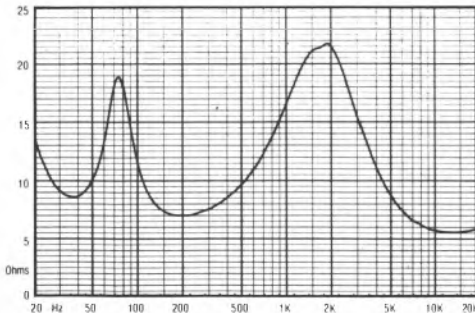
The *Kub's* impedance averaged 10ohms with a minor dip to 5.6ohms at 14kHz, thus rating as a good amplifier load.

Summary

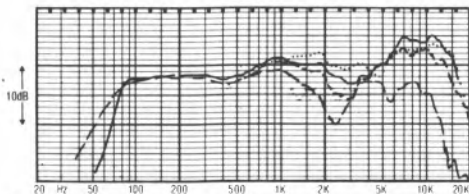
Despite its diminutive size, and our minor reservations, the *Kub* has again scored a Best Buy rating in this edition. It packs a surprisingly clean and detailed punch, with a pleasing tonal quality, and it offers unobtrusive wall mounting. The treble is its weak area, and bright pickup cartridges should 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

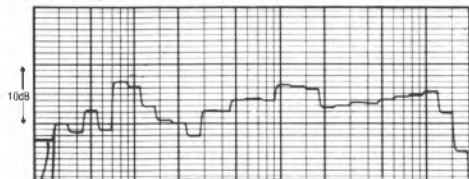
Size (height x width x depth)	29 x 18 x 21cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(10)—75W
Recommended placement	shelf
Frequency response, within ± 3 dB, a 2 metres	80Hz to 6kHz
Low frequency rolloff (-6 dB point) at 1 metre	63Hz
Voltage sensitivity (ref. 2.83V, 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



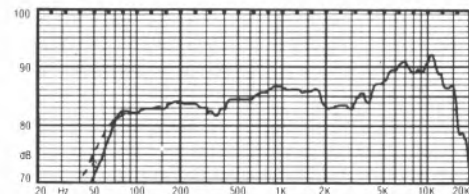
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



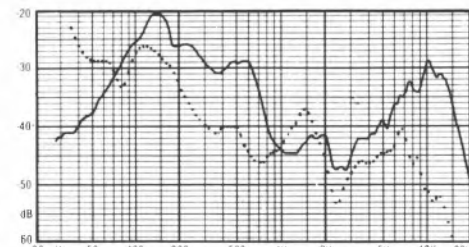
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



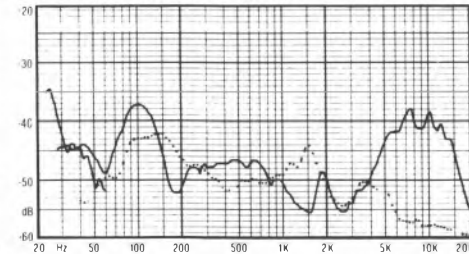
Averaged forward characteristic response in room at listening position.



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).

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HIFI Answers November, 1982

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"THE VERDICT - I found PROTECH to be a potentially very useful insurance which fully met its makers claims. In a perfect world we would not need such protection units but given the state of reality a little investment today could save a lot of money and quite a few tears tomorrow."

Price: £35.50.

QED AUDIO PRODUCTS LIMITED

Unit 12, Ashford Industrial Estate, Shield Road, Ashford, Middx. Tel: Ashford 46236

KEF Coda II/Coda III

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP. Tel (0622) 672261



In recent years KEF have been noted for some of the more costly 'reference' speakers on the market, but they have now reaffirmed their interest in the budget class, with this substantial two-way model retailing at around £80.00 a pair.

The *Coda* comprises a 19 litre sealed-box tuned to a 3rd order low frequency alignment by a series capacitor of computed value. The bass/midrange is handled by a 200mm flared pulp cone driver, whose cone is light enough to offer useful sensitivity without excessive magnet expenditure (the latter is surprisingly small but sufficient to properly damp the low frequency response). The treble unit is the Audax 25mm fabric dome which is already used by KEF in their successful *Celeste/Concord* series. A four-element crossover of high power capacity marries the units around 4kHz.

The enclosure is simply constructed of chipboard with a rather dull synthetic walnut covering. No panel damping is used, but some internal

absorption is achieved by a polyester blanket fill. Electrical connection is *via* rear flush fitted spring clip terminals, and the driver panel is well finished which is fortunate in view of our recommendation that this model should be used with the grilles removed! The grille is a plain unrebated panel 12mm thick which had surprisingly severe effects on the speaker's frequency response and stereo image properties, as well as causing a smaller but noticeable change in subjective smoothness. Having discerned these effects early on, the listening tests were done with the grilles removed, and this should be borne in mind by the prospective purchaser.

Lab performance

The sensitivity was higher than claimed at an above average 88.5dB/W, and KEF's frequency response was substantially met (they specify with the grilles removed in any case!) At 2m the characteristic curve showed a very fine set of off-axis results, with the evidence suggesting that 25° should give the flattest result and provide the most pleasant tonal balance as well as good stereo imaging. The range 80Hz-2kHz was remarkably smooth for such an inexpensive system.

Good dynamic potential was shown by its handling of the 100W pulsed inputs, with a mild 0.2dB compression at 500Hz accompanied by 3.8% 2nd and a modest 0.55% of 3rd harmonic distortions. At 5kHz, there was 0.6dB of compression as well as more distortion, namely 4.5% 2nd and 1.0% 3rd, though neither was considered serious at this high 108dB spl. 3rd harmonic distortion was low at both 90 and 96dB steady state, rising above 1.0% only below 100Hz, and measuring only 3.5%, 50Hz 96dB. The printed graph was in fact dominated by less serious 2nd harmonic at the 1.0% level. The 8 ohm specification was almost perfectly met, so the system will be easy to drive to the full voltage/sensitivity rating of the amplifier. Averaging showed just how well this speaker worked within the room, +/-2.5dB limits sufficing from 60Hz to 15kHz. The rolloff beyond 15kHz was a little steep, the bass falling below 50Hz and the midrange being slightly humped, but the room system response nevertheless beat many models at much higher prices.

Our power rating was for a minimum of 10W/channel rising to 100W peak maximum, the latter allowing high sound levels of up to 104dBA in the listening room from a stereo pair. Reasonable extension was shown at low frequencies with the -6dB point at 50Hz.

Sound quality

This speaker scored very well on all the listening tests, performing with a consistency that we have come to expect only from much costlier models. It would be all too easy to ignore its faults in the light of this astonishing performance, but obviously it is not perfect. Some coloration and a tendency to brightness was demonstrated, while the treble also showed an uneven tendency on occasion, with some of the characteristic Audax 15kHz 'fizz'.

Conversely it provided a fine stereo presentation with above average depth, good spatial effects and ambience plus a transparency and detail which conveyed a high proportion of the musical information contained in a variety of programme.

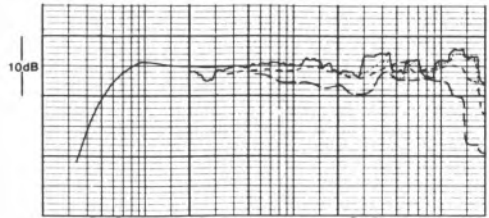
More coloration was noted on the live comparisons, but the system's detail and tonal accuracy won the day and high scores were recorded. Up to a 150W peak of bass guitar was happily tolerated, the system demonstrating a fair fundamental bass power, a neutral and even character, plus an ability to play loud.

Summary

With a new tweeter and numerous detail refinements, the *Coda III* arrived in time for auditioning, although the measurements given here relate to the *II* which it supersedes. The new version if anything sounded better, and hence the Best Buy rating is comfortably retained despite its higher price. The *Coda* is a speaker of many attributes, notably good sensitivity, wide dynamic range and power handling with moderate distortion, and an essentially neutral frequency balance with satisfactory bass extension. It also demonstrated fine stereo, good clarity and detail, so it deserves to be fed good quality material – a second rate turntable with a 'fizzy' cartridge will destroy it. The *Coda* is not only a classic Best Buy but will, I believe, set the standard for budget compacts for years to come. If used on stands without the grilles and angled inwards by about 20° to cross in front of the listener, the results compare with many models costing up to £300 a pair.

GENERAL DATA

Size (h x w x d) 47 x 28 x 22cm
 Weight 7kg
 Recommended amplifier power per channel
 (for 96dBa per pair at 2 metres minimum) (10)-100W
 Recommended placement ... open shelf or ideally on open stands
 Frequency response within ± 3 dB (2m) 62Hz to 18kHz
 Low frequency rolloff (-6dB) at 1m..... 50Hz
 Voltage sensitivity
 (ref 2.83V, ie: 1 watt in 8 ohms) at 1m..... 88.5dB/W
 Approximate maximum sound level (pair at 2m) 104dBa
 Impedance characteristic (ease of drive) very good
 Forward response uniformity excellent (grille off)
 Typical price per pair inc VAT £80 when reviewed, now £99



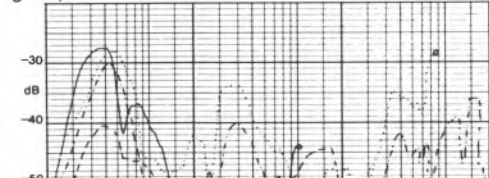
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



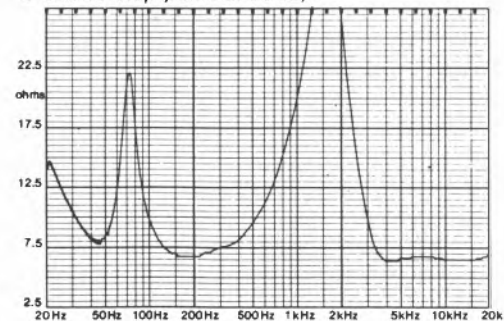
Averaged forward characteristic response in room at listening position.



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



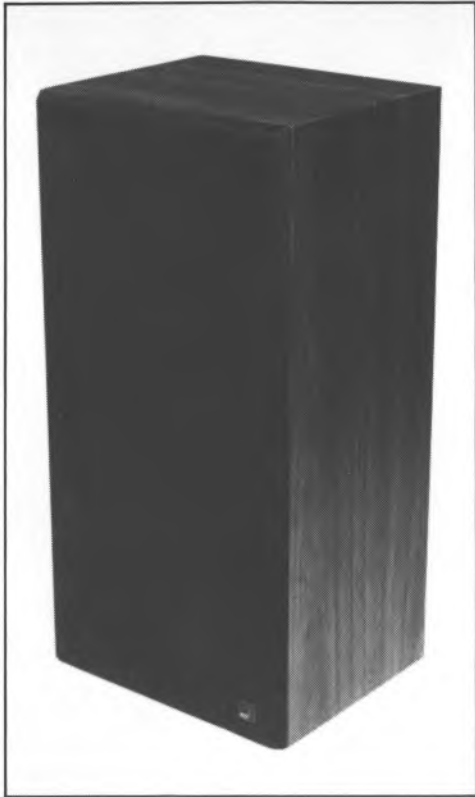
Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, O shows stop point at 96dB).



Impedance (mod Z).

KEF Carina

KEF Electronics Ltd, Tovil, Maidstone, Kent ME15 6QP
Tel (0622) 672261



KEF's new £140 a pair *Carina* loudspeaker is intended to replace the earlier *Concorde II*, both systems being two-way designs, but incorporating three drive units — a pair of 200mm bass units married to a 25mm soft fabric dome tweeter. In the older model the treble unit was made by Audax and mounted above the two mid-bass drivers, but in the *Carina*, the tweeter is KEF's own design, another 25mm dome but ferro-fluid damped and cooled, and is located between the two bass/midrange units.

Constructed on new profile pressed steel frames, the bass/mid drivers have lightweight flared pulp cones with 25mm motor coils and surprisingly small magnets. They appear to be driven symmetrically which implies a narrower vertical radiating angle, this confirmed on test. The drivers are integrated by a commercial-quality crossover network comprising five elements plus two resistors, and electrical

120

connection is via 4mm socket/binding posts.

This 33-litre enclosure is ostensibly a sealed box design but it includes KEF's third order loading principle which uses a large series capacitor to tune the low frequency 'corner' and provide a good immunity to subsonic overload. Final rolloff is then at 18dB/octave.

The plain chipboard cabinet is made from undamped 15mm panels, vinyl walnut covered. A dense filling of fibre wadding is used for standing wave absorption and the drivers are connected using push-on connectors. Two grilles are supplied — a thick wood-framed type of doubtful acoustic qualities and a slightly limp-looking foam grille which is acoustically transparent, and to be preferred on sound quality grounds.

Sound quality

The *Carina* scored a disappointing 'below average' on the listening tests though perhaps this is not too unreasonable at its below group average price level. One of its problems seemed to be an excessive fullness and boxiness in the upper bass/lower-mid, the sound appearing thickened with reduced bass articulation as well as a lack of sparkle and transient attack on several instruments, ranging from cello to acoustic guitar. Some loss of presence as well as transparency was apparent, and the stereo image appeared rather wide, localised more at the boxes and less so in space. Impressions of depth in the image were also seemingly subdued, and while high sound levels were possible the speaker never really came to life.

Lab results

Good results were obtained from the measurements with a high sensitivity approaching 90dB/W which is well above average. A 75W maximum power handling was indicated and generous 104dBA sound levels were possible from a stereo pair, and as little as 10W could give satisfying volume levels. Bass was reasonably extended to 52Hz, -6dB, and the bass was certainly perfectly tuned in anechoic terms. Pair matching was also good. The wooden grille impaired the performance and should only be used if the looks of the foam alternative are unacceptable and the difference between the two inaudible to the customer.

The *Carina* proved to be somewhat axis-sensitive in the vertical plane, a 15° shift up or down resulting in a dip at 2kHz or so. In consequence the speaker must be carefully lined up for the median treble axis to beam at the

listener's head. In the lateral plane however the off-axis results at 2metres were exemplary.

At 2 metres, $\pm 2\text{dB}$ limits were met from 60Hz to 16kHz, this tolerance including a mild response downtilt with increasing frequency.

At a 96dB sound level, distortion held to below 1% at frequencies above 80Hz, with regions of much lower third harmonic. At the lower 86dB level, a general distortion reduction took place, typically measuring 0.2 to 0.3% for second and third harmonic; these are fine results.

Room-averaged, the KEF showed good low frequency integration, but a mild lower-mid energy prominence.

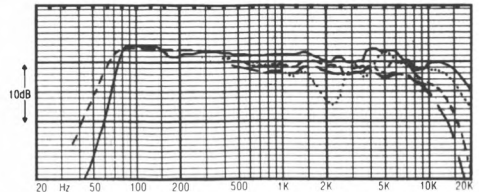
Summary

Although it performed well technically, the *Carina* failed to generate significant enthusiasm among the panel. Its thickened 'boxiness' and lack of general transparency coupled with an average stereo performance ruled recommendation out, and in our opinion, the older *Coda II* still outperforms this new arrival.

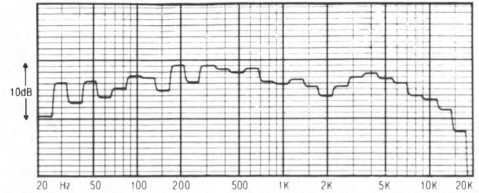
Before we went to press, a second pair of *Carinas* was finally obtained, and these demonstrated somewhat reduced 'boxiness'. On this basis, the model is included in the 'worth considering' category.

GENERAL DATA

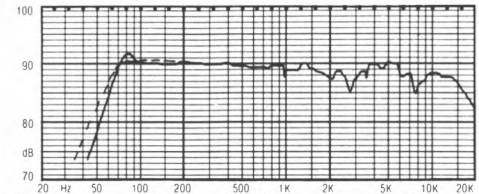
Size (height x width x depth)..... 60 x 30 x 25cm
 Recommended amplifier power per channel
 (for 96dB minimum per pair at 2 metres)..... (10)—75W
 Recommended placement..... open stands
 Frequency response, within $\pm 3\text{dB}$, a 2 metres... 55Hz to 17kHz
 Low frequency rolloff (-6dB point) at 1 metre..... 52Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre..... 89.5dB/W
 Approximate maximum sound level (pair) at 2 metres..... 104dB
 Impedance characteristic (ease of drive)..... fairly good
 or-ward response uniformity..... very good
 Typical price per pair, inc VAT..... £140



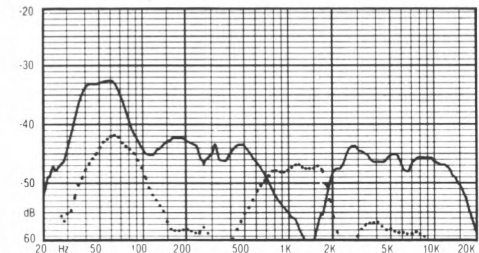
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



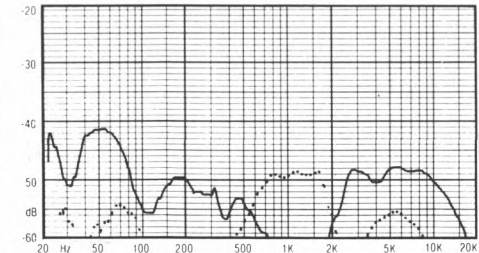
Averaged forward characteristic response in room at listening position.



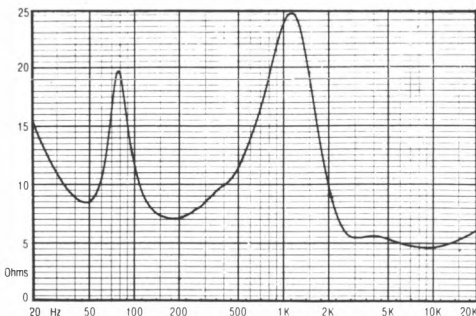
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



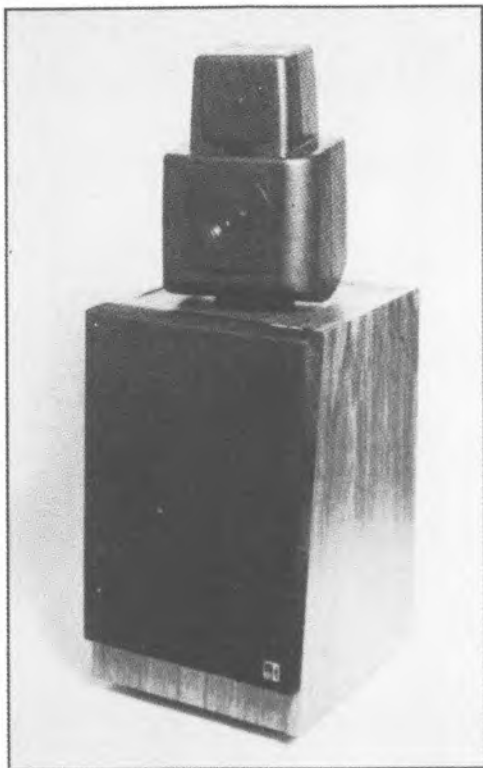
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

KEF R105.4

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP. Tel (0622) 672261



Well established in *Mark 2* form, the *R105* continues to set an enviable standard for sound quality. The rather confusingly named *R105.4* represents an effort to bring *105* technology to a lower price category, and is not intended to replace the *R105.2*. However much of the latter's elaborate foolproof protection systems have been retained, together with the unique head assembly with its advanced 110mm Bextrene-coned mid-range unit, and the sophisticated high-slope crossover/equalisers which provide a remarkable degree of driver integration. The 200W peak power indicator is also included, and this is also a sighting light to aid accurate positioning of the adjustable heads.

Although smaller than the *Mk 2*, the *R105.4* is still substantial, measuring just under a meter high. The major difference between the *Mk 2* and *4* concerns the bass enclosure, which has been reduced to 40 litres for this new model, and uses two less expensive 200mm bass units operating

in parallel, rather than the costly 305mm unit of the *105.2*. Radiating area is much the same, and the reduced band-width has endowed the '4' with even higher power handling capacity, though at a cost of some 13Hz of bass extension. A new 25mm soft dome tweeter is used, allowing a small increase in sensitivity.

Lab performance

We disagree slightly with KEF concerning the shape and level of the low frequency response. With nearfield correction relative to our 85.5dB reference sensitivity, we charted a hump of some 2.5dB, accentuated by a rolloff below 100Hz. KEF's own computed data from their reference system at the factory shows that the hump barely exists, at just 1dB above their reference taken at a 2m measuring distance. Our low frequency overlay for the *Choice 2m* characteristic response showed less lift, but 100Hz was still fractionally over 2dB above the 1kHz point. While these may seem small discrepancies, in fact the described variations in low frequency tilt and balance were audible, and the listening panel proved sensitive to such factors.

With the bass grille removed (it adds a reflecting edge below the mid unit), the speaker produced a remarkably smooth response, ± 1.5 dB from 150Hz to beyond 20kHz, which is better than a number of precision microphones! The bass slope has already been noted, while the -6 dB point was moderately extended to 46Hz and with a slow decay thereafter to 35Hz, -10 dB.

At 2m the characteristic responses were exemplary. A significant and subjectively important aspect of the tonal balance was however revealed by a gentle upwards trend from 200Hz, the converse of the gentle down-tilt in the *105.2* previously measured (especially with grilles on). A slight energy depression was present from 600Hz to 1.5kHz: that this is a deliberate compensation is clearly evident from the averaged room response, which is correctly balanced in this region, in contrast to the *105.2*. In fact comparing the room responses for these two models tells us a great deal about their subtle sound quality differences. The '2' has the smoother, deeper bass, but betrays a falling output with frequency only relieved by the mid prominence, while the reduced extension of the '4' leaves the upper bass more prominent, but gives a more consistent and better balanced response up to 4kHz. Above this the anticipated smooth die away occurs. Averaging 10 ohms, the *104.4* was an excellent amplifier load and will be easy to drive to the potential of its rated 85.5dB/W sensitivity,

with up to 500W generating 107dBA maximum levels, and 20W representing a sensible minimum.

At 96dB third harmonic distortion was held to around 1% down to 55Hz, while 2nd harmonic was higher reaching 3.0% around 600Hz. At the reduced 90dB level 2nd and 3rd order effects were still evident in the 0.3 to 1.5% range, and this performance could be better in view of the price level.

Sound quality

The 105.4 had no difficulty in matching the high scores attained by the '2 on all the listening tests, and while broadly similar, the comments reflected the measured differences. The '4 sounded 'livelier' and more 'open' with enhanced 'see-through transparency' and some extra detail, so that it appeared even less coloured.

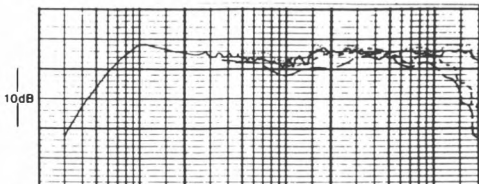
The comparisons with live sounds were in the '4s favour, though a trace of 'boxiness' and 'nasality' remained, with a mildly 'plummy' and 'chesty' quality in the upper bass. Stereo imaging was exceptionally good, with a seemingly effortless recreation of space, ambience, and depth (when present in the programme). Where the '2 impressed by its 'scale', and relaxed, more distant perspective, the '4 provided greater excitement and 'immediacy', without any sacrifice of the depth impression.

Summary

Two years ago the 105.4 was enthusiastically recommended for its technical merit as well as its sonic performance largely judged using analogue material. However, to our dismay the same pair of speakers performed less well this time round on the 'blind' panel listening tests using digital programme, a result which I subsequently verified in later tests. The bass appeared to lack some definition and attack while the upper mid seemed harder and more nasal. Some fine detail and transparency were lacking – significant failings at this price level. It remains highly satisfactory on conventional programme but our new tests indicated a downgrading to 'worth considering' when using predominantly digital programme although it is obviously up to the individual purchaser to decide his or her priorities.

GENERAL DATA

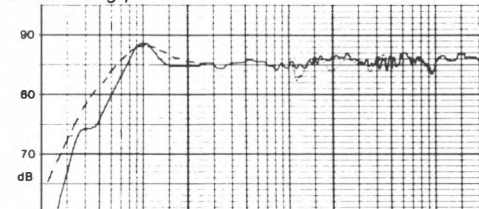
Size (h x w x d)	93.6 x 35 x 38cm
Weight	22kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	500W
Recommended placement	on floor, clear of walls
Frequency response within ± 3 dB (2m)	55Hz to > 20kHz
Low frequency rolloff (-6dB) at 1m	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	85.5dB/W
Approximate maximum sound level (pair at 2m)	107dBA
Impedance characteristic (ease of drive)	excellent
Forward response uniformity	excellent
Typical price per pair inc VAT	£650



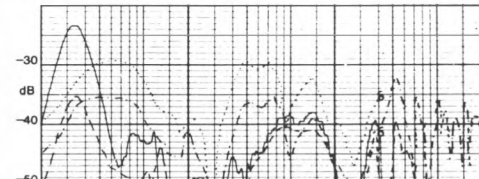
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



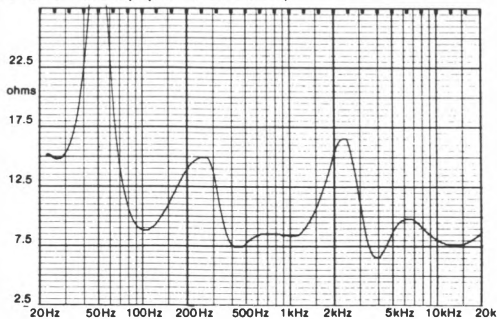
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response with grille).



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



Impedance (mod Z).

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Koss Kossfire 110

Koss UK Ltd, 114 Ashley Road, St Albans, Herts AL1 5JR
Tel St Albans 69763



The '110 is a medium sized speaker of some 35litres internal volume, and appears to offer a lot for the money at around £190 a pair. A total of four drivers are used, two being small 35mm cone tweeters mounted in a recessed panel, horizontally disposed and angled towards each other and provide wide dispersed radiation. Mounted off-centre directly below this assembly is a third cone tweeter, this time a 45mm diameter unit, together with a treble volume control adjustment.

Bass and midrange frequencies are handled by a 250mm thin-framed driver fitted with a plastic decorative rim, and inscribed 'Pneumatic Bass Loading,' by which Koss presumably refer to the nearby bass reflex port, this 65mm in diameter and 105mm long. The bass unit has very light and flexible cone together with one of the smallest ceramic magnets I have seen yet, but nonetheless, a decent sensitivity is

promised. The crossover comprises a couple of electrolytic capacitors plus a small overload trip.

Turning to the enclosure, the 14mm chipboard cabinet is finished in a rather bright printed wood vinyl and has no damping or filling whatsoever — it is quite empty! After this examination the number of drivers offered at the price was no longer so surprising.

Sound quality

After analysing the panel score sheets from the 'blind' listening tests, I am embarrassed both for *HFC* and Koss in reporting on our findings for the '110. I feel that more extensive market research should have been undertaken by the company before marketing this model, whose score in our tests was distinctly poor.

The sound was found confusing, lacking in detail and what could only be described as 'tuneless'. The treble was scratchy, tizzy and directional, with the midrange forward as well as hard, and the bass was rather boomy as well as lacking in extension. Stereo images were overwide, poorly focused and showed no depth while colorations abounded — 'wardrobe', 'wooden', 'boxy', 'nasal', 'cuppy', 'hollow', 'leaden' and 'boomy' were among the panel's comments.

Lab results

As promised, sensitivity was high at 90dB/W which with up to 50W of peak input could give pretty loud 105dB sound levels. Pair matching was mildly suspect above 1kHz (see dotted curve for second enclosure) the speaker showing a boomy bass rising 3dB at 80Hz before falling to a satisfactory -6dB point at 51Hz.

At 2metres the smoothed axial response was surprisingly good but at 15° above axis the curves were poor, with a severe dip at 2.5kHz. The lateral off-axis responses were also weaker than average and the bass hump remained. Measured at 96dB the third harmonic distortion below 1kHz averaged 0.4% while second rose to 2% below 1kHz. At 86dB third harmonic changed little but second did improve greatly averaging 0.8% at the lower frequencies.

Room averaged response was really quite promising from 200Hz to 10kHz although it was overextended above that level and showed a pronounced boom at 80-120Hz, plus a rapidly falling bass output below 50Hz.

The *Kossfire* qualifies as a true 8ohm speaker, its impedance never falling below

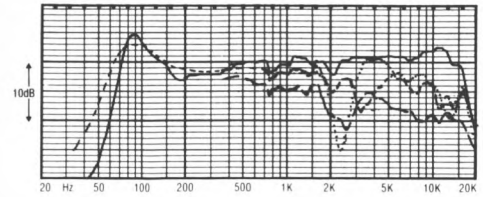
6.2ohms, and consequently it was a very good amplifier load.

Summary

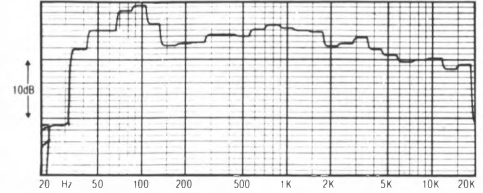
I am sorry to say that in my opinion the *Kossfire* is not a speaker offering hi-fi sound quality. Its design and construction reminded me of certain now defunct radiograms of the '60s, and the 'hi-tech' appearance under the grille is certainly misleading in so far as the audible quality of the product is concerned — a speaker which is greatly overpriced in terms of its subjective performance. It gives me little pleasure to have to make such a negative product report. I can only hope that the Koss Corporation in the States will take a more serious interest in the sound quality aspects of speaker design in the future, and hope for better things when the next *HFC* comes around.

GENERAL DATA

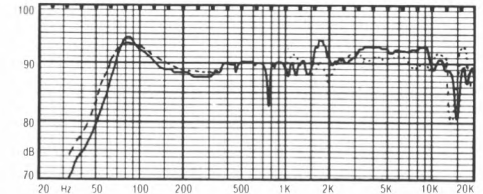
Size (height x width x depth)	58.5 x 35.5 x 27cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres)	(10)—50W
Recommended placement	stands
Frequency response, within ±3dB, at 2 metres	70Hz to 16kHz
Low frequency rolloff (-6dB point) at 1 metre	51Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre)	90dB/W
Approximate maximum sound level (pair) at 2 metres	105dB/A
Impedance characteristic (ease of drive)	very good
Forward response uniformity	poor
Typical price per pair, inc VAT	£190



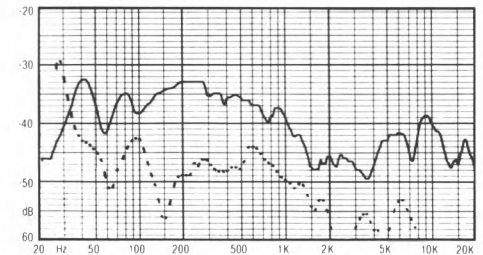
Forward characteristic response (1/3 octave at 2m, dotted 15' vertical, small dash 30' lateral, long dash 45' lateral).



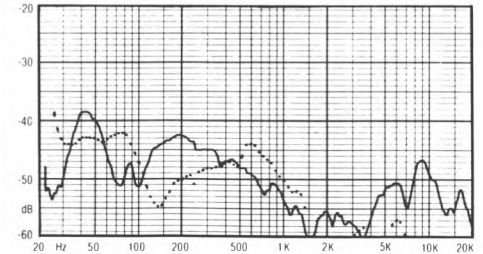
Averaged forward characteristic response in room at listening position.



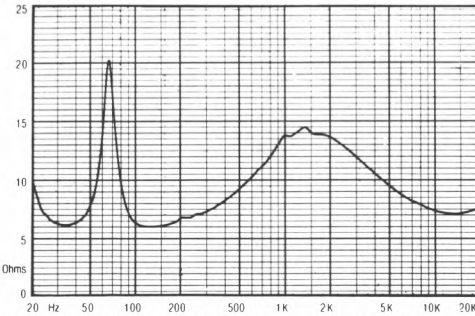
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



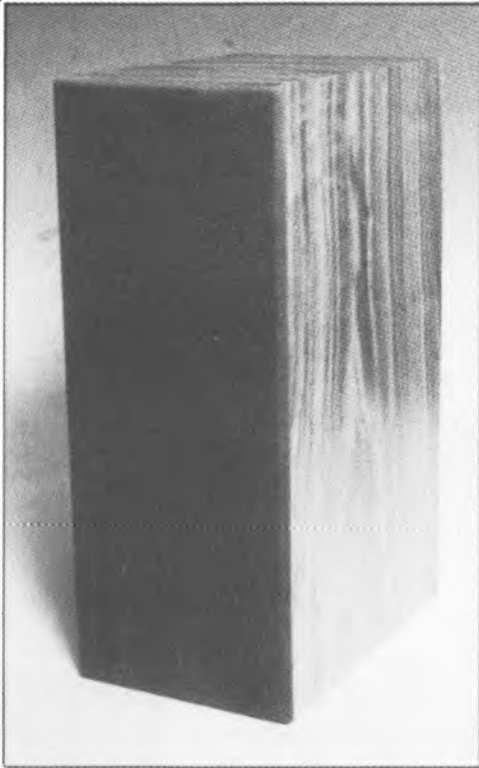
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Lentek S5

Lentek Audio Ltd., Edison Road Ind. Est, St. Ives, Huntingdon, Cambs. Tel (0480) 62225



Known for their conscientious attention to detail and finish, as well as no-compromise attitude to design, Lentek have come up with their interpretation of the classic stand-mounted two-way reflex system. A low coloration design, the S5 is larger than usual at close on 50 litres internal volume. The thinwall double-veneered chipboard cabinet is heavily damped by internal bituminous cladding plus a top quality acoustic foam lining. The generous port is 75mm in diameter backed by a 180mm long duct. Despite its volume the S5 is comparatively narrow, but when seen side-on the depth is considerable. It is superbly finished on all surfaces with a fine American walnut veneer, and a matching solid wood stand is also available.

Two proven drive units are used, the bass/mid is a 200mm Bextrene large magnet long throw design from KEF, offering good sensitivity and ideal characteristics for a large reflexed system. As in the S4, the established Audax 25mm soft

dome tweeter is used, in this case a high sensitivity version to give scope for crossover equalisation.

Considerable care has evidently been taken over the crossover, which comprises 13 elements, of which four are damping/attenuating resistors. Lentek claim good power handling for the S5, as well as low distortion which in class and bandwidth broadly supercedes the larger and earlier *Monitor X*.

Lab performance

At 1m the S5 showed an even balance, which is a characteristic hallmark of an accurate design. However Lentek's ± 2.5 dB limits were judged a trifle too narrow, and we needed ± 3.5 dB to contain the peaks and troughs between 2.5kHz and 6.0kHz; this apart, the system met ± 2.0 dB, 60Hz to 20kHz.

The sensitivity was above average at 88dB/W, with a useful bass extension to 44Hz, -6 dB, rolling off slowly to -10 dB at 34Hz. With $\frac{1}{3}$ -octave analysis at a more representative listening distance (2m), the system retained that mild 'lumpiness' in the presence range, and the S5 must be used with the tweeter near to ear level, as the 15° above response shows a 7dB loss at the 3kHz crossover frequency. Overall the lateral off-axis trends were very good.

Somewhat compromising the sensitivity, the impedance rated as an average amplifier load, with a dip to 4.5 ohms, 4kHz, and continued low impedance to 8kHz. Lentek in fact claim a 8 ohm value with a 6.4 minimum, but we cannot endorse this.

Distortion levels were low reflecting the very good power handling, which was exemplified by the bass guitar tests which reached 250W programme. High sound levels of up to 107dBa were possible from a pair, though satisfying results could be obtained using as little as 15W/channel. At 96dB 3rd harmonic was excellent at well below 0.3% down to 150Hz; 2nd harmonic varied from 0.3 to 1.5%, and was also very good, reducing at lower levels. The 500Hz 100W pulse gave a little trouble with 0.3dB compression and 8% 2nd harmonic, but 3rd still held to 0.55%. At 5kHz compression was negligible with 0.8% 2nd, though here 3rd harmonic distortion had increased to a 3.0% level and 5th appeared at 0.8%. Though capable of 250W the last few dB of the dynamic range will in fact show some distortion in the mid and treble.

The room response was not as good as the axial curves might suggest. This is believed to be related in the midband at least to the speaker's narrow width and unusual depth. Two prominences

appeared in the region of 500Hz and 5kHz, though the bass was almost ideally balanced and extended. As with other systems showing deviations in their room-averaged responses, a point of interest was whether any correlation could be made with the listening test results.

Sound quality

Some conflict was apparent in listening test results, for while the live session results were above average they were not outstanding, but the scores on the stereo programme sessions were significantly better.

On the solo live sounds criticism was made of an 'altered' tonal balance in the midrange, with some 'hardness' and attendant 'boxiness'. The treble range could be harsh in the lower registers while extreme high frequencies were deficient. The bass showed good extension with strong reproduction of low bass fundamentals, but with slight 'softness' and overhang.

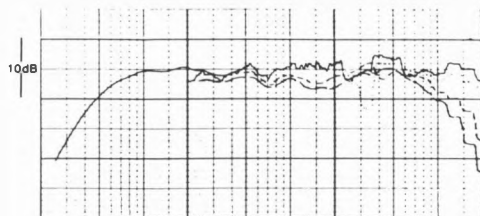
On the stereo sessions the speaker was found to image well with good depth reproduction and a high level of lateral precision. String tone was a trifle 'wiry', and voice slightly 'thin' tonally, with some hardness on piano. Extreme treble was deficient, although this was not judged too serious. Most listeners liked the speaker nonetheless, and felt that it was comparatively neutral, clear and 'powerful'.

Summary

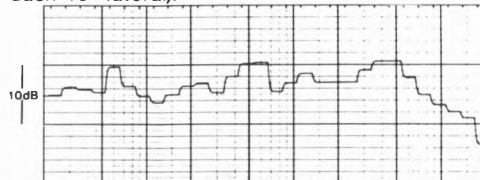
This fairly expensive, substantial and well-finished speaker has a performance commensurate with its price, and meets *Choice's* required standards for recommendation. It offers moderate distortion, good sensitivity, an extended low frequency response, and fine stereo imaging. The choice of amplifier needs some consideration, and the minor idiosyncracies described above indicate that a thorough audition would be worthwhile before purchase.

GENERAL DATA

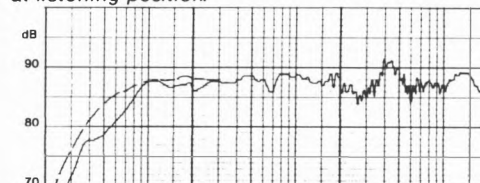
Size (h x w x d)	66 x 26.5 x 41cm
Weight	21.5kg
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(15)-250W
Recommended placement	open stand
Frequency response within ± 3 dB (2m)	64Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	88dB/W
Approximate maximum sound level (pair at 2m)	107dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£380



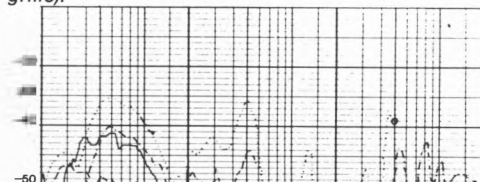
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



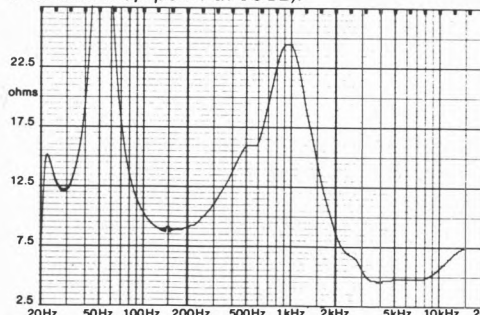
Averaged forward characteristic response in room at listening position.



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).

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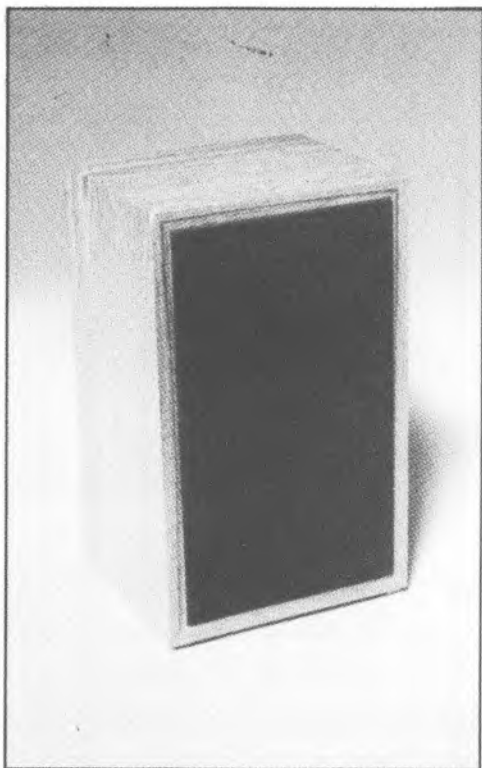


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Linn Kan

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-1 kHz, 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'.

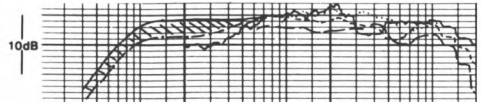
On the special tests with Linn sources the balance did improve a little, and I suspect that a listener impressed by the loudness and clarity of such a small box might well like it enough to buy. With careful choice of programme one can achieve an exciting effect, but the panel still felt that the *Kan* deviated too far from accepted standards of tonal and balance accuracy.

Summary

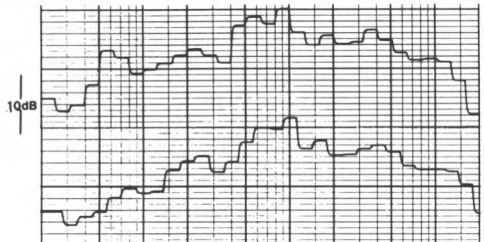
Activation of the *Kan* is now possible (for example using A&R units) and the speaker has undergone some further development since the original review was carried out. Essentially however the performance and design is unchanged, but a small, beneficial improvement has been made to the midrange which 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

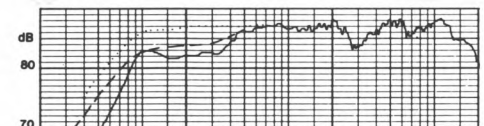
Size (h x w x d).....	30.5 x 19 x 16.5cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum).....	(15)-100W
Recommended placement.....	against clear wall, at or below listener axis
Frequency response within $\pm 3\text{dB}$ (2m).....	130Hz to 16kHz*
Low frequency rolloff (-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	



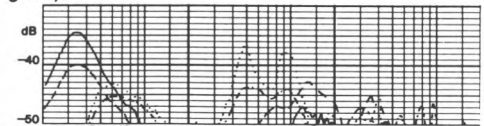
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral). Shading shows possible LF reinforcement of wall mounting.



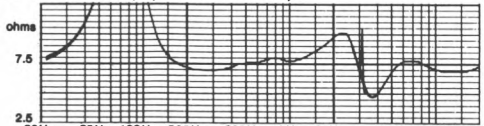
Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



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, \circ 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.

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.

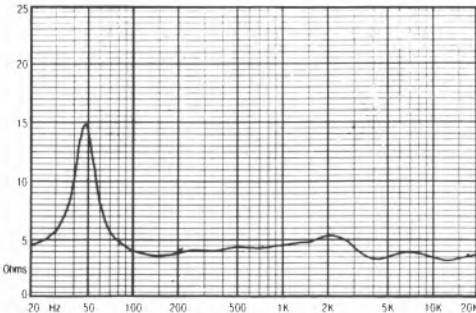
For interest's sake the computed room curve was run with open space as well near-to-wall positioning, the former giving the smoother result, although the latter was in fact better balanced especially around 100Hz.

Summary

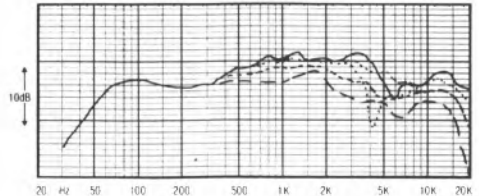
This speaker is an unusual blend of strengths and idiosyncracies. It does not present very good value, and cannot be recommended in the HFC context, particularly if predominantly digital programme is to be used. Conversely it provided a most interesting and generally 'involving' performance with vinyl 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

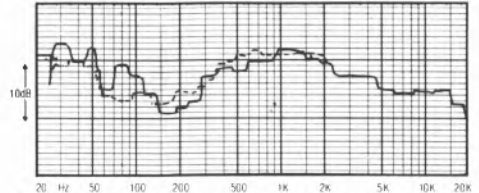
Size (height x width x depth) 43 x 34 x 24cm
 Recommended amplifier power per channel
 (for 96dB minimum per pair at 2 metres) (25)– 100W
 Recommended placement wall stands
 Frequency response, within ± 3 dB, a 2 metres 60Hz to 20kHz
 Low frequency rolloff (– 6dB point) at 1 metre 42Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre) 87.5dB/W
 Approximate maximum sound level (pair) at 2 metres 105dB/A
 Impedance characteristic (ease of drive) severe
 Forward response uniformity very good
 Typical price per pair, inc VAT £552



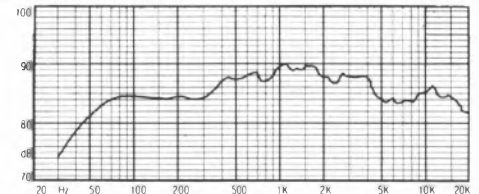
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



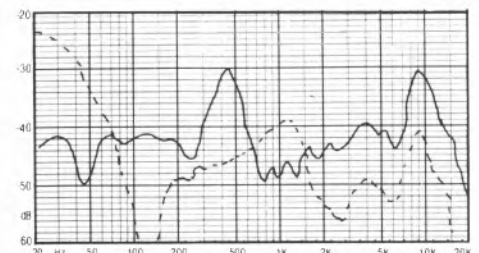
Forward characteristic response (1/5 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



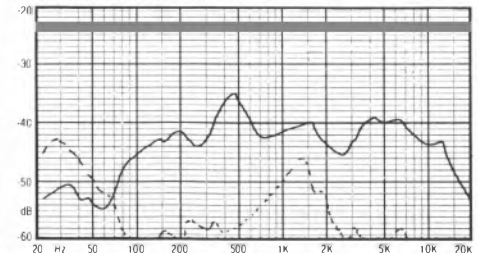
Averaged forward characteristic response in room at listening position.



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).

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 ± 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.

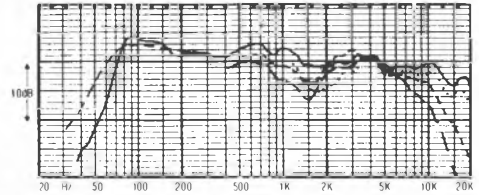
Impedance dipped to 6ohms, at 150Hz, with the typical value nearer 10ohms, and the LD30 was thus quite an easy amplifier load.

Summary

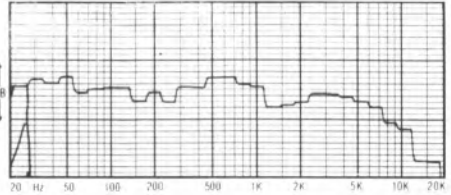
The LD30 is not an entirely neutral sounding speaker and yet it has a character which can make less expensive turntables and amplifiers sound rich and spacious with a relaxed, musical stereo. Digital programme revealed some colorations but none were too serious, and having demonstrated a good standard in most respects, the LD30 can be comfortably recommended.

GENERAL DATA

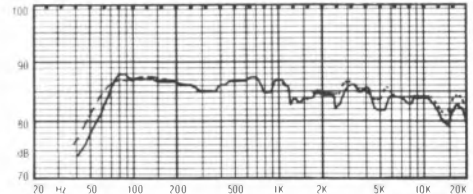
Size (height x width x depth).....	42 x 27 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(20)—100W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, at 2 metres.....	52Hz to 14kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	47Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre.....)	85.5dBW
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



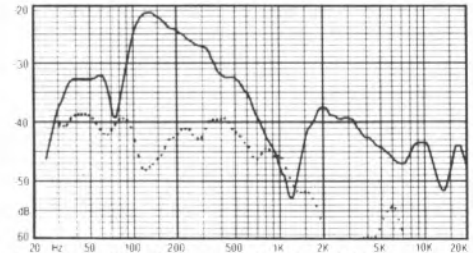
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



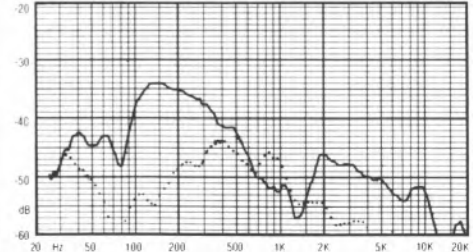
Averaged forward characteristic response in room at listening position.



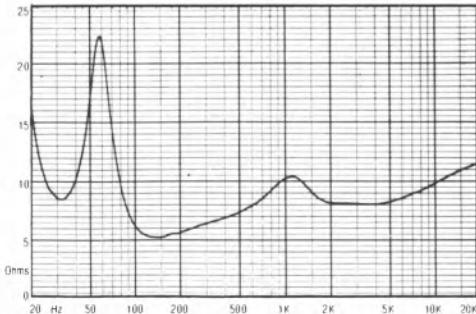
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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.

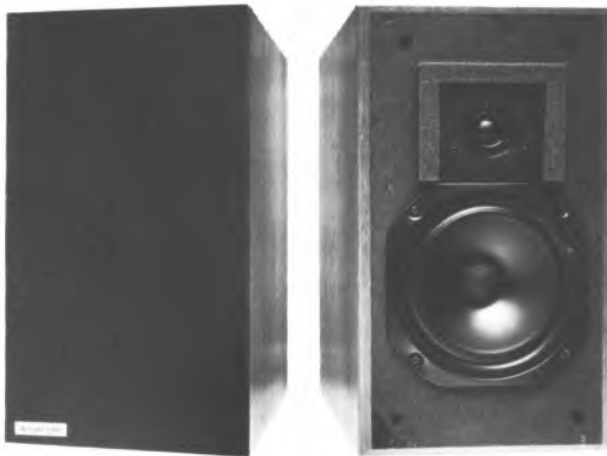
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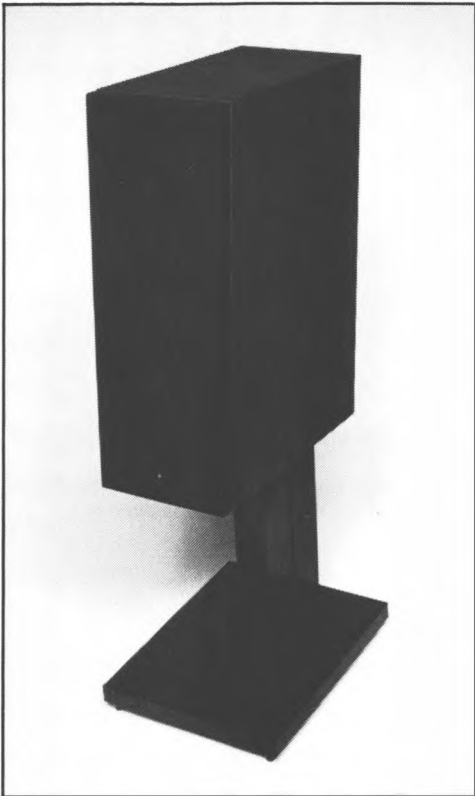
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RECOMMENDED

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 'thundering' 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.

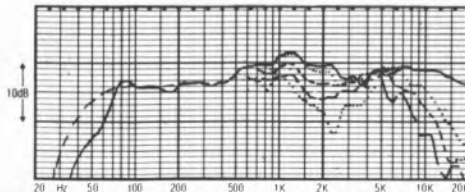
Summary

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.

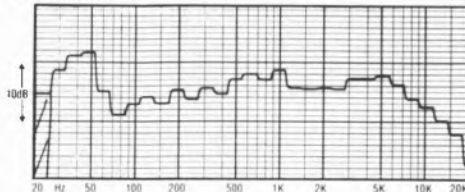
While not entirely neutral, the M2 had many likeable qualities, and gave a 'big speaker performance' from a tidy attractive package, including the sturdy integral stand. Personal audition is recommend, preferably in your own home, but with its sound quality rated in the 'good plus' category the M2 nonetheless achieves recommended status.

GENERAL DATA

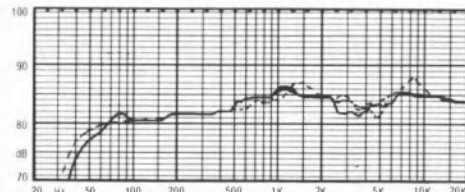
- Size (height x width x depth).....50" x 18 x 38cm
- Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....active
- Recommended placementopen space, on integral stand
- Frequency response, within ± 3dB, at 2 metres60Hz to 20kHz
- Low frequency rolloff (- 6dB point) at 1 metre.....45Hz
- Voltage sensitivityactive, 1V for full power
- Approximate maximum sound level (pair) at 2 metres.....102dB
- Impedance characteristic (ease of drive)active/balanced
- Forward response uniformityfairly good
- Typical price per pair, inc VAT.....£700
- *83cm including stand



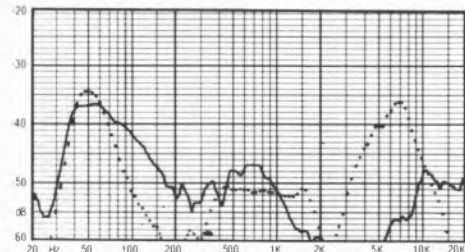
Forward characteristic response (1/3 octave at 2m, vertical, small dash 30° lateral, long dash 45° lateral).



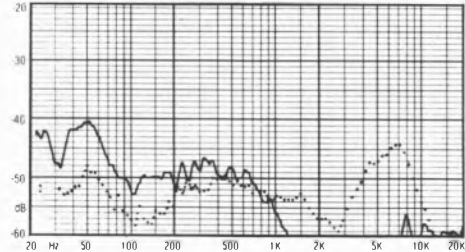
Averaged forward characteristic response in room at listening position.



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).

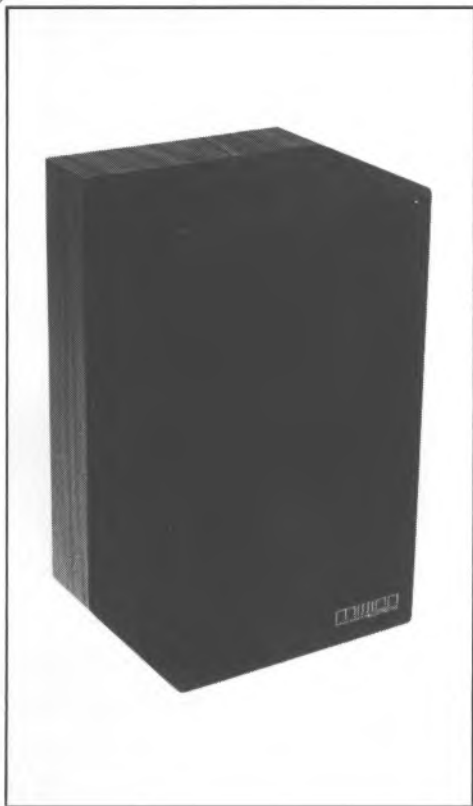


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

BEST BUY

Mission 70

Mission Electronics, Stonehill, Huntingdon, Cambridgeshire
Tel (0480) 57477



The 70 is a diminutive new speaker from Mission, their smallest yet, measuring just 13litres in internal volume. Some early production models were released to the press and dealers but Mission subsequently felt they had acted prematurely, as further development of the model was undertaken; indeed, even after submitting the samples here reviewed further variations and refinements have occurred to the basic 70 theme, which complicate the findings somewhat and gave me a headache! However we believe the measured findings at least give a good idea of the speaker's basic technical performance.

In this two-way sealed-box system, the bass/midrange unit is a shallow paper-coned 160mm steel-framed type with heavy damping coating, and a Vifa 19mm soft plastic dome tweeter covers the treble above 3kHz, this a ferro-fluid cooled and damped driver.

Binding posts incorporating 4mm sockets are used for electrical connection to the hard-wired four-element crossover, which uses high-power components. The cabinet is built of MDF and chipboard panels. The styled front has a deep wraparound cloth section with an integral grille, while the entire rearward section of the cabinet, including the back panel, is covered in wood-effect vinyl. Internally the enclosure is filled with a dense acoustic foam block.

We found the fitting of the two cabinet shells was none too perfect on a couple of samples we had, but understand that this area has now been reinforced inside to prevent splitting of the internal frame.

Sound quality

Earlier samples we received were quite promising, but the following comments relate to the 'final production' samples eventually delivered.

Reasonably good marks were obtained from the listening panel, indicating a 'average plus' rating which was fine at the price. Undoubtedly the 70 had some faults, but none of the criticisms were too serious — though the adjectives boxy, hollow, small, zitty, bright and uneven were all in evidence.

Bass was free of boom and reasonably defined, with the midrange promisingly clear, showing realistic stereo effects on occasion, as well as quite a good tonal balance. The speaker sounded quite open, but at the same time somewhat bright, while the overall treble quality was somewhat grainy as well as uneven sounding. It often sounded more interesting on rock programme rather than on classical orchestras, the overall balance tending to lightness and thinness; a trace more richness would be preferable.

Lab results

Pair matching was judged very good, the system demonstrating an 87.5dB/W sensitivity, which was a little above average. Bass was well damped, possibly even overdamped, falling to -6dB at 60Hz. The effect of the grille could not be judged since it was integral with the enclosure. The available 15-75W power handling capacity produced maximum sound levels of 101dB.

At 2metres (a more realistic measuring distance) the output was fairly uniform, meeting ± 3 dB limits from 80Hz to 20kHz, but it also showed some lupiness around 1kHz and 12-14kHz.

As usual two vertical measuring axes were

tried, namely 15° above and below the median axis. The latter was inferior, suggesting that in use the median position should not be above ear level, but in all other planes the speaker showed excellent off-axis dispersion and linearity.

In the room-integrated response the 'shy' nature of the bass balance was evident, plus a slight 'corner' in the treble around 10kHz; otherwise the result was quite smooth.

At 96dB sound level, distortion was just satisfactory, averaging 1%, and rising to 3% at 200Hz. Reducing the level to 86dB, a general improvement took place, though third harmonic was still average, and had not improved as much as one would have liked.

With a dip to 5ohms at 150Hz, the impedance was still typically 8ohms, and the 70 can thus be considered a good amplifier load.

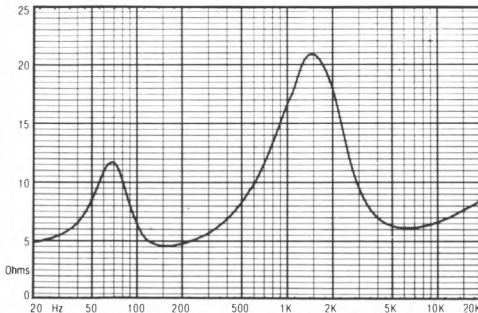
Summary

In view of the possible variation deriving from continuing or future development of this model, I feel I must advise audition at a reliable dealer prior to purchase. With this reservation in mind, the 70 has nonetheless done pretty well on test in view of its price, and must be included in the Best Buy category.

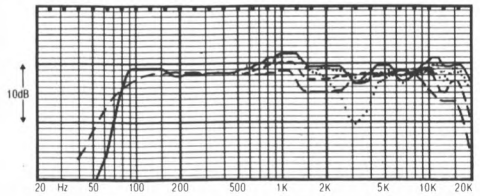
GENERAL DATA

Size (height x width x depth).....	35 x 21 x 21cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(15)—75W
Recommended placement.....	open stands or wall mounting
Frequency response, within ±3dB, at 2 metres.....	80Hz to 20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	.60Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	.87.5dB/W
Approximate maximum sound level (pair) at 2 metres.....	101dBA
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	excellent
Typical price per pair, inc VAT.....	£79

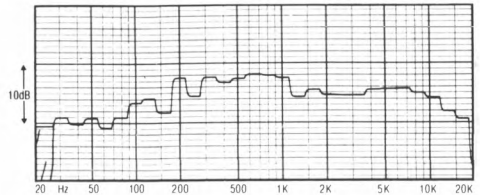
(Note: Readers should bear in mind a price increase to £89, announced as we went to press).



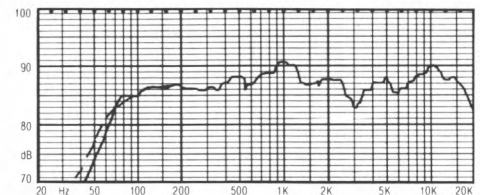
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



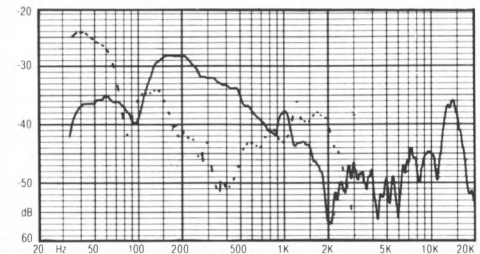
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



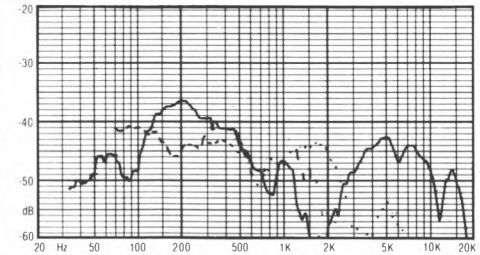
Averaged forward characteristic response in room at listening position.



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).

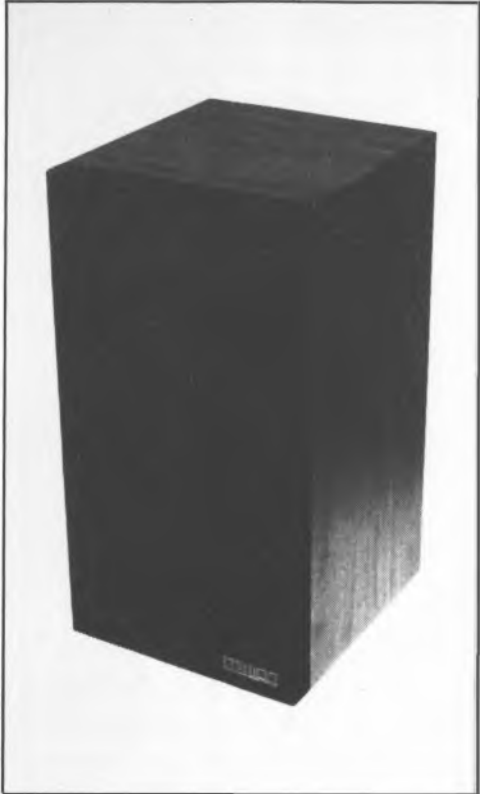


Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).

Mission 700S

Mission Electronics, Stonehill, Huntingdon, Cambridgeshire
Tel (0480) 57477

BEST BUY



The original Mission 700 did well over the past two editions, as indeed it did in the pages of other hi-fi journals. It now carries an 'S' suffix to denote extensive improvement, and now built using the new and better Mission reinforced cabinet with wrap-around grille.

The 700S is a two-way bass reflex design, the port now using the Mission multicellular moulding with a 55mm exit diameter. Internal volume is approximately 22litres, the enclosure tuned to 33Hz with quite heavy damping, and the interior is filled with an acoustically absorbent foam block. MDF is largely used for the construction of the cabinet itself, the exterior walnut veneered.

Bass unit is a Mission-designed 200mm pulp cone unit using a decent-sized magnet system, with the treble allocated to a 20mm soft plastic dome tweeter, ferro-fluid damped and capable of high power handling.

A large reinforced moulded panel is employed for the back connector board, which carries sections internally for various crossover components which are then wired by hand using high quality cable. Decently sized 4mm socket/binding post connections are provided.

Sound quality

The 700S scored a 'good' rating which was impressive at the price. Panelists agreed on its open, lively and transparent character, revealing of programme acoustics and detail.

Stereo staging was also good, and images were well focused with pleasing depth effects. The bass gave moderate extension with good articulation and power handling, and although it was slightly bright and sibilant as regards tonal balance, it was not severely so.

Some boxiness and plumminess was also observed on vocal sections, but not enough to upset the favourable scoring, and it seemed equally well suited to both digital and analogue material.

Lab results

Pair matching was very good, with the sensitivity established at a high 89dB/W, this complemented by a favourable impedance loading. The response was pretty smooth with a -6dB bass rolloff at an average 57Hz with a well damped decline thereafter.

Decent sound levels of up to 104dBA were possible, from the 10-100W power handling capability.

At 2metres the highly uniform nature of this speakers forward response was evident, and in this respect it represents Mission's best effort to date. A mild bump at 10kHz was all that is worth criticising while the off axis curves were exemplary.

From the room response the bass appears well integrated as well as quite extended, if a little shallow in relation to the midrange. The mid/treble was very good but marred slightly by the 10kHz 'corner' — a slightly too sharp rolloff is seen here.

Measured at 96dB spl, good results for second and third harmonic distortion were obtained, averaging 0.8% and 0.3% respectively. Reducing the sound level to 86dB gave a substantial improvement to a fine 0.3% second and 0.3% third.

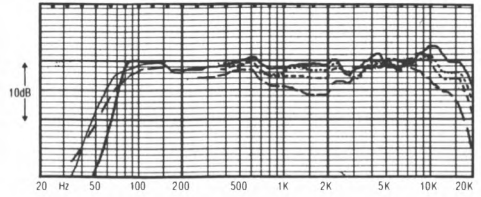
Dipping only slightly below 6ohms at 7kHz, the 700S was in other respects a kind 10ohm average amplifier load which means it easy to drive.

Summary

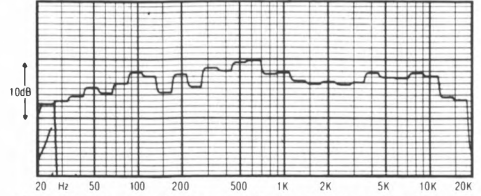
Offering high sensitivity, low distortion and a uniform response together with fine dispersion, the 700S provides a 'kind' amplifier load plus good stereo and overall sound quality, all at a very realistic price. Best Buy listing is comfortably attained here.

GENERAL DATA

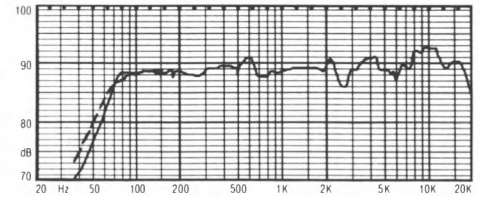
Size (height x width x depth).....	46 x 26 x 26cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10) – 100W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, at 2 metres	70Hz to 18kHz
Low frequency rolloff (– 6dB point) at 1 metre.....	57Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	89dB
Approximate maximum sound level (pair) at 2 metres.....	104dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity	excellent
Typical price per pair, inc VAT	£139



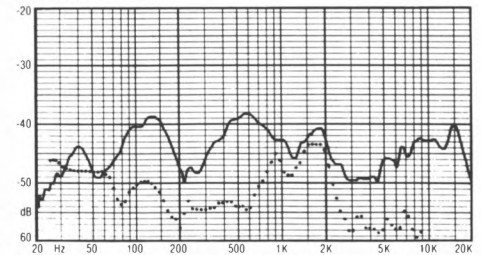
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



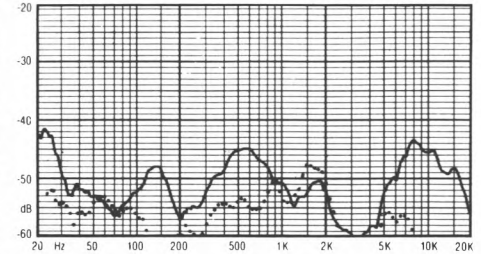
Averaged forward characteristic response in room at listening position.



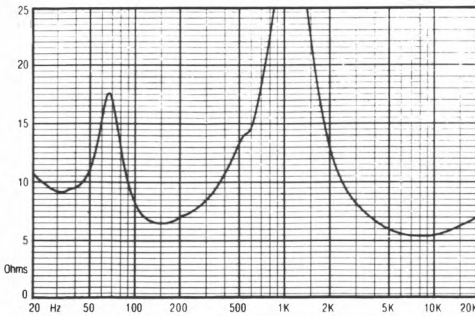
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



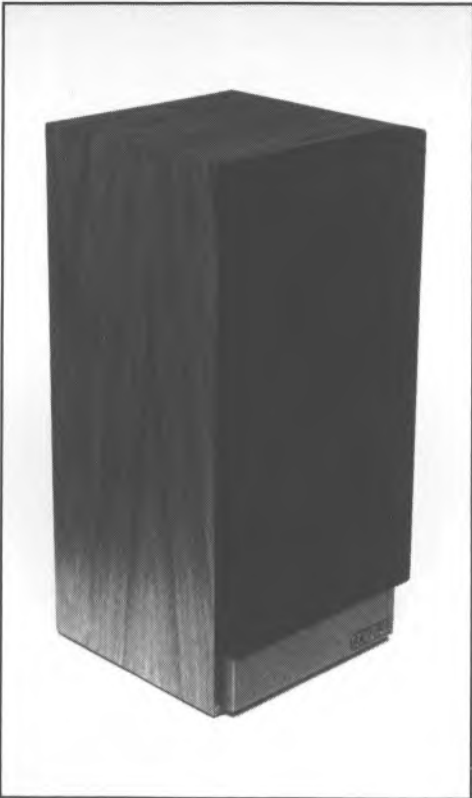
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Mission 737

Mission Electronics, Stonehill, Huntingdon, Cambridgeshire
Tel (0480) 57477



Mission has recently launched a new range of speakers which bears some resemblance to their earlier lines. The new 737, intended as a replacement for the older 727 reviewed in the last issue, also contained elements common to the earlier 770, notably the special Mission polypropylene bass driver — but all at a much reduced cost.

The 737 is a two-way bass reflex design whose internal volume is approximately 24 litres, tuned to 33Hz by a multiholed ducted port 55mm in diameter by 80mm long. This is a moulded structure, cut to various lengths to suit the different Mission systems.

Superbly finished, the enclosure is substantially built of 15mm material, while the impressive hammer-finished and screen printed front panel is made of 20mm MDF stock. A deep but well designed grille fits over the deep front baffle, leaving a styling section exposed below. Inside,

a thin bituminous damping layer helps control panel vibration.

Built on a universal mounted panel the crossover is hardwired using good cable, and comprises five high-power elements. Electrical connection is via 4mm socket/binding posts.

Bass and midrange is handled by the established Mission high power, cast-frame 200mm polypropylene driver and for this new model the treble is allocated to the ubiquitous Audax 25mm soft dome.

Sound quality

Despite its promising appearance, when auditioned 'blind' the 737 proved to be a distinct disappointment, falling below the level of performance we remember from its 727 predecessor.

It ranked rather below average, which is poor at the price, and it was also found to deliver a weak stereo performance. Images seemed localised at the enclosures while ambience and the natural recorded acoustic was suppressed, and depth curtailed.

Noticeable coloration was observed, including dulled, metallic, 'cuppy' boxy and chesty effects, these distinct from the perceived frequency response which the panel judged to be relatively smooth. The performance showed impaired clarity, except in the bass, which was felt to be to a good standard.

Lab results

Demonstrating a fine pair match the 737 sensitivity was just average at 86dB/W. The axial response met quite close limits, but was a trifle lumpy — although the bass was well tuned, free of overhang and extended to 48Hz, -6dB. In conjunction with a wide 20-150W power range, sound levels of up to 103dBA could be achieved in a typical room.

At 2metres the lumpiness in response was more clearly shown and the 15° above-axis response demonstrated a lift above the main response coupled with a mild trough at 8Khz, a rather high frequency for such interaction to occur. The speaker is thus vertically axis-sensitive though the response uniformity in the lateral plane was in the very good class.

Measured by room response averaging, the result was fairly typical and did not explain the general sound, which in the case of the 737 was dominated by coloration and delayed resonance phenomena.

At 96dB third harmonic distortion was very good and second was also encouragingly low at

around 1%. A reduction in sound level to 86dB produced a substantial improvement however to fine low levels of both second and third harmonic.

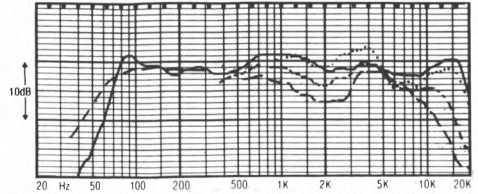
A minor dip in impedance to 5ohms, at 3kHz, was not considered to be too serious, and the amplifier loading was rated as good.

Summary

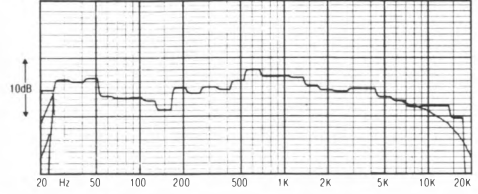
The new 737 cabinet series, despite or perhaps because of its revised design, appears to suffer from increased coloration which has resulted in below average sound quality ratings, and no recommendation is appropriate here.

GENERAL DATA

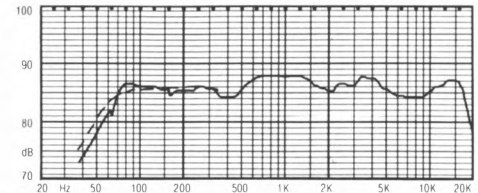
Size (height x width x depth)	54 x 25 x 27cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(20)—150W
Recommended placement	stands
Frequency response, within ± 3 dB, at 2 metres	60Hz to 18kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	48Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	86dB
Approximate maximum sound level (pair) at 2 metres.....	103dBA
Impedance characteristic (ease of drive)	good
Forward response uniformity	very good
Typical price per pair, inc VAT.....	£240



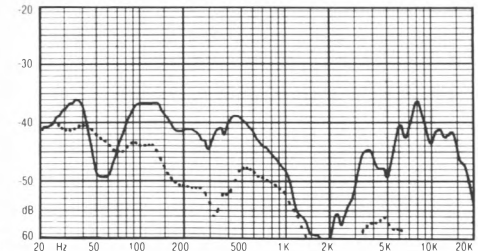
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



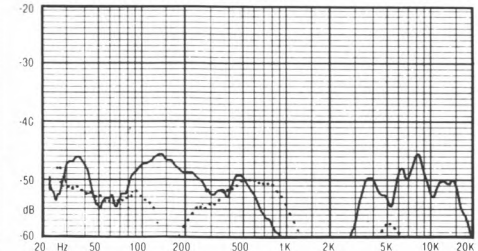
Averaged forward characteristic response in room at listening position.



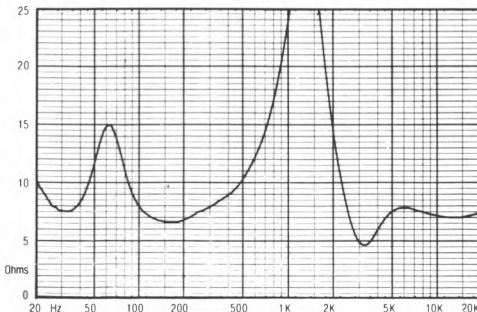
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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.

Mission 770S

Mission Electronics, Stonehill, Huntingdon, Cambridgeshire
Tel (0480) 57477



This new 770S, at a more competitive price than its predecessor, in fact bears little resemblance to the previous 770 model, sounding and measuring rather differently.

As with the 737, a thick 20mm MDF front panel is fitted, finished in an elegant silver-hammer paint and screen printed with the company logo. In this bass-reflex design, the speaker's 30litre internal volume is tuned by a short, multi-hole port, (55mm equivalent diameter), 25mm deep. The bass unit is a special design built for Mission by Saire, using a die-cast frame and a generous motor. In fact from the test result one might accuse it of having too much magnet! It uses a deeply flared synthetic cone with radial ribs, the basic frame size being 200mm. A 25mm soft plastic dome tweeter, ferro-fluid damped, complete the lineup.

Crossing over at around the usual 3kHz, the

network is a very high power type, using excellent components — plastic film capacitors etc. — all hardwired using thick cable. 4mm socket/binding posts are used for electrical connection.

Plastic recesses are fitted to the base of the superbly veneered enclosure to accept matching studs on the special Mission speaker stands.

Sound quality

Scoring more highly than the 737s on the blind listening tests, the 770 achieved an 'average' rating, but in truth this was uninspiring in view of the price level.

As with the 737, the speaker suffered from noticeable coloration, this including metallic, boxy, 'middy', nasal, recessed and pinched effects on voice. Such effects are known to degrade stereo imaging performance, and indeed the stereo perspectives were felt to be flattened with a loss of ambience and space, as well as a less well defined central focus.

Tonally speaking, the overall balance was rather dry, with the lower bass registers too severely attenuated, but the upper bass range was considered quite good with promising detail. Somehow the system was weak on the subtler aspects of the music but it could punch out a rock track in a loud and lively manner.

Lab results

As with the other Missions we have reviewed, pair matching was judged very good, and checks showed that the grille exercised a negligible effect on the sound response.

An interesting aspect of the frequency response result was that the trace showed a large-radius curvature over the whole range, contributing to the 'middy' effect we heard. Bass was rather overdamped with the -6dB cutoff at 59Hz, rather higher than usual for the type. Sensitivity was above average at 88.5dB/W and in conjunction with the high power handling of 200W per channel, will provide high sound levels of typically 106dBA per stereo pair.

Out at 2metres the rounded shape of the response curve continued, but in a more obviously lumpy manner. In the vertical plane the + and - 15° axes were tried, showing some variation, the response taken below the median axis being the better one. This implies tilting up the speaker and/or using a fairly high stand. The 770's output only just met ± 3 dB limits and the forward integration was not particularly impressive.

By room-response averaging, the bass was better extended than expected, but shallow compared with the mean midrange level. The characteristic was rather lumpy overall, though correctly shaped in the upper treble.

Measured at 96dB, good distortion results were obtained averaging 0.7% second harmonics and 0.3% third, and even better results were shown with the level reduced to 86dB

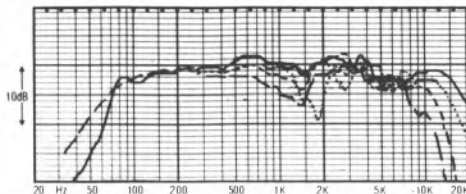
The impedance curve illustrated the system damping by the small variation at low frequencies. Impedance varied strongly at higher frequencies, dipping almost to 3.5ohms at a peak power point, 2.2kHz, making it a fairly difficult amplifier load.

Summary

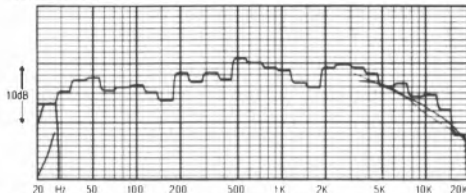
The new 770S is a well-built and well-finished loudspeaker, which offered a rather average overall performance both subjectively and objectively judged. In its favour, it proved capable of high sound levels at low distortion, but is not very easy to drive and also suffers from some coloration. However it could be worth trying for high level rock programme duty, particularly if tight bass is considered important.

GENERAL DATA

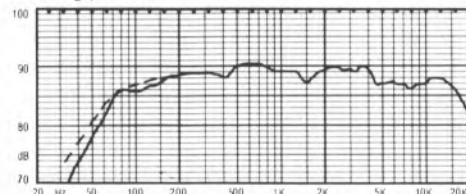
Size (height x width x depth).....	61 x 27 x 30cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(15)—200W
Recommended placement	stands (Mission optional)
Frequency response, within ± 3 dB, at 2 metres	80Hz to 17kHz
Low frequency rolloff (-6 dB point) at 1 metre	59Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	88.5dB
Approximate maximum sound level (pair) at 2 metres	106dBA
Impedance characteristic (ease of drive).....	difficult
Forward response uniformity.....	good
Typical price per pair, inc VAT	£330



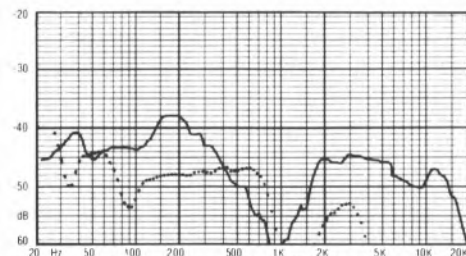
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



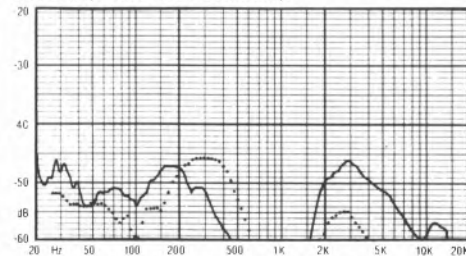
Averaged forward characteristic response in room at listening position.



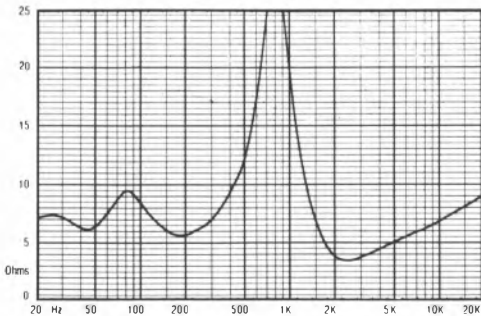
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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.

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RECOMMENDED

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 ± 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 86dB level, with an average of 0.3% recorded here.

Bar a mild dip to 5.5ohms at 10kHz, the

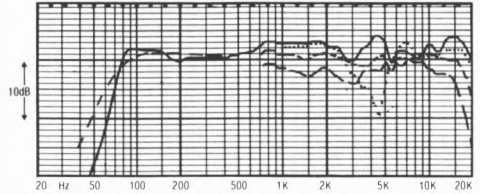
impedance was well behaved over the range, and the R252 was classed as a good amplifier load.

Summary

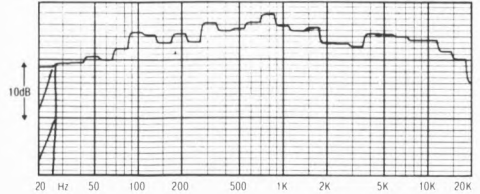
For the price this powerful two-way design is unusually well finished and constructed. It possesses low distortion, a usefully high sensitivity and quite a good standard of sound quality in its latest form. It comfortable attains recommendation, and in addition to open stand mounting, its size indicates that shelf mounting would also be a possibility.

GENERAL DATA

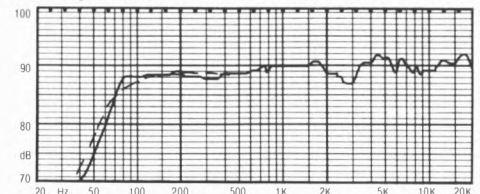
Size (height x width x depth).....	47 x 25 x 24cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—75W
Recommended placement	
Frequency response, within ± 3 dB, at 2 metres	80Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	62Hz
Voltage sensitivity (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.....	£99



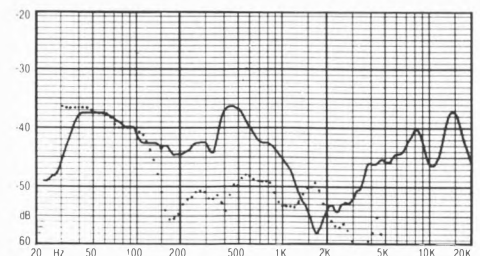
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



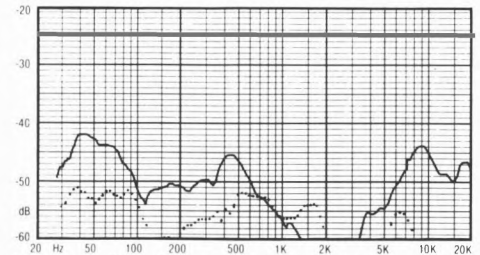
Averaged forward characteristic response in room at listening position.



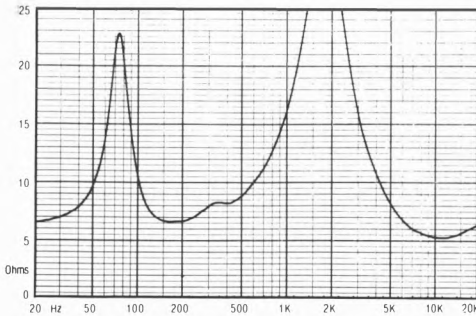
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



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

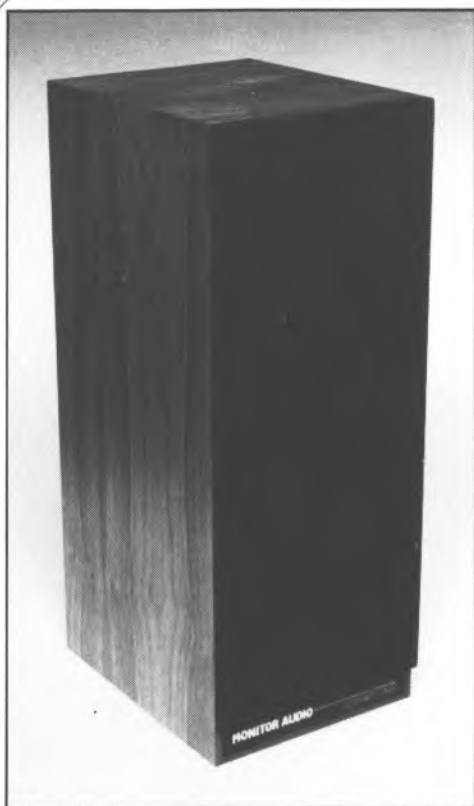


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

BEST BUY

Monitor Audio R352

Monitor Audio Ltd, 347 Cherry Hinton Road, Cambridge CB1 4DJ
Tel (0223) 42898



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. ±3dB 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.

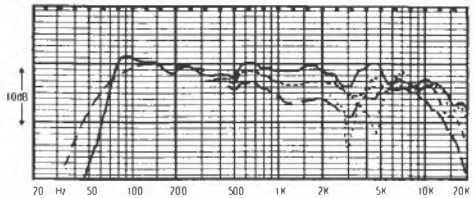
Impedance averaged 12ohms and possessed no injurious low levels at any frequency, so the 352 should be particularly easy to drive, and as such presents a 'kind' amplifier load.

Summary

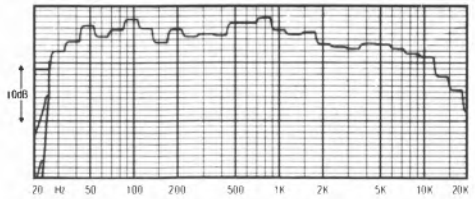
This well-finished and constructed speaker provides a sound quality and engineering performance that only a few years ago was expected of models costing twice as much. It is sensitive, low in distortion, accurate in balance and predominantly faithful to the programme fed it, and it will also provide 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

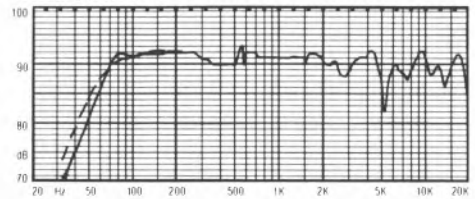
Size (height x width x depth).....	64 x 25 x 32cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10) — 100W
Recommended placement.....	stands (Monitor Audio optional)
Frequency response, within ± 3 dB, at 2 metres.....	55Hz to 15kHz
Low frequency rolloff (-6dB 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 uniformly.....	average
Typical price per pair, inc VAT.....	£150



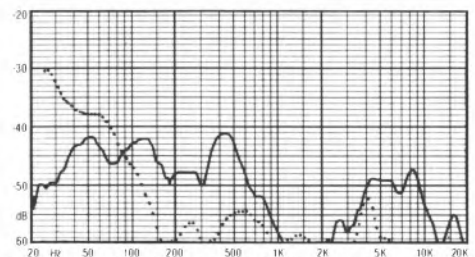
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



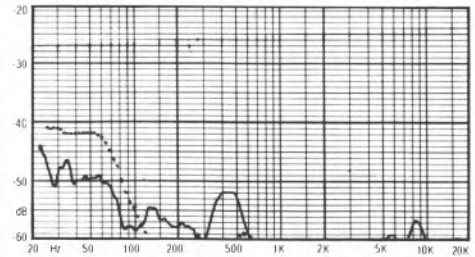
Averaged forward characteristic response in room at listening position.



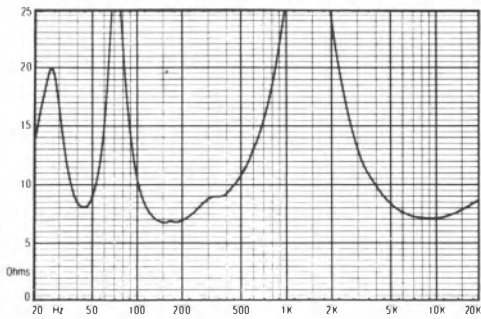
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



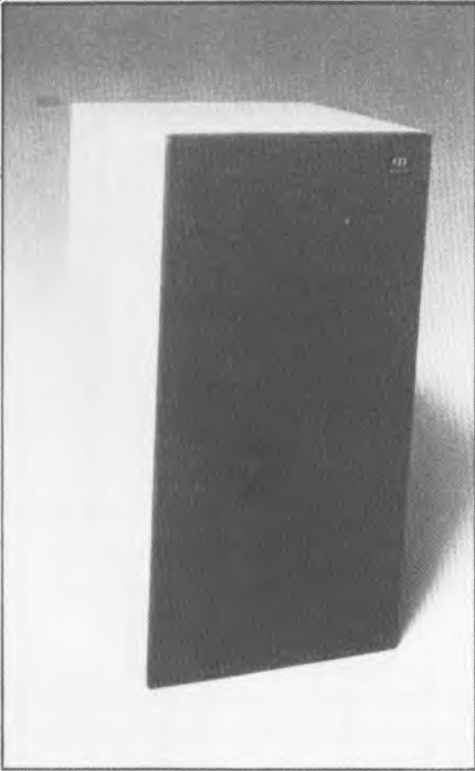
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Monitor Audio MA66

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



During the last twelve months, the successful MA6 II has been superseded by a new MA66 model. This owes a lot to its predecessor, and retains the same mid and treble units, namely a 25mm grille-protected Audax soft-dome tweeter, and an exclusive 200mm unit from Dales which uses a lightweight flared pulp cone, and a nitrile surround damped by applied visco-elastic coating. The internal volume remains unaltered at 33 litres.

Obvious differences concern the driver panel, where the original ducted port has been replaced by a very long throw 200mm ABR (auxiliary bass radiator), fitted with a dense and inert bextrene cone. The bass driver resonance occurs at 63Hz and the ABR is tuned to 33Hz. Internally the cabinet damping has been upgraded to incorporate bituminous panel cladding, with the internal absorption including both a thick polyurethane foam lining plus a polyester volume filling. The grille frame is quite open, and

is effectively rebated on its inside edge to reduce diffraction effects in the treble.

Nominally placed at 3.5kHz, the crossover employs 8 elements including two damping attenuator resistors, and the components are made to a high power rating. Externally the system was finely finished in a real light oak veneer of unusual quality. Electrical connection is via the usual 4mm socket/screw terminals, recessed to avoid damage.

Lab performance

The reference sensitivity was just about average at 86dB/W, with useful bass extension to 42Hz, -6dB. Although the low frequency range was generally well balanced, it was elevated by some 2dB referred to the rated sensitivity.

At 2m the $\frac{1}{3}$ -octave characteristic made the basic trends more obvious. The overall forward off-axis response was very well controlled, though with a slight mid prominence around 1.2kHz and a shelf elevation in the treble. A shallow depression was present in the 300 to 700Hz region, while at lower frequencies a definite tendency to bass 'richness' was present. Despite these comments, a wide 50Hz to 20kHz range could be encompassed within +/-3dB limits.

With a 100W maximum power input suggested by the tests, this speaker was capable of a moderately loud 101dBA for a pair in a typical room, with 20W as the recommended minimum. 100W pulsed inputs were effectively dealt with, the speaker showing little compression, and at both 500Hz and 5kHz test frequencies a 2nd harmonic level of around 2-5%, and a 3rd harmonic level of 0.5-0.8% were obtained. Steady state measurement gave good results, with negligible 3rd harmonic until frequencies below 100Hz were reached, and even here results were not unacceptable. The response curve shows small regions of second harmonic generally less than 1.0%, and of little significance. Comfortably meeting the 8 ohms specification, the '66 possessed a minimum impedance of 6.7 ohms and rated as an easy amplifier load.

The room response perhaps gives a better idea of what the panel actually heard. The bass prominence below 100Hz is unmistakable, notwithstanding the dominant room mode at 60Hz. Above 100Hz the trend met +/-2.5dB limits to 8kHz, and demonstrated a rather fortunate interaction with the room when stand-mounted clear of walls as intended. The treble range rolled off smoothly in the preferred manner.

Sound quality

The bass was considered cleaner and deeper than the MA6, showing fairly good fundamentals plus an ability to play quite loud. The panel noted some criticisms as regards balance and distortion on the live sound comparisons, but they nevertheless awarded surprisingly high marks. On speech some 'chestiness' was noted, while the treble sounded a little 'exposed' and 'sibilant', with mild 'boxy' and 'nasal' effects also present.

On the recorded programme the 66 still did very well, and the midrange was particularly liked. A mild unevenness in balance was recognised, together with a touch of excess bass, but the overall effect was well above average. Some loss of clarity and stereo depth were apparent, and with a 'tighter' bass plus 'sweeter' treble this model could have rated very highly.

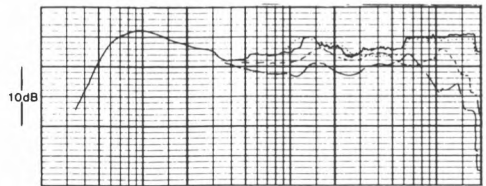
Summary

The MA66 did well a few years ago considering its realistic price, and was well suited to analogue derived programme. However using digital material, the mild idiosyncrasies of the balance are likely to be more noticeable to the user, as regards the mildly sibilant, somewhat exposed upper treble, as well as the bass prominence.

We nonetheless feel that a continued recommendation is deserved for this, a substantial piece of well finished speaker engineering for the price. We also briefly auditioned its new companion the R152 and feel that the latter represents a worthy successor to the '66, which in time it will probably supplant.

GENERAL DATA

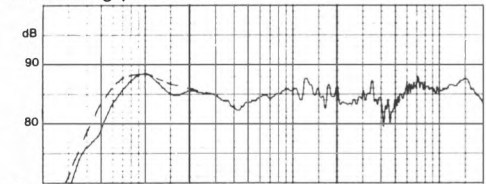
Size (h x w x d)	58 x 30 x 29cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(20)-100W
Recommended placement	stand, clear of walls
Frequency response within ± 3 dB (2m)	50Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	42Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	86dB/W
Approximate maximum sound level (pair at 2m)	101dBA
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good
Typical price per pair	Price estimated at time of review as £180, now £212 including VAT



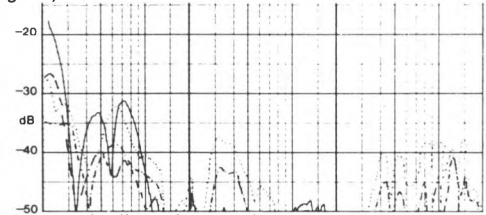
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



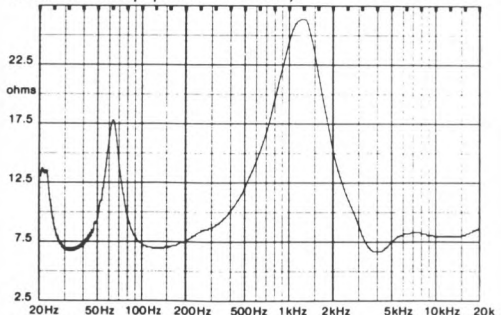
Averaged forward characteristic response in room at listening position.



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).

BEST BUY

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.

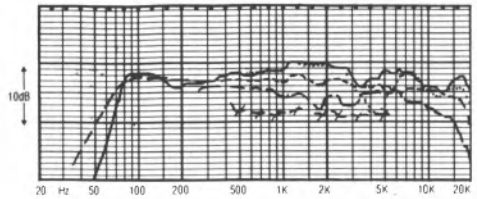
The integrated room response was most revealing, showing the midrange forwardness, plus a surprisingly extended, slightly 'shy' bass as well as a treble which uniformly decayed with the right curvature.

Summary

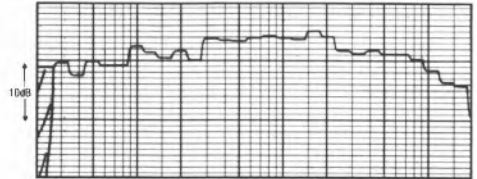
This speaker produced a remarkably good performance for the price. Slightly upper-mid forward, in all other respects it offers a finely-balanced array of subjective and objective qualities, which made Best Buy classification mandatory. Subsequent experiments with the MS20 have shown that if well positioned it can do justice to very costly ancilliary equipment and in a very real sense must be said to be one of the outstanding successes of this edition.

GENERAL DATA

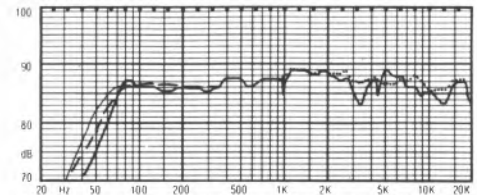
Size (height x width x depth).....42 x 25 x 20cm
 Recommended amplifier power per channel
 (for 96dBA minimum per pair at 2 metres).....(15)—75W
 Recommended placement open stands or shelf
 Frequency response, within ± 3 dB, at 2 metres65Hz to 20kHz
 Low frequency rolloff (-6 dB point) at 1 metre.....55Hz
 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 uniformly.....good
 Typical price per pair, inc VAT.....£89



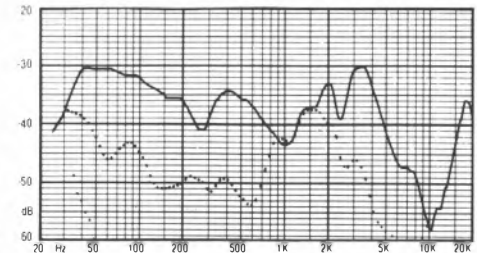
Forward characteristic response ($1/3$ octave at 2m, dotted 15° lateral, small dash 30° lateral, long dash 45° lateral).



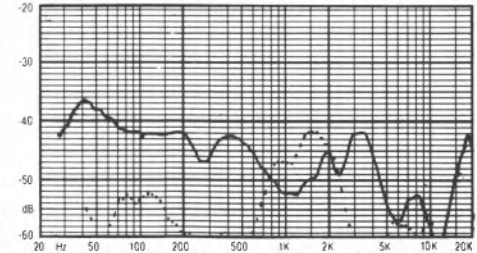
Averaged forward characteristic response in room at listening position.



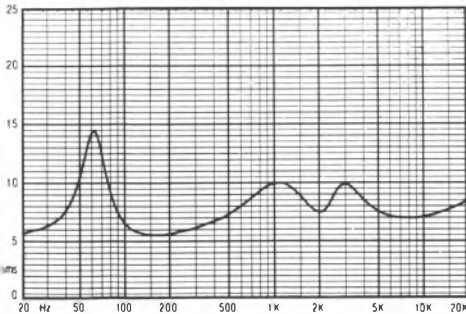
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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 cone/dome 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

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.

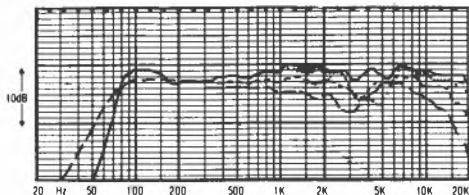
Summary

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

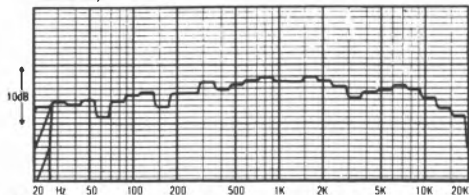
treble register, and how this affects the end result may well depend on the programme source — a 'duller' sounding moving magnet cartridge could also be beneficial here. However despite our reservations, the speaker has nonetheless done well enough to merit recommendation.

GENERAL DATA

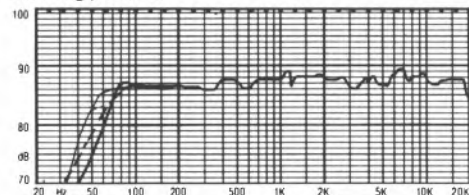
Size (height x width x depth).....42 x 25 x 20cm
 Recommended amplifier power per channel
 (for 96dB minimum per pair at 2 metres).....(20)—100W
 Recommended placement.....open stands
 Frequency response, within ± 3 dB, at 2 metres65Hz to 20kHz
 Low frequency rolloff (-6 dB point) at 1 metre.....54Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....87.5dB
 Approximate maximum sound level (pair) at 2 metres103dB
 Impedance characteristic (ease of drive).....very good
 Forward response uniformity.....very good
 Typical price per pair, inc VAT.....£130



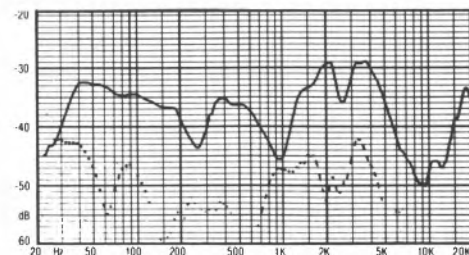
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



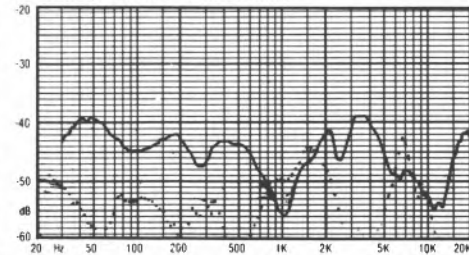
Averaged forward characteristic response in room at listening position.



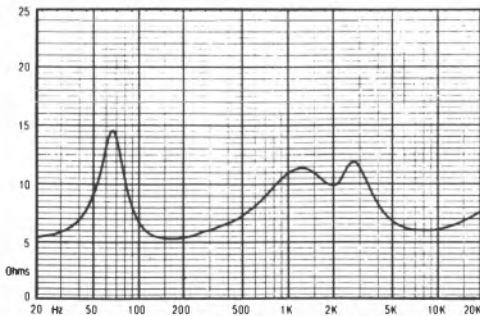
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF



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



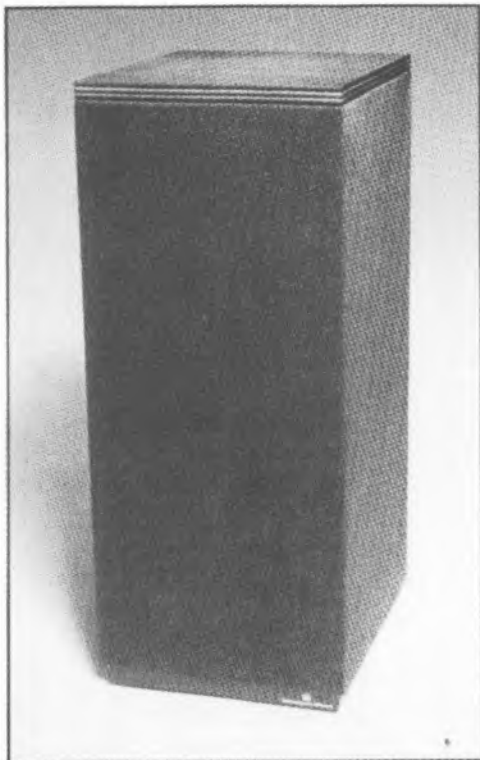
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Mordaunt-Short Pageant 3

Mordaunt-Short Ltd., Durford Mill, Petersfield, Hants. GU31 5AZ Tel (073 080) 721



After a long run the *Pageant* has now been updated to *Mark III* form – a wise move in view of the speaker's reputation, but a confusing one, since the *III* is more of a redesign than a revamp, and is entirely different from its predecessor. The latter was a two-way system, but now three drivers are used in a larger more expensive box which looks quite different. This time Mordaunt Short are using the 'soft furnished' look, the slim form of the *III* covered on all sides by a sleeve of textured material, with the end caps teak veneered, rather in the manner of the KEF *Concord/Celeste* series. In many rooms they do appear less obtrusive than conventional systems.

The internal volume of 25 litres is reflex-tuned to 26Hz by a twin port system, each of which is 43mm in diameter and 150mm deep, and the driver resonance occurs at 68Hz. Built of 15mm chipboard, the designer has abandoned damping in favour of extensive internal bracing to re-

inforce the enclosure, and a polyester fibre filling provides internal absorption.

A vertical-in-line system, the bass is handled by Mordaunt Short's *DS208* 200mm driver, derived from the *Pageant series 2*, and comprising a rigid pulp cone unit of good performance. A modified Audax 100mm unit covers the midrange, and the treble is allocated to another Audax unit, this time a ferrofluid 12mm cone/dome. All three are integrated by a fine quality 12-element crossover operating at 750Hz and 4000Hz.

Lab performance

Good pair matching was shown, with a fine 1m axial frequency response giving a typical ± 2.5 dB 48Hz–20kHz. The rated sensitivity was about average at 86dB/W, and bass extension was good for the size at 41 Hz, -6 dB.

The forward characteristic response showed excellent consistency and integration, plus a promisingly uniform frequency balance under $\frac{1}{3}$ -octave averaging, namely ± 2.0 dB, 55 Hz–20kHz. Best on axis, the speaker will be available with matching pillar stands to maintain the correct listening height.

Rated at up to 100W programme, the 500Hz pulsed power input was just beginning to overload the system with 1.2% 2nd and 1.8% 3rd harmonic. At 5kHz 3rd harmonic was much improved to 0.7%, with 2nd at 2.5% (a moderate value). The steady state distortion graphs reflected a more complex picture: at 96dB, 3rd harmonic was satisfactory at an average of 0.4–0.8%, while 2nd measured double this and showed a distortion peak in the treble unit at 15–16kHz, reaching 8.0%. Low frequency distortion was quite good, but interestingly over most of the range the distortion did not improve greatly at reduced power. It should be noted that the *III* did meet spec, except above 14kHz.

With a 100W maximum input, high sound levels of 105dBA can be achieved from a pair, with 20W suggested as a sensible minimum.

Assessed by room averaging, with the exception of a mild and partly room-induced excess at 60Hz, the result looked extremely promising, with a near perfect mid balance and a well controlled smooth rolloff towards the highest frequencies. Decent output was still present down to 40Hz. Specified at 8 ohms, the *III* just failed the test by dipping to 5.8 ohms, 150Hz, although this is comparatively harmless, and the amplifier rating is still good.

Sound quality

This speaker performed better on the recorded

than the live tests. On the latter some colorations were noted: a 'tube' effect in the mid, plus a degree of 'edginess' and 'sibilance' in the treble, not apparent from the response graph. The bass register proved powerful with fair depth extension, but some 'nasality' and blurring of definition were also noted, and the overall score was average in this respect.

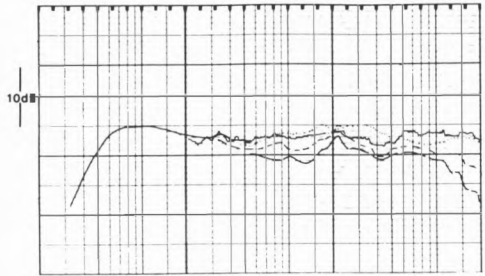
The marks improved significantly on the stereo sessions, sufficient to bring the III into the recommended class. Stereo presentation was well liked, with fine lateral stability and precision plus promising depth, while clarity was good in the midrange, though not quite as good as we would have liked at the frequency extremes. The treble again gave rise to some reservations regarding smoothness particularly on transient sounds, despite the smooth measured response. Overall the frequency balance was pretty well neutral, with the sound fairly open and transparent.

Summary

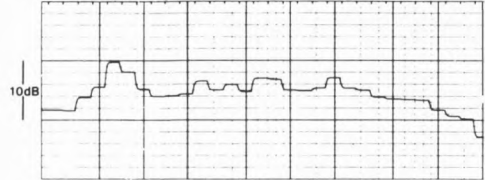
A more recent production sample of this speaker was briefly auditioned for this new edition, and showed marginally higher sensitivity and a slightly brighter, 'thinner' tonal balance than before. It remains a competent three-way design, with good bass extension and smooth, well integrated on- and off-axis frequency responses. The treble was however judged just average, while distortion levels were also a little high. We were not wholly convinced by this speaker considering its price level, but still believe it to be worth considering.

GENERAL DATA

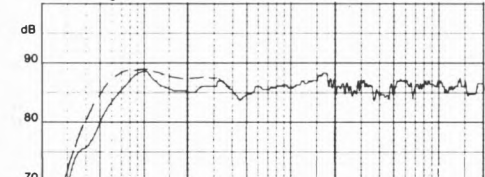
Size (h x w x d)	62 x 26.5 x 30cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(20)-200W
Recommended placement	clear of walls on stand
Frequency response within ± 3 dB (2m)	52Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	41Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	86.5dB/W
Approximate maximum sound level (pair at 2m)	105dBa
Impedance characteristic (ease of drive)	good
Forward response uniformity	excellent
Typical price per pair inc VAT	£290



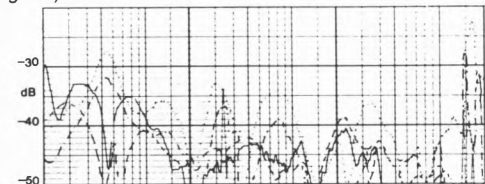
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



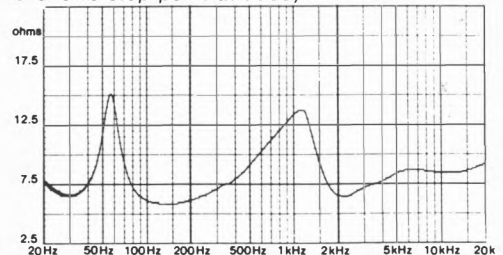
Averaged forward characteristic response in room at listening position.



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).

Quad ESL-63

The Acoustical Manufacturing Co. Ltd., 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 last 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 of around £1000.00 a pair.

A single large-area damped plastic film 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 damped 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 ± 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° 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 –6dB 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 10–100times 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 makes 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.

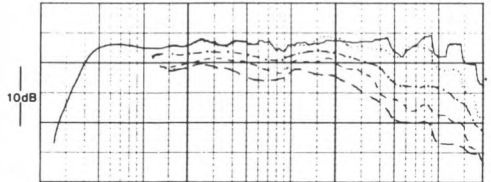
Summary

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.

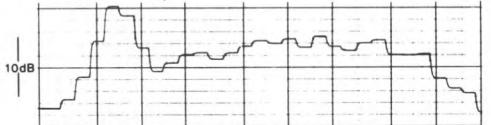
The Quad has uniquely musical qualities through the vital mid registers, and deserves auditioning on high quality material if its blend of strengths and weaknesses are to be fairly assessed by the intending purchaser. The results continue to justify a *Choice* recommendation despite the elevated price.

GENERAL DATA

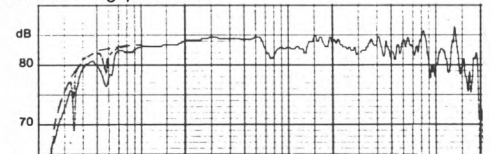
Size (h x w x d)	93 x 66 x 27cm
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	(25)-100W
Recommended placement ... on open stand, well clear of rear wall	
Frequency response within ± 3 dB (2m)	40Hz to 18kHz
Low frequency rolloff (-6dB) at 1m	34Hz
Voltage sensitivity (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 £1150
*see text	



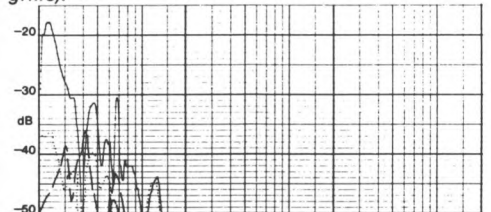
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



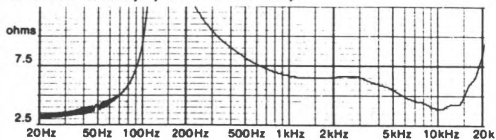
Averaged forward characteristic response in room at listening position.



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).

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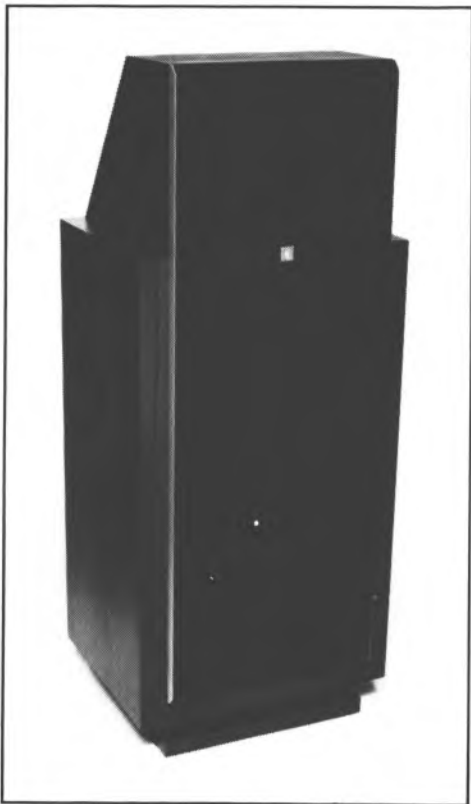
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Revox Symbol

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Tel 01-953 0091



The Revox *Symbol* is a massive and costly floor standing system, somewhat reminiscent of the now discontinued but long-lived Celestion *Driton 66*. In fact the basic lineup of the two is very similar, comprising a 300mm ABR (auxiliary bass radiator) plus 300mm die-cast frame pulp cone bass/midrange, a 55mm soft dome midrange and a dome tweeter — a 19mm unit in the case of the Celestion and a 25mm driver in the *Symbol*. Both are fairly sensitive systems, with a big power handling capacity of around 200W per channel in the case of the Revox.

The *Symbol*'s ABR has a flat diaphragm, and was found to be susceptible to several resonance modes, and a further series of unfortunate resonances were also identified in the metal protective grilles covering the mid and treble units.

A good-quality crossover comprising 15 elements plus five resistors divides the frequency

ranges, and also carries protection in the form of a thermistor plus a magnetic trip. Slip-on connectors are used for internal wiring.

The heavy 100litre enclosure is built of 28mm-thick veneered chipboard which is extensively braced and lined with bonded fibreglass wadding, but it carries no panel damping to reduce enclosure coloration.

Sound quality

I must admit to being surprised at the poor panel scoring for this Revox speaker, the comments describing a seriously colored loud-speaker, well behind modern standards of sound reproduction.

Coloration criticisms ranged from boomy, one-note bass and 'wardrobey' to fizzy, sibilant and cardboardy, and were all judged serious. Little recorded acoustic could be heard, the stereo images appearing to be localised around the enclosure positions, with little depth registered. On one track a female vocalist was felt to sound more like a tenor through this speaker!

Its only apparent virtue on our tests was an ability to take massive power inputs and produce near-deafening sound levels.

Lab results

The *Symbol* was certainly very efficient at 93dB/W which was four times the group average. Pair matching was good, and a series of response irregularities between 1 and 8kHz were traced to the outer grille. The result with grille removed is shown as the dotted trace superimposed on the 1metre response. The bass had a mildly rising characteristic, well extended to 40Hz, -6dB, and falling quickly at lower frequencies.

At 2metres the lateral forward responses were pretty good, but the 15° vertically off-axis plots showed some anomalies. The 15° below trace revealed the presence band suckout, a likely listening axis in view of the enclosure's considerable height. However the 15° above response was in fact superior, suggesting that the speaker should be auditioned when downtilted slightly. A 11kHz peak, 4dB high, disfigured the otherwise smooth axial result.

Averaged in 1/3 octaves and by room integration the response in overall balance terms showed a rapid low bass curtailment but with a broad upper-bass excess. The mid was fairly balanced but the treble output was excessive and lacking in the correct and characteristic rolloff typical of this measurement.

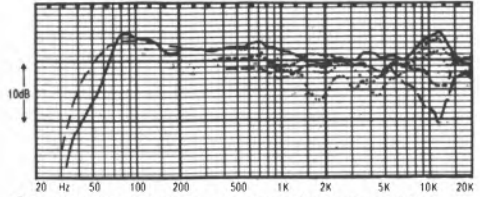
Dipping to 3.5ohms in several places, the *Symbol* qualifies as a difficult amplifier load. Distortion was fairly good at 96dB spl, averaging 0.5% for second harmonic but third measured 1% in the lower midrange which was poorer than usual. The latter remained even at the lower 86dB spl, though second harmonic was much improved.

Summary

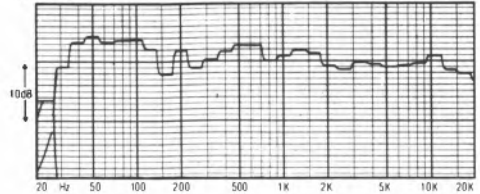
There seems to us little to redeem this model save sheer acoustic level, as over 110dB was possible from a pair in a typical room. It sounds colored and masked as well as tizzy, and lacks stereo character. No recommendation is possible.

GENERAL DATA

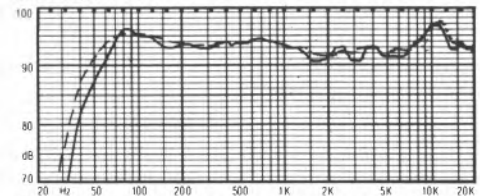
Size (height x width x depth).....	110 x 46 x 39cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—200W
Recommended placement.....	floor standing
Frequency response, within ± 3 dB, at 2 metres.....	50Hz to 20kHz
Low frequency rolloff (- 6dB point) at 1 metre.....	43Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	93dB
Approximate maximum sound level (pair) at 2 metres.....	111dBA
Impedance characteristic (ease of drive).....	difficult
Forward response uniformity.....	good
Typical price per pair, inc VAT.....	£920



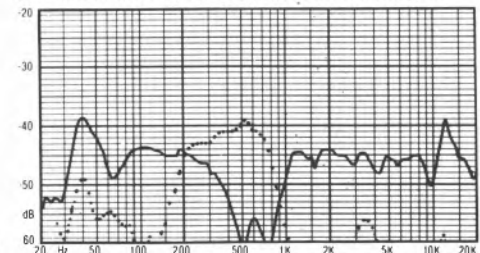
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



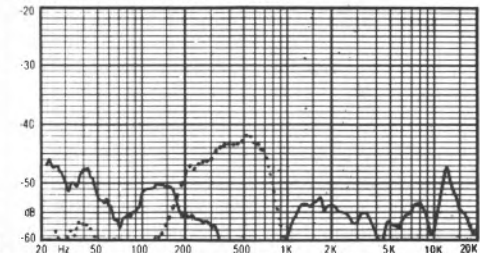
Averaged forward characteristic response in room at listening position.



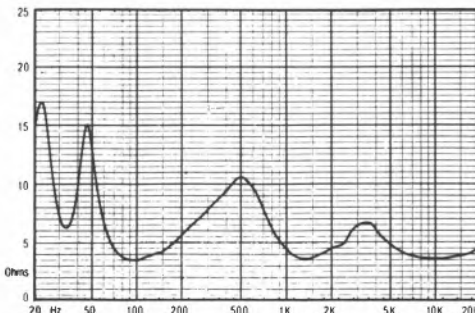
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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



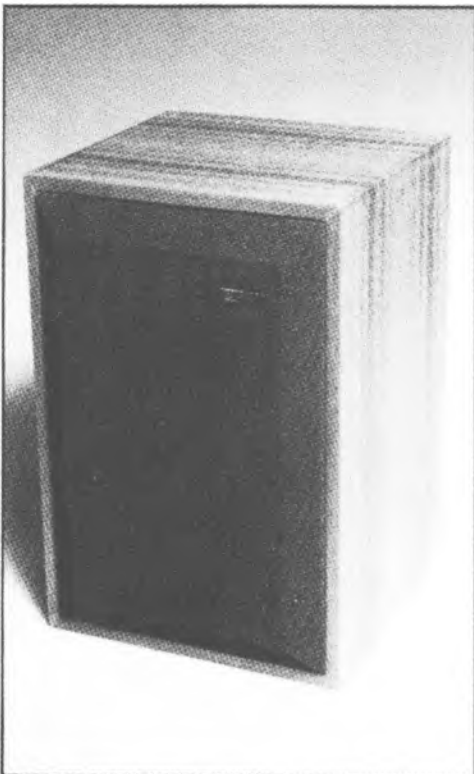
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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 -3.0dB.

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 -4.5dB 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° 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 98dB/A per pair and providing a modest bass extension to 50Hz -6dB. 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 *RA8* 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'.

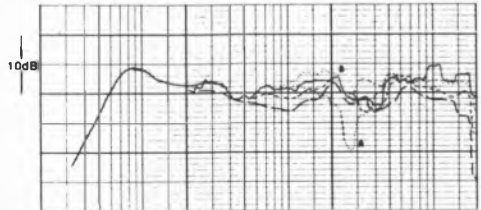
Below par on the commercial stereo sessions, the treble register emphasised hiss and occasionally added a tizzy quality. Detail was lacking and the stereo imaging suffered from a lack of impact and 'immediacy'. Even on stands the bass showed a 'one-note' undamped tendency, and could not 'play tunes' respectably. Once again it was the midband alone which was promisingly smooth.

Summary

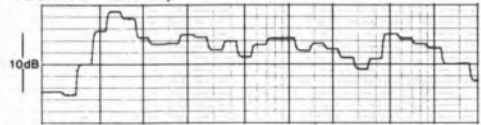
While this speaker is inexpensive and offers quite a lot of engineering and finish for the money, it is lacking in openness and immediacy resulting from poor phase control and a lack of presence, which in turn probably derives from the crossover design. If this area could be reshaped then R/A might have 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

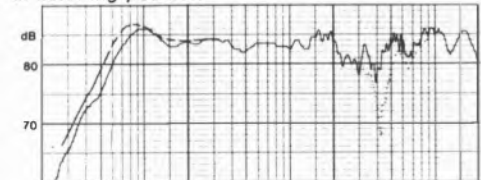
Size (h x w x d).....	39.3 x 26.5 x 27 cm
Weight	6.8 kg
Recommended amplifier power per channel (for 96dB/BA per pair at 2 metres minimum).....	(25)–50W
Recommended placement.....	open shelf or stand
Frequency response within ± 3 dB (2m).....	55 Hz to 20kHz
Low frequency rolloff (-6 dB) at 1m.....	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m.....	85dB/W
Approximate maximum sound level (pair at 2m).....	98dB/BA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	fairly good
Typical price per pair inc VAT.....	£125



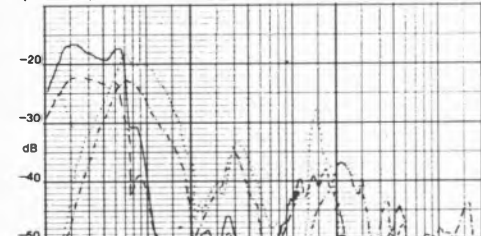
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



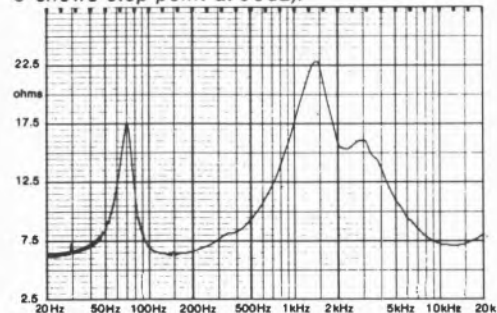
Averaged forward characteristic response in room at listening position.



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).

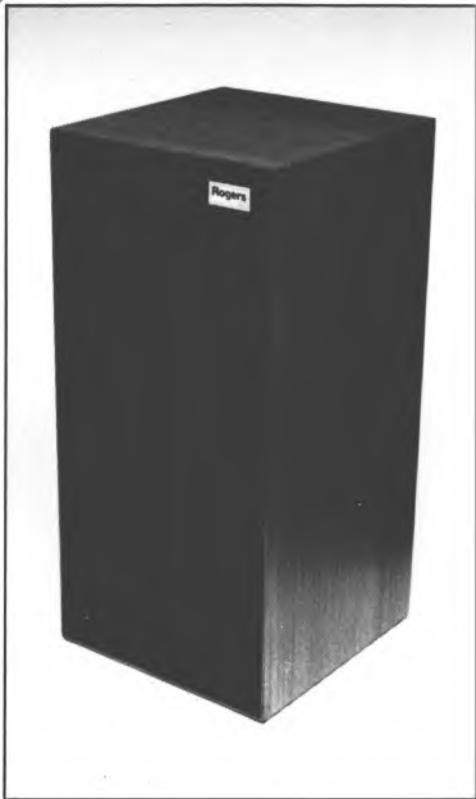


Impedance (mod Z).

BEST BUY

Rogers LS7

Swisstone Electronics Ltd, 310 Commonside East, Mitcham, Surrey
Tel 01-640 2172



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 edgy 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!

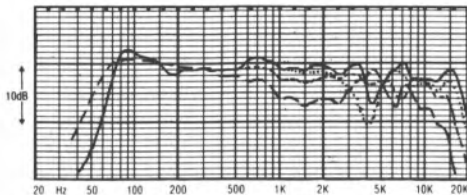
Summary

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.

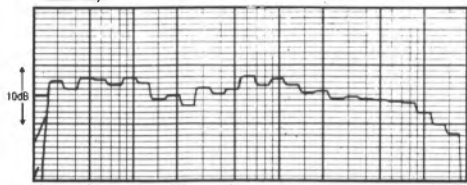
The LS7 sets the upper price limit among the Best Buys in this issue and proves that a realistically priced, compact speaker can reproduce a very high degree of audio fidelity.

GENERAL DATA

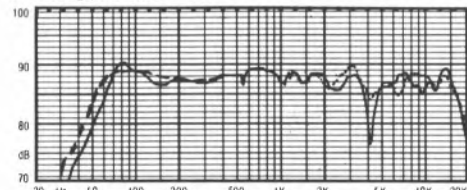
Size (height x width x depth).....	56 x 27 x 28cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(10)—200W
Recommended placement.....	open stands
Frequency response, within ± 3 dB, at 2 metres.....	55Hz to 18kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	49Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	88dB
Approximate maximum sound level (pair) at 2 metres.....	106dB
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	very good
Typical price per pair, inc VAT.....	£260



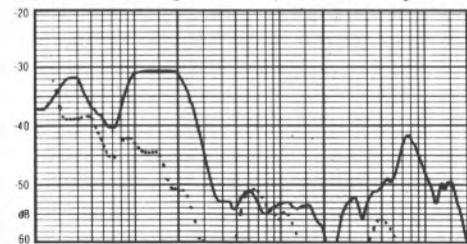
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



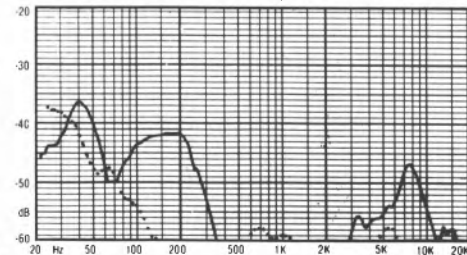
Averaged forward characteristic response in room at listening position.



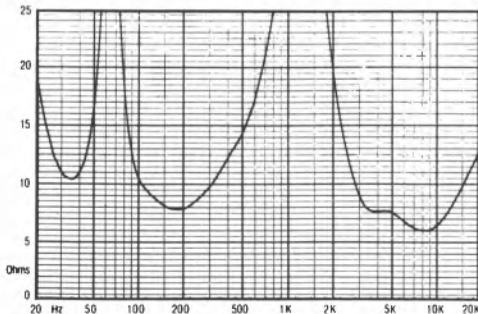
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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



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

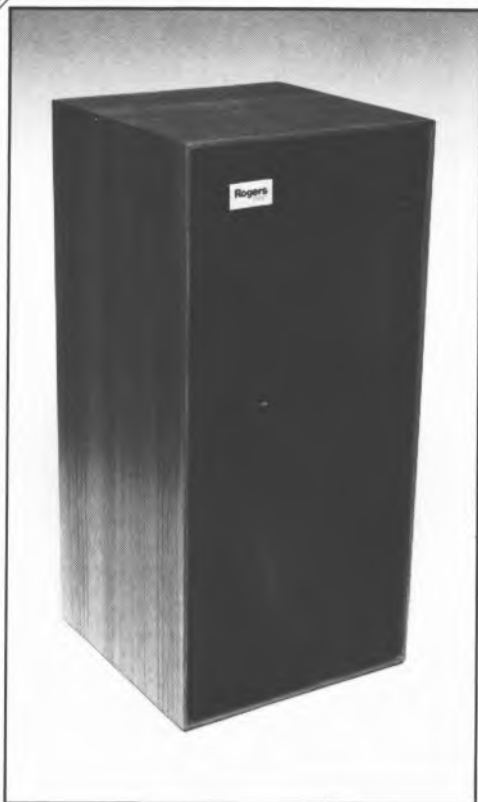


Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.

Rogers Studio One II

Swisstone Electronics Ltd, 310 Commonsides East, Mitcham, Surrey
Tel 01-640 2172

RECOMMENDED



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.

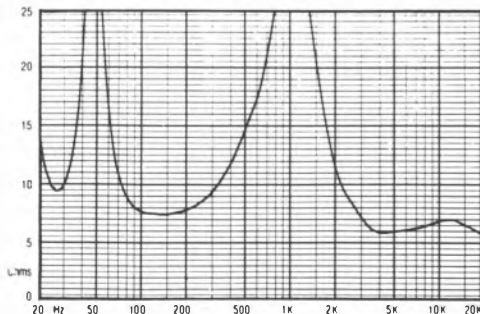
There were no serious impedance anomalies, with the value typically at the 12ohm level, and the *Studio* may thus be classed as a good amplifier load.

Summary

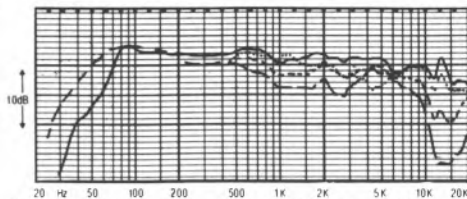
The *Studio* remains a finely-crafted and well engineered system, offering a quite good value and a good all round performance. Although falling a little behind on the new digital material, it still performs well on analogue material, and continues to merit recommendation. The bass extension is extraordinary for a system of this moderate size and reasonable sensitivity.

GENERAL DATA

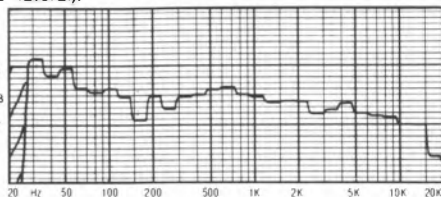
Size (height x width x depth).....	63.5 x 30.5 x 30.5cm
Recommended amplifier power per channel (for 96dB minimum per pair at 2 metres).....	(20) — 200W
Recommended placement	
Frequency response, within ± 3 dB, at 2 metres	42Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	.36Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	86.5dB
Approximate maximum sound level (pair) at 2 metres	104dB
Impedance characteristic (ease of drive).....	very good
Forward response uniformity	very good
Typical price per pair, inc VAT.....	£380



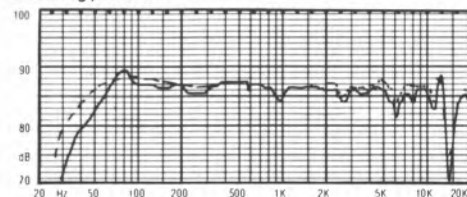
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



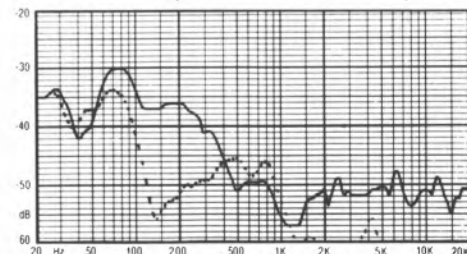
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



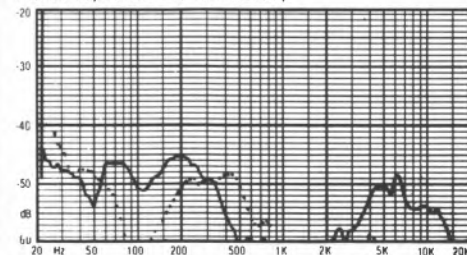
Averaged forward characteristic response in room at listening position.



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



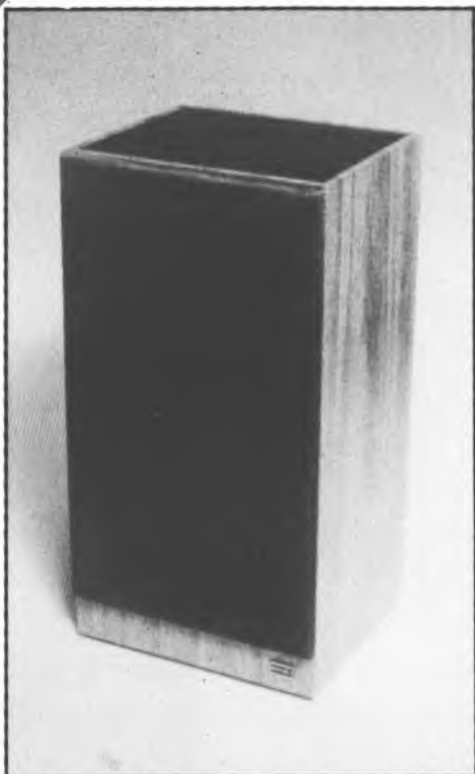
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Rotel RL915

Rotel Hi-Fi Ltd., 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks. Tel (0908) 317707



It is probably to the advantage of both Rotel and Mordaunt-Short to explain the origin of this UK designed speaker. It is in fact a custom version of the M-S *Pageant 2*, possessing a similar internal volume, crossover and drivers but with a new enclosure shape plus certain detail improvements to the overall recipe, which has resulted in what is essentially a new model.

Moderately priced, the well finished vinyl walnut exterior is complemented by a smoked glass top, neatly inset and fitted by the purchaser after unpacking. A plain 12mm thick detachable grille is used and has no rebate. The internal volume is 28 litres with the main system resonance at 56 Hz, and the system is reflex-tuned by a small ducted port 37mm in diameter, with the box/vent resonance occurring at 25 Hz.

Comprising an integral part of the rear connector panel (which offers DIN and spring terminals), the crossover comprises an 8-element high power design, and includes two resistors.

Bass/midrange is allotted to the established Mordaunt-Short 200mm unit, a rigid damped pulp cone driver possessing a useful sensitivity. The vertical line up is completed by a 25mm soft-dome tweeter.

When last reviewed the *Pageant 2* showed considerable merit but was marred by a degree of prominence in the lower mid which made the sound tonally unbalanced and emphasised a 'boxy' coloration. It is therefore interesting to see whether the new Rotel version has overcome this weakness, bringing the design up to date.

Lab performance

Checked by the 1m reference curve, pair matching was fine to within ± 0.75 dB, and the axial responses also gave a promisingly smooth result. Sensitivity is fractionally above average at 87 dB/W, which in conjunction with the good power handling will provide high maximum sound levels of up to 104 dBA for a stereo pair. The low frequency response was quite well extended to 43 Hz -6 dB, and the overall range met ± 2.5 dB limits from 55 Hz to 16 kHz.

At 2m the forward characteristic was better defined, with the system showing a slight upwards trend with frequency. As may be seen from the off-axis curves, the speaker was very well integrated, showing fine lateral uniformity and only a slight dip at 5 kHz, 15° above axis. In $\frac{1}{2}$ -octave tests and despite broadband trends, the system met ± 1.5 dB, 65 Hz-9 kHz, which is no mean achievement.

Inspection of the distortion graphs shows that our selection of 5 kHz and 500 Hz as the high power pulse test frequencies was particularly fortunate for this design. At 500 Hz, compression was slight at 0.3 dB, with 2.0% 2nd and 0.4% 3rd harmonic distortions, while at 5 kHz compression was negligible with 0.24% 2nd and 0.5% 3rd harmonic. At the 90 dB test level, the swept distortion results were good, with less than 1.0% 3rd; above 40 Hz 2nd was slightly higher but still under control. At 96 dB 2nd harmonic increased, particularly at 300 Hz and 2 kHz, reaching 2-3.0%.

Classed as an 8 ohm system, and thus a very good amplifier load, the minimum impedance was precisely 6.4 ohms at 140 Hz, and exactly to spec. Reactive effects were low, with a mean impedance of 12 ohms above 500 Hz.

Assessed by room averaging the Rotel was most impressive. Including the room modes, the overall tolerance was ± 2.5 dB from 40 Hz to 10 kHz, with the response commendably balanced. The only minor criticism might be directed at the steep fall above the 16 kHz third octave band.

Sound quality

The *RL915* scored above average results on all the listening tests, and looking back to the data for its progenitor, this would appear to represent an improvement over the *Pageant*. Capable of high power handling, the bass register showed minor port chuffing and distortion at a 50W peak input, but went on to accept over 100W before more serious overload. A reasonable bass extension was demonstrated, with a trace of 'lumpiness' when driven hard, and the lower register was relatively diminished due to port blocking resulting from airflow turbulence – an effect common to all small ports driven to high sound levels.

Compared to live sounds, a fair measure of the 'sharpness' and clarity of the original was demonstrated. Negative effects included a degree of midrange 'thinness' and 'harshness', a trace of 'tizz' in the high treble, and a degree of general 'boxiness', with one panelist noting aptly that speech reproduction sounded a little bit 'speakerish'.

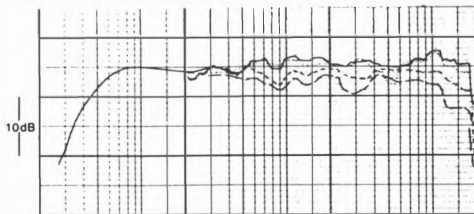
On recorded stereo programme the *915* made a good effort. Detail was evident throughout the tonally well-balanced range, and the image quality showed good stability as well as precision in the lateral plane. Residual coloration appeared to mask the full impression of stereo depth, and the sound stage was thus flattened in perspective terms, while mid coloration was noted as mild 'graininess' and 'boxiness'.

Summary

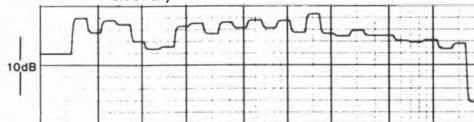
Well made and finished and possessing a quite natural neutral balance and a wide response, the *RL915* has done well enough to be included in the Recommended category at its price of a little under £200.00 a pair. Producing the best results on an open stand clear of the walls, Rotel have chosen this model wisely.

GENERAL DATA

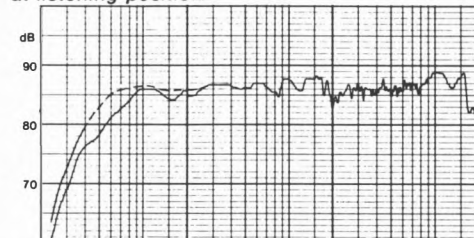
Size (h x w x d)	57 x 30 x 26.5cm
Weight	9.9kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(15)–150W
Recommended placement	stand, clear of walls
Frequency response within ± 3 dB (2m)	58Hz to 18kHz
Low frequency rolloff (–6dB) at 1m	43Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	87dB/W
Approximate maximum sound level (pair at 2m)	104dBa
Impedance characteristic (ease of drive)	very good
Forward response uniformity	excellent
Typical price per pair inc VAT	£200



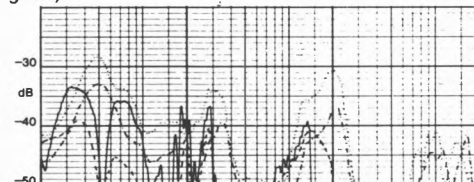
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



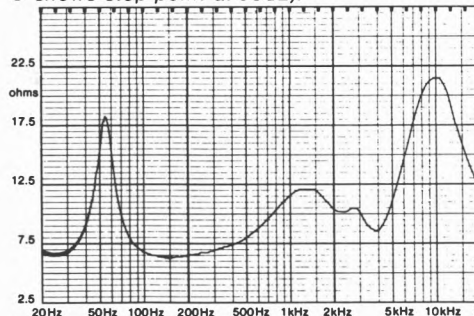
Averaged forward characteristic response in room at listening position.



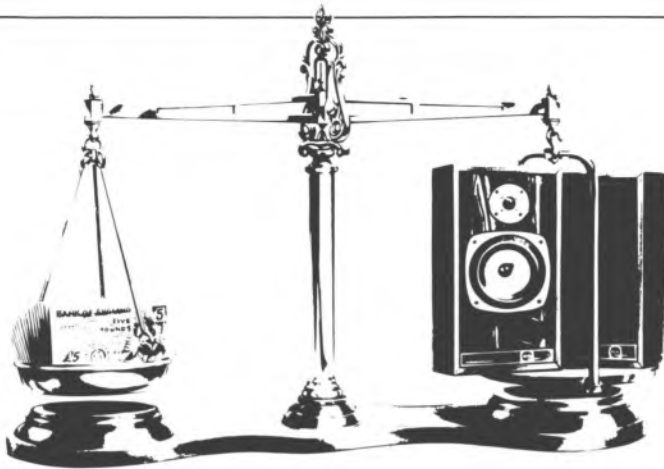
Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



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



Impedance (mod Z).



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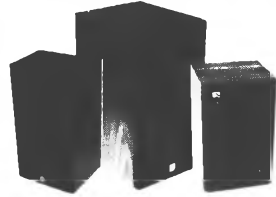
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Sony SSG1 II

Sony (UK) Ltd., Staines House, 158-162 High Street, Staines, Middlesex
Tel Staines 61600



In line with the current policy among Japanese hi-fi manufacturers to seek closer ties with their European markets, this new system from Sony is built in West Germany, using special versions of SEAS drive units made in Norway. Finely finished in the Sony tradition the 37 litre enclosure is well veneered in a dark rosewood or equivalent material.

A vertical array of drivers is employed, namely a reflex loaded 250mm bass (carbon fibre reinforced pulp cone), a doped 80mm pulp cone midrange and a 25mm soft plastic dome tweeter. The crossover points, basically 12dB/octave, are placed at 800Hz and 4kHz, and while time-delay-compensate properties are not claimed, the bass unit is in fact brought forward from the front panel on a cast ring mount.

Lab results

A very good pair match was illustrated to within

0.5dB over the whole frequency range. Claimed at 91dB/W, our estimate for sensitivity was nearer 89dB/W, which is still well above average, while the -6dB bass rolloff was well damped at 50Hz, being typical for the size and sensitivity. (It is in any case amenable to bass lift).

Rated as excellent on third harmonic distortion, values were very low in the bass and quite remarkable in the treble where they measured well under 0.1%.

Scoring average on amplifier loading, largely due to a dip to 5.5 ohms at 100Hz, the remaining range was near to 8 ohms and was notably free of reactive components, helping to mitigate the impedance dip. Power handling was exceptional with the clear and even sound on electric bass guitar sustained up to 200W peak program. While a touch 'hard' on rock program, a very high 105dBA was produced at 250W, with the peak level per channel causing the *G1* little embarrassment.

Using sine wave drive on axis at 1m, the *G1* did not look so promising, with some minor diffraction problems between 5 and 10kHz, increased irregularity from 1.5 to 5.0kHz, and a trough in the 200Hz region.

When averaged in $\frac{1}{3}$ -octave band (much as the human ear perceives the frequency response), the result was much tidier, in practice meeting ± 2 dB limits from 63Hz to 14kHz. A mild plateau was evident around 250Hz, while the vertical off-axis responses were a little untidy above 4kHz, the best response being that obtained on axis. Clearly the speaker should be axially aligned to face the listener in the vertical plane. On the lateral axis the results were fine and appeared less critical.

Sound quality

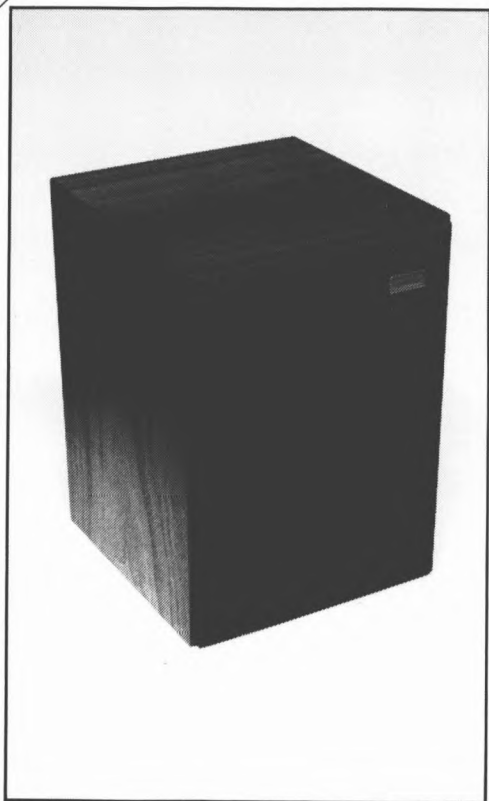
The *G1* performed very well on all listening test sequences. Rated as 'good' on the live tests, it demonstrated a relatively neutral if slightly hard and forward sound with a trace of hollowness, but its fine bass performance and 'open' clarity were strongly in its favour.

Ranked as 'very good' on stereo programme, the imaging was commended with satisfactory stability and a fair depth impression. Possessing above average clarity, nonetheless it did not escape certain criticisms of coloration, these

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 ± 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 96dBA 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 ± 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

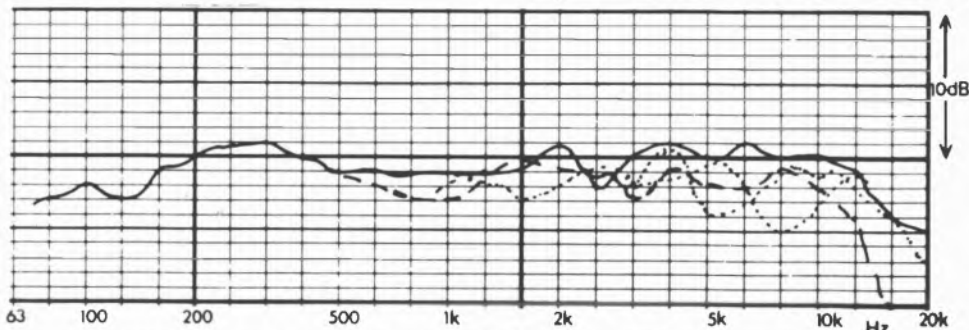
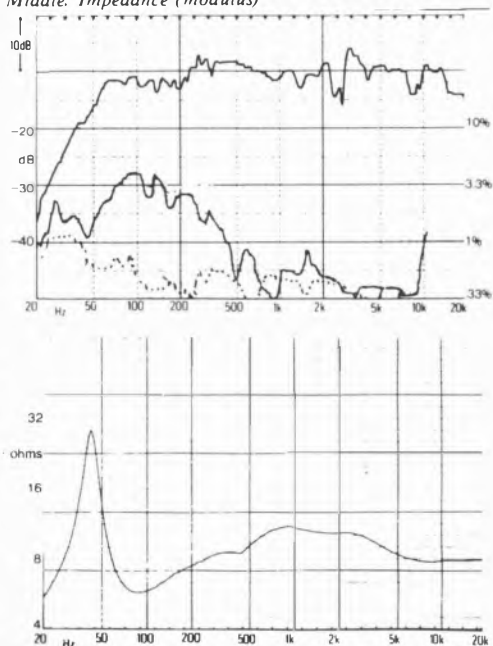
mainly concerned with mild 'hard', 'wiry', 'nasal', 'boxy' and 'brash' effects whose subjective importance will tend to vary with each listener.

Summary

Reviewed originally two issues ago, and in its Mk II form for the last edition, the G1 design is ageing gracefully. Against recent competition it can no longer claim a 'Best Buy' rating, but it still deserves inclusion in the 'recommended' group. Its tight bass and open forward sound will stand it in good stead on digital programme, although this is countered by an increasingly noticeable mid-hardness and mild treble brashness, accentuated by the primitive grille. For a well engineered and finished three way system, capable of punchy high levels, the Sony G1 II still represents good value for money.

Size	59.5(23) H. 33.4(13) W. 30(12) D: cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dB/BA per pair at 2 metres minimum)	10-100W
Recommended placement	stand or open shelf
Frequency response within ± 3 dB (2m)	63Hz to 20kHz
Low frequency rolloff (-6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie 1 watt in 8 ohms)	89dB/W at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	excellent
	64Hz-0.8%, 100Hz-0.35%, 500Hz-0.4%,
	3.6kHz-0.08%, typically 0.1% in the treble
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc VAT	£210

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



1/3-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

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.

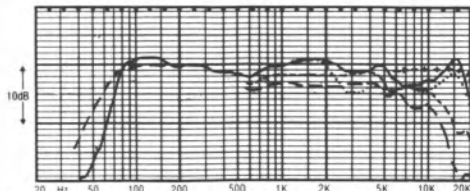
The impedance was rather high, and never fell below 8.5ohms, with its typical value at 16. Obviously this is an excellent load for any amplifier, and in fact these impedance values could be reduced to improve sensitivity without compromising the load characteristic.

Summary

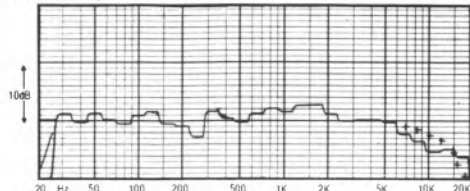
The SA1 achieved an important revival in our tests, using modern digital programme. On grounds of sound quality alone it almost achieves Best Buy status, but when its low sensitivity, somewhat limited maximum sound level and power handling are taken into consideration, a 'recommended' rating would seem more suitable. This surprising miniature is well worth trying on tall open-frame stands, using a generous amplifier. But please, Spendor, do something about that awful grille!

GENERAL DATA

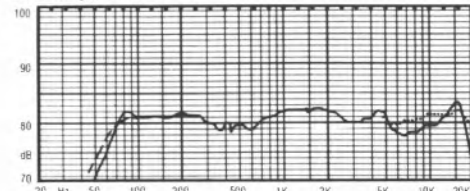
Size (height x width x depth).....	30.5 x 22.5 x 21.5cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(30)—100W
Recommended placement.....	tall open stands
Frequency response, within ± 3dB, at 2 metres.....	59Hz to 19kHz
Low frequency rolloff (- 6dB point) at 1 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



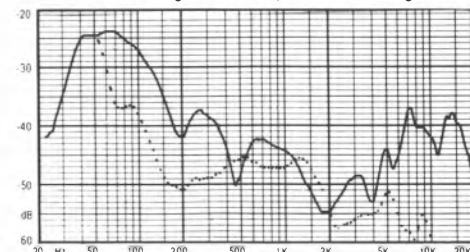
Forward characteristic response (1/2 octave at 2m, dotted 15" vertical, small dash 30" lateral, long dash 45" lateral).



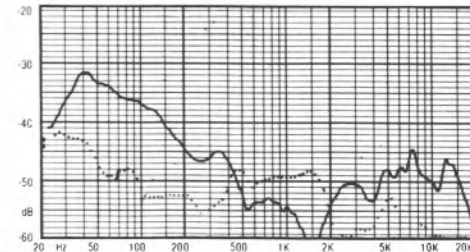
Averaged forward characteristic response in room at listening position.



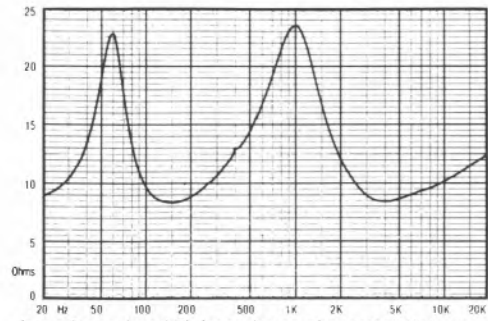
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grille.



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.

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 marries 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 ± 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.

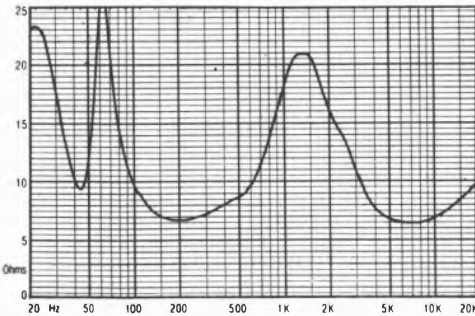
Summary

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.

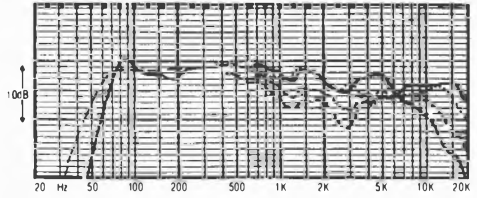
The *Prelude*, at a small sacrifice in cabinet finish achieves much the same performance as the SA2, and in the opinion of some may even achieve a better sound. Good sensitivity, smooth natural sound and fine stereo, all at an extremely attractive price, ensure that the *Prelude* is awarded a Best Buy.

GENERAL DATA

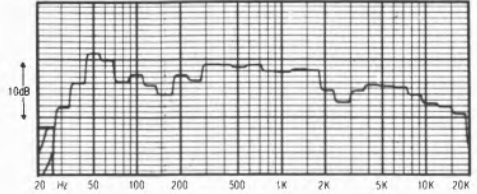
Size (height x width x depth).....	50 x 26 x 28cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(15)—200W
Recommended placement.....	open stands
Frequency response, within 13dB, at 2 metres	55Hz to 20kHz
Low frequency rolloff (-6dB point) at 1 metre.....	48Hz
Voltage 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	<i>Prelude</i> , £210 SA2, £320



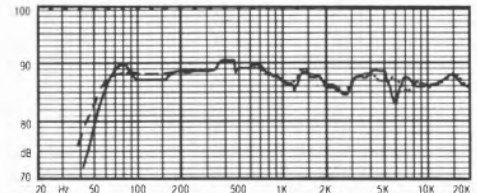
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



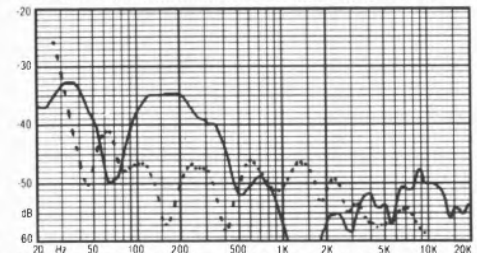
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



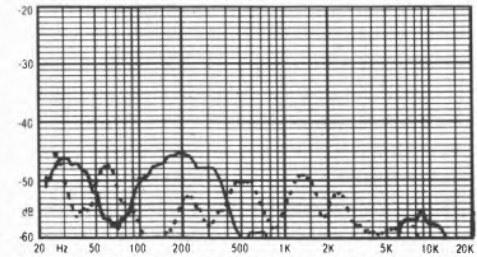
Averaged forward characteristic response in room at listening position.



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



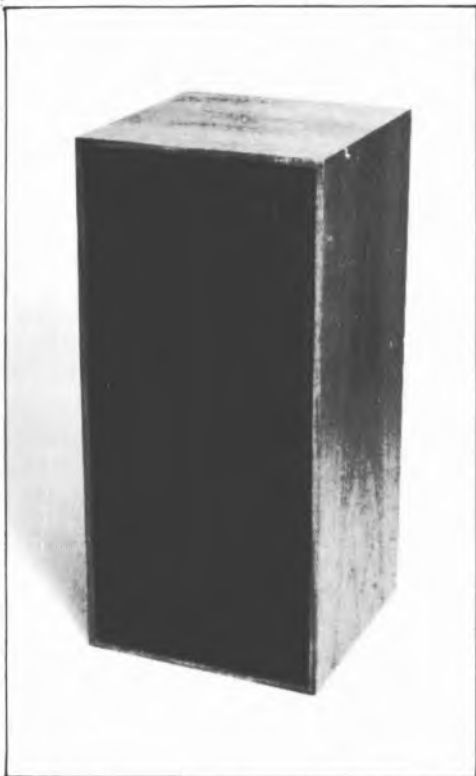
Harmonic distortions at 96dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

Spendor BC1

Spendor Audio Systems Ltd., Unit 12 Station Road Ind. Est., Hailsham, Sussex BN27 2ER. Tel (0323) 843474



As is our custom in each succeeding issue, we have taken another look at a speaker which has established itself as a long term reference by virtue of its consistent ability to fight through to a front rank position in more blind listening tests than I care to remember. This year's sample is of some interest due to two small design changes, but neither of these, it must be said at the outset, affect the sound very greatly. One concerns the reflex port which has had its acoustic power capacity increased by substituting a foam lined duct of larger diameter for the original foam lined aperture; the other is the application of a little damping to the pleated surround of the super-tweeter.

First produced in the late 1960s and widely used since as a compact medium power professional monitor, this reflexed system has 44 litres of internal volume and uses two main drivers. The 200mm bextrene-cone bass/midrange of Spendor design and manufacture covers the

40Hz to 3kHz range, while above 3kHz the specially selected Celestion *HF1300* comes in. The final half octave is augmented by a 19mm plastic dome unit. The professional quality crossover has auto-transformer provision to match the driver sensitivities on production test.

Another Spendor special is the unusually low coloration enclosure, a costly birch multi-ply carcass heavily damped with bituminous pads and lined with absorptive acoustic foam. Both front and rear panels are screwed into place, and far from representing a weakness these joins are in fact part of the complex boundary conditions affecting internal resonance damping of the enclosure panels.

Lab performance

Partly re-measured for this issue, a new axial response was produced together with distortion, sensitivity and room averaged data.

Still showing the characteristic mild bass response 'hump', the revised tuning appears to have provided more bass extension, with the -6dB point now appearing at 39Hz. Sensitivity was much the same at 83.5dB/W, below average for the group, and in conjunction with the comparatively modest peak power capacity, the maximum possible sound level from a pair is limited to around 98dBA, with 30W a sensible minimum rating.

As before, excellent pair matching was shown, with the axial response demonstrating a fine overall balance. There are the usual mild anomalies at 4kHz and 14kHz, which nonetheless do not seem to prejudice the subjective results unduly.

Possessing a minimum impedance of 6 ohms, the *BC1* rates as a good amplifier load, and was easy to drive.

Comparing the new and old 96dB distortion data, above 150Hz the satisfactory performance was unchanged, though the 4.4% 2nd at 200Hz is still more than I like. However, below 150Hz and down to 60Hz, 3rd harmonic has been reduced by several orders of magnitude, and 2nd has also benefited. On balance the low frequency distortion has been reduced to between a half and a third of that found previously. As before the system happily tolerated the 100W pulsed input with little compression and no increase in distortion.

The forward characteristic responses were generally very good, though some misbehaviour was evident around the 3.4kHz crossover region. The balance is as before, and the bass region is still prominent, but with a uniform trend elsewhere.

Assessed by room averaging the result was very promising, fitting ± 3 dB limits above 80Hz and up to 16kHz, and with a fine mid/treble transition. The bass extension is clear enough and the 30Hz band is well maintained, tending to disguise the effect of the 60Hz prominence in an overall gently rising bass trend.

Sound quality

Extensively reauditioned, the BC1 demonstrates with little difficulty that its continuing high reputation is wholly justified. Scoring very well on the live sound comparisons despite its 'richer' than average tonal balance (the brighter speakers as a rule have the advantage here) the BC1 was felt to be a consistently smooth all-rounder. The treble was clearly favoured due to a lack of the usual criticisms in this area, although some 'deadening' and 'nasality' was noted in the mid, while speech was a little 'chesty' (à la BBC). The bass was somewhat deeper and clearer than before, and the overload limit was little changed at around 100–150W.

Firmly placed up with the leaders on stereo programme, the BC1 showed excellent tonal balance transparency and depth in the midrange, without the usual emphasis or exaggerations. Good bass extension was apparent, though frankly the bass was of a mildly 'leadern' quality as well as somewhat excessive, particularly at high volume levels. This speaker proved more faithful to intrinsic programme balance and tonal differences than almost any other model we tried – the hallmark of a true monitor.

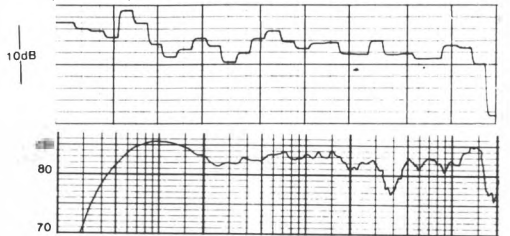
Summary

The high subjective ranking and general attainment merits Best Buy classification, particularly in terms of the still unrivalled mid and treble performance for the price. However it is not without its faults, and the prospective purchaser should bear in mind that by recent standards the BC1 leaves something to be desired in terms of bass neutrality and damping, as well as in overall power handling and sensitivity.

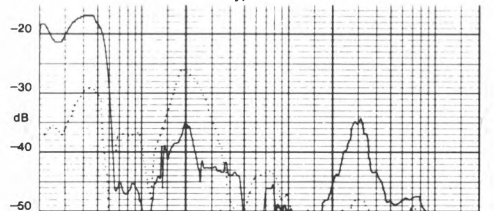
GENERAL DATA

Size (h x w x d).....	63.5 x 29.5 x 30.5cm
Weight.....	14kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum).....	(30)–130W
Recommended placement.....	stand, well clear of walls
Frequency response within ± 3 dB (2m).....	44 Hz to 20kHz*
Low frequency rolloff (–6dB) at 1m.....	39Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m.....	83.5dB/W
Approximate maximum sound level (pair at 2m).....	98dBa
Impedance characteristic (ease of drive).....	good
Forward response uniformity.....	very good
Typical price per pair inc VAT.....	£350

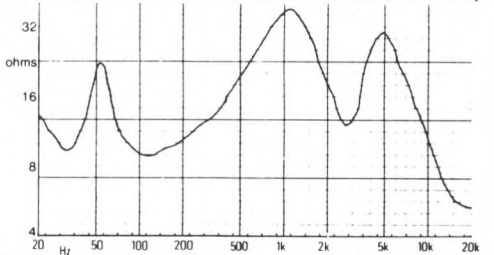
*depends on precise mike axis



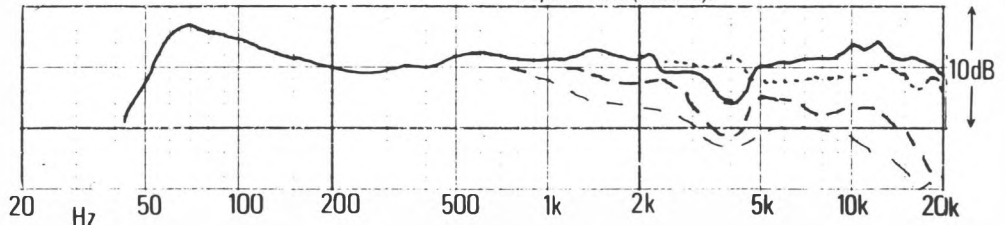
Reference sine wave response (1m on axis, 2.83V input shows sensitivity)



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB,



Impedance (mod Z).

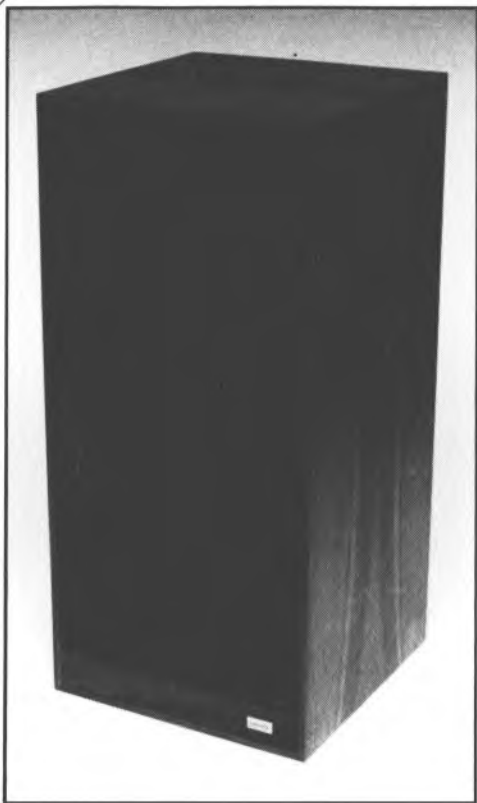


Forward characteristic response ($\frac{1}{3}$ -octave @ 2m, solid axial, thick-dash 30° horiz, thin dash 45° horiz, dotted 15° vert).

RECOMMENDED

Spendor SP1

Spendor Audio Systems Ltd, Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER Tel (0323) 843474



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

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 ± 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

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.

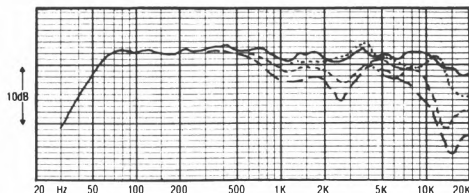
Summary

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.

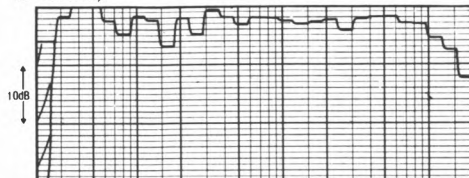
The SP1 receives a warm recommendation and will probably slowly displace the BC1 from its time-honoured position, especially where master-quality programme reproduction is concerned.

GENERAL DATA

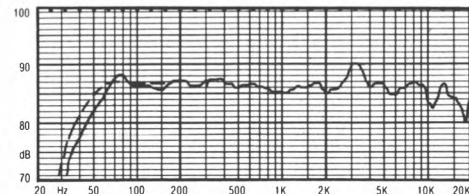
Size (height x width x depth)63.5 x 29.5 x 30.5cm
 Recommended amplifier power per channel
 (for 96dBA minimum per pair at 2 metres).....(12)—150W
 Recommended placementfloor stand
 Frequency response, within ± 3 dB, at 2 metres45Hz to 20kHz
 Low frequency rolloff (-6dB point) at 1 metre.....41Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....87dB
 Approximate maximum sound level (pair) at 2 metres103dBA
 Impedance characteristic (ease of drive).....very good
 Forward response uniformityvery good
 Typical price per pair, inc VAT.....£470



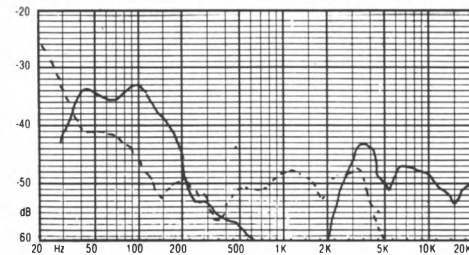
Forward characteristic response (1/2 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



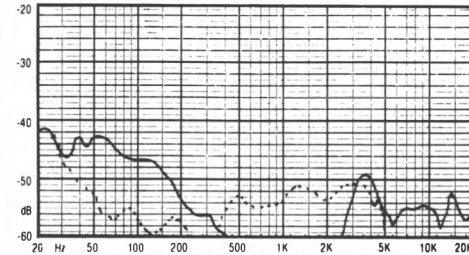
Averaged forward characteristic response in room at listening position.



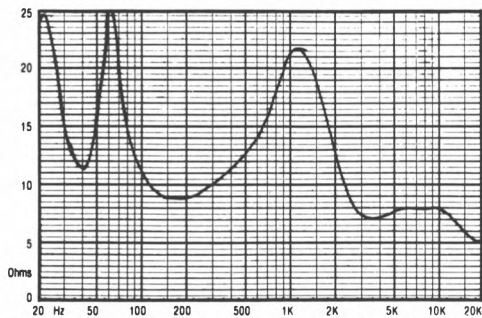
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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



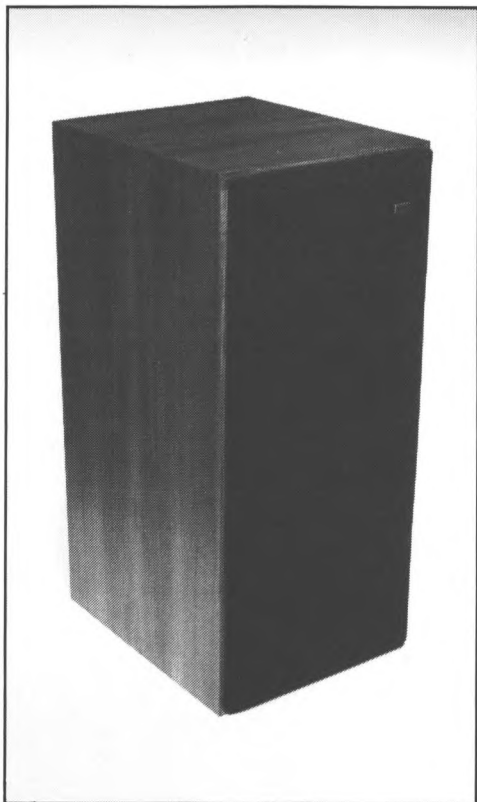
Harmonic distortions at 86dB SPL (solid 3rd harmonic, dotted 2nd harmonic).



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

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.

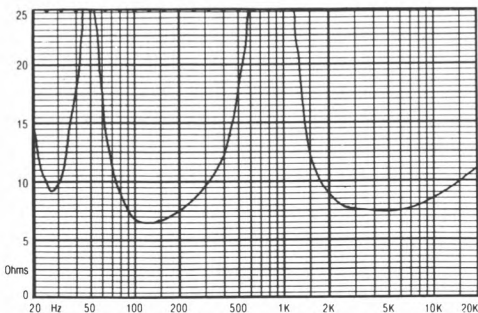
Summary

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.

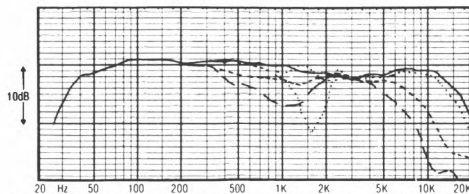
The active version does give a significant improvement in clarity, acoustic level, and control, and for these reasons, the SA3 is definitely worth considering if the conditions are right.

GENERAL DATA

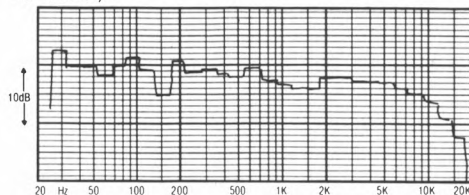
Size (height x width x depth).....	85 x 38 x 46cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—200W
Recommended placement	rigid open stands
Frequency response, within ± 3 dB, at 2 metres	35Hz to 15kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	32Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	89dB
Approximate maximum sound level (pair) at 2 metres	107dBA
Impedance characteristic (ease of drive).....	very good
Forward response uniformity.....	good
Typical price per pair, inc VAT.....	£900



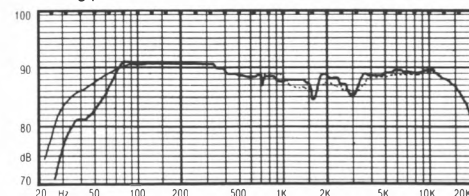
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



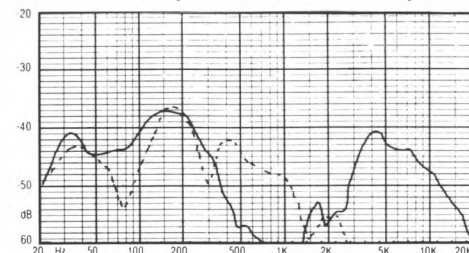
Forward characteristic response ($1/3$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



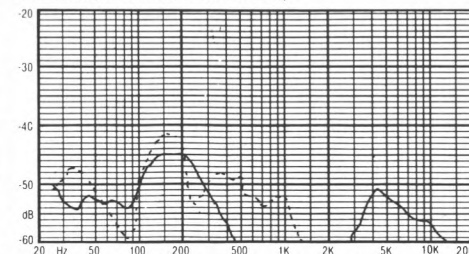
Averaged forward characteristic response in room at listening position.



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).

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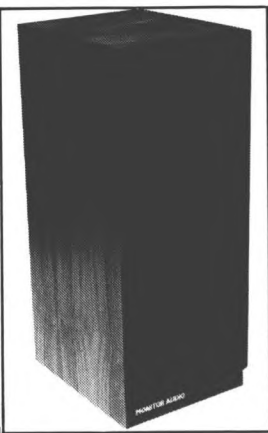
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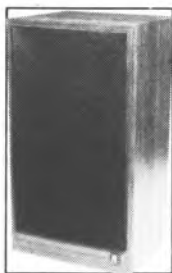
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Units 5in polypropylene cone bass/mid range
unit: 1in fabric dome HF unit.

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Tannoy Mercury

Tannoy Products Ltd, 21 Canterbury Grove, West Norwood, London SE27 0TW
Tel 01-670 1131



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 unrebrated 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.

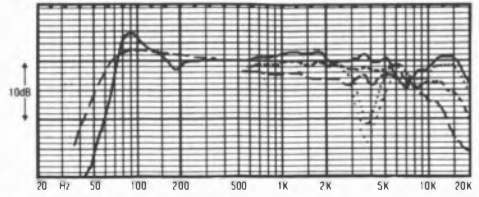
At 96dB sound level, distortion was good in the important midrange and about average at lower frequencies, peaking to 8% second harmonic at 100Hz which is probably just audible as a bass tonal quality change. Third harmonic was rather better, this in any case arguably the more important result, averaging 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

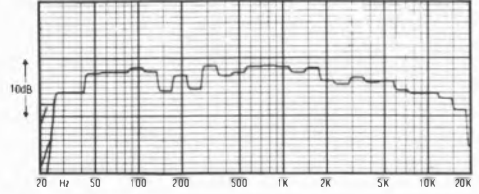
Tannoy have an undoubted winner in the *Mercury*. If treated like a big speaker and mounted on stands clear of room walls, a highly satisfactory sound was obtained, with fine detail, clarity and stereo image presentation. Essentially neutral and vice-free, the *Mercury* was usefully sensitive and easy to drive, fully deserving its Best Buy rating. This system will do good justice to some surprisingly expensive ancilliary equipment!

GENERAL DATA

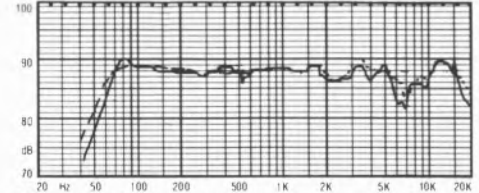
Size (height x width x depth).....	48 x 26.5 x 23cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(12)—100W
Recommended placement	open stands or shelf
Frequency response, within ± 3 dB, at 2 metres	53Hz to 20kHz
Low frequency rolloff (-6 dB point) at 1 metre.....	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



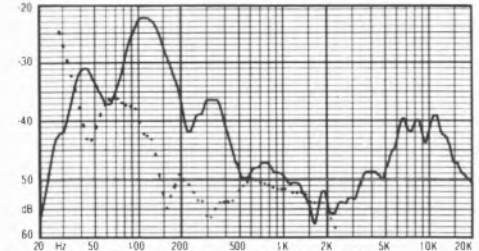
Forward characteristic response ($\frac{1}{3}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



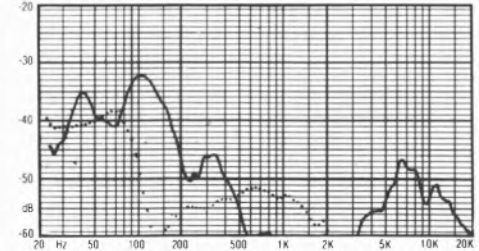
Averaged forward characteristic response in room at listening position.



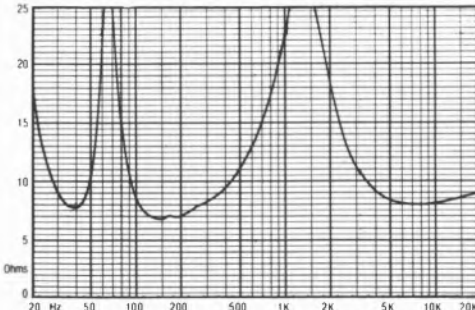
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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.

Visonik David 7000 (with Sub 3)

Uher Ltd, 30-31 Lyme Street, London NW1 0EE
Tel 01-485 0943



The Visonik *David 7000* is an ultra-compact miniature speaker for wall or bookcase mounting, but may also be partnered by the passive matching Visonik sub-woofer, the *Sub 3*, to provide the complete system reviewed here.

In fact, the *Sub 3* is a mono unit — a permissible technique at very low frequencies — with both power amplifier channels fed to it and summed. The enclosure is a simple chip-board box, fibre-glass-filled and driven by a steel framed 250mm pulp cone bass unit. Internal volume is around 50litres. The filtered upper range response is then available at a second pair of spring terminals on the sub-woofer for connection to the *7000* satellites. These can be sited somewhat remotely from the *Sub 3* which rests on the floor, but if the distance is too great then the different sources may be audibly located.

Only a few litres in volume, the *7000* uses a

115mm pulp cone bass mid unit plus a 25mm fabric dome tweeter, the two linked by a commercial-quality 12dB/octave crossover network. A moulded plastic grille is fitted for styling reasons, but this introduces an acoustically-serious front cavity, which spoils the frontal response and sound.

Keyhole apertures at the rear of the *7000* cabinets facilitate wall mounting on a single screw.

Sound quality

The panel did not favour the Visonik system. 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. It sounded thin, hard and 'loud', quite lacking in ambience and perspective, while the lower-mid was subjectively depressed as well as distant. Despite the presence of the sub-woofer, bass was quite inadequate in balance terms, while stereo images appeared warped in spatial terms and little depth was observed.

Lab results

Pair matching was fairly good, and system was distinguished by a high 90dB/W sensitivity. However, this was gained at the expense of a non-standard impedance which fell to 4ohms at low frequencies, and was therefore classed as a fairly hard amplifier load.

Removal of the grille showed that it had been the cause of much of the charted treble irregularity, and the high sensitivity was in fact somewhat artificial, relying as it did on the bright treble.

Referenced to the lower midband, the sub-woofer had reasonable bass extension to 43Hz, -6dB.

At two metres the treble-forward trend of the *7000* was absolutely clear from the response graph. Very good off-axis integration was shown, though, and if properly balanced, this system should have some potential.

Measured by room-integration the strange response character was again evident. The major lower-mid octaves were severely depressed, while the bass was uneven and too low in mean level, and the treble too extended in the final octave, where ideally it should smoothly decay.

The distortion results were unfortunately omitted from the measurements of this speaker.

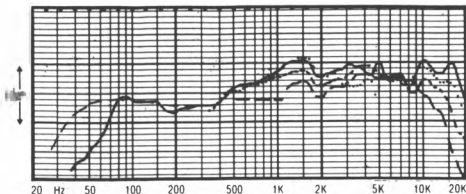
Summary

Possibly exemplifying what some UK designers have termed the 'German' sound, the Visonik 7000/Sub 3 system gave, to UK ears at least, an unacceptably inaccurate tonal balance.

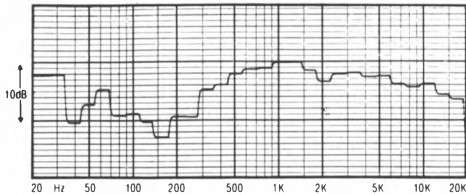
The bright forward upper mid and treble meant little objective assessment of programme quality was possible and furthermore, matters were complicated by the 7000's grille, which clearly colored the sound. This system does not therefore win HFC approval.

GENERAL DATA

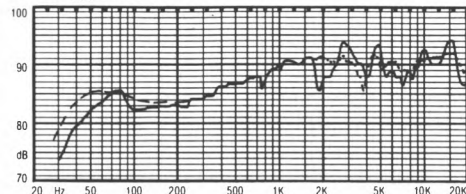
Size (height x width x depth)*24 x 16 x 17cm
 Recommended amplifier power per channel
 (for 96dBA minimum per pair at 2 metres).....(10)—100W
 Recommended placementdependent on room
 Frequency response, within ± 3 dB,
 at 2 metres400Hz to 18kHz, see text
 Low frequency rolloff (-6 dB point) at 1 metre.....43Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....90dB
 Approximate maximum sound level (pair) at 2 metres105dBA
 Impedance characteristic (ease of drive).....below average
 Forward response uniformityvery good
 Typical price per pair, inc VAT£124 (plus £112 for Sub 3)
 *Sub 3, 50 x 37 x 36cm



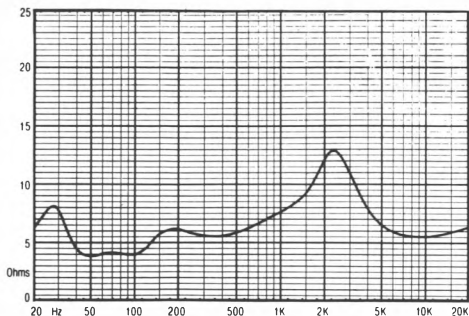
Forward characteristic response ($\frac{1}{2}$ octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



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, dotting shows response without grill.



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

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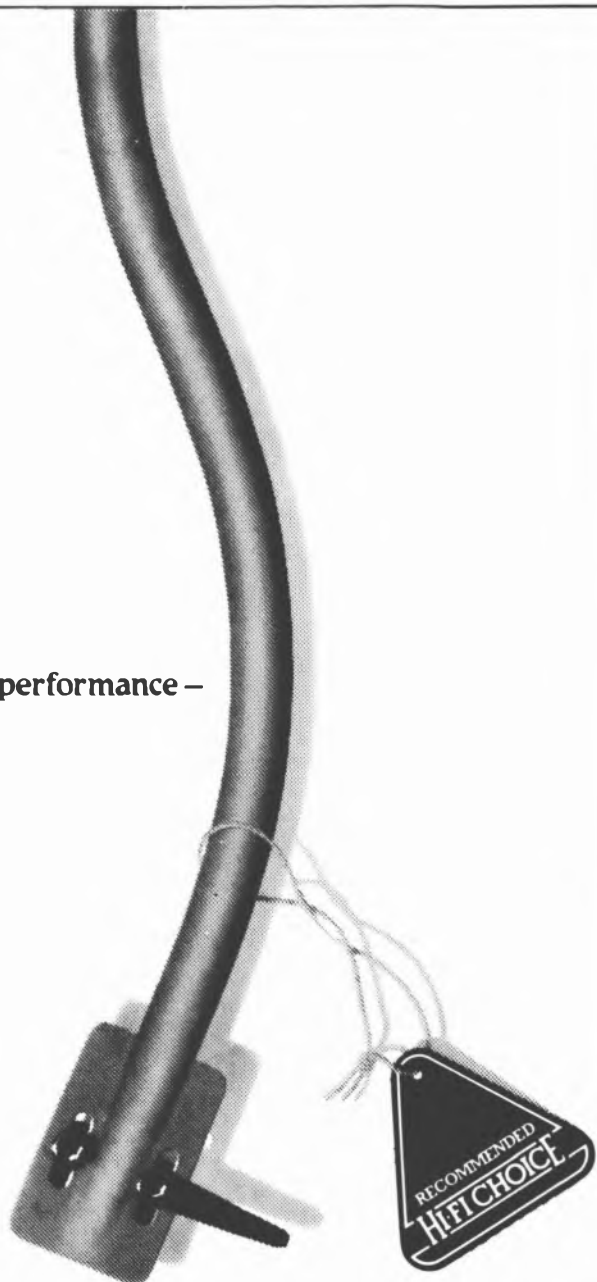
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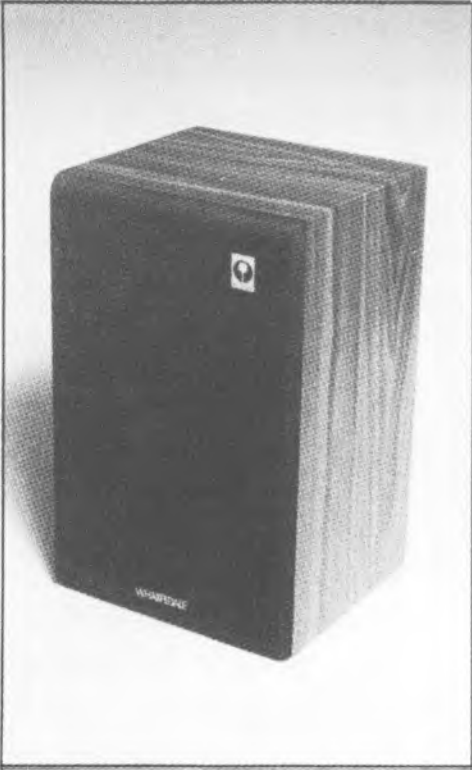
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Wharfedale Laser 60

Rank Hi-Fi, Highfield Road, Idle, Bradford BD10 8SF. Tel (0274) 611131



One of the least expensive Wharfedale models currently available, the *Laser 60* broadly continues the lineage established by the famous Denton. A compact two-way system, it uses the same ferro-fluid damped high frequency unit as all the other Wharfedales, namely a 19mm polyamide dome manufactured by Wharfedale themselves. In this model it is partnered by a 200mm driver of surprisingly low overall weight: a thin steel chassis supports a small magnet, and the unit is fitted with a light pulp cone and a plastic half roll surround. A three element crossover marries the drivers, and is a low cost solution using average power capacity components.

The simulated veneer cabinet encloses a sealed volume of 17 litres, resulting in a rather high system resonance of 82Hz. The external finish has a good appearance and not unexpectedly no panel damping is used, though internal absorption is taken care of by a

polyester fibre filling. One might expect wall mounting to suit a speaker of this size, but the measured bass 'hump' suggests that it would in fact benefit from stands if at all possible.

Lab performance

As with the *Laser 120*, the grill seemed likely to be prejudicial to a good response; the speaker was plotted both with and without, giving the expected result: 'better off than on'. Superficially smoother than the *120*, the *60* nevertheless showed strong 'boom and tizz' tendencies, namely a 5dB bass lift at 100Hz and a similar prominence at 15kHz in the treble.

Sensitivity was about average at 86.5dB/W, with the bass response extending rather lower than expected to -6dB, 55Hz, due to the excessive lift preceding the rolloff. The speaker showed rattling and overload problems at bass power inputs much above 30W, and this restricted the maximum sound to just 96dB for a pair when fed wide range programme; a 20W minimum is suggested. The speaker was not felt to be a good load, as it dipped to 4 ohms at 12kHz, and some care may be required in the choice of an accompanying amplifier.

Examining the forward response characteristic, the output in the 200Hz to 10kHz range was surprisingly good, and in theory at least a degree of bass and treble cut could largely solve this speaker's frequency balance problems. In the important mid region it in fact performed well on the measurement axes.

At first sight the smoothness of the room-averaged response was surprising; in fact the location of the speaker's bass lift had compensated for a room dip, and the room lift at 60Hz had in turn compensated for the loudspeaker's rolloff. Apart from the presence band energy trough, the overall trend was potentially favourable.

A fair quantity of distortion was evident on the 90 and 96dB charts, notably in the 100Hz to 600Hz range where 2.0% was not uncommon. Nonetheless the results were satisfactory, and the system coped quite well with the 100W pulsed inputs, with 5.0% 2nd and 2.0% 3rd at 500Hz, and 0.8% 2nd and 1.0% 3rd at 5kHz, with negligible compression. 96dB could be achieved with 10W of continuous input, but over 100W of electric bass guitar produced very audible distortion, while at the 40W level the bass was clearly entering overload, justifying our 30W maximum power rating recommendation.

Sound quality

Even allowing for the price, the *Laser 60* results

were unsatisfactory on both sets of listening tests, and it is doubtful whether the 60 qualifies as a true hi-fi speaker by *Choice* standards. The results were dominated by an excessive and 'one note' bass, lacking in real extension or tonal differentiation.

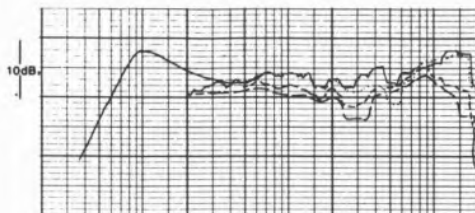
The midrange character of the sound was felt to be a long way from reality, with a poor frequency balance, and with numerous colorations described including 'tizzy', 'boxy', 'honky', 'disjointed', 'peaky', 'ragged', 'thick', 'harsh', and 'chesty' effects. There seemed to be hardly any programme or sound where some departure from the hoped for standard did not seem quite obvious to the listening panel.

Summary

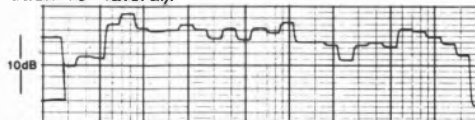
Admittedly inexpensive, this compact offers average sensitivity, poor power handling, limited dynamic range and a significantly below average sound quality. The sound is dominated by a 'boom and tizz' tendency, and the *Laser 60* cannot match the level of competition set by worthwhile new models from several other large manufacturers at this end of the market. The poorer than average amplifier loading must also be a consideration, but the overall standard might just merit audition.

GENERAL DATA

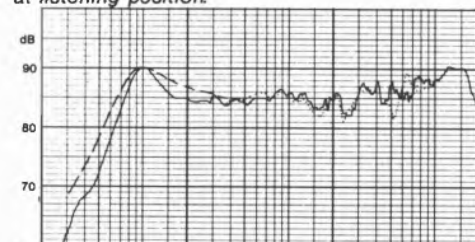
Size (h x w x d)	41 x 26 x 23cm
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(20)-30W
Recommended placement	stand
Frequency response within ± 3 dB (2m)	130Hz to 12kHz
Low frequency rolloff (-6dB) at 1m	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	86.5dB/W
Approximate maximum sound level (pair at 2m)	96dBa
Impedance characteristic (ease of drive)	fairly difficult
Forward response uniformity	good
Typical price per pair inc VAT	£80



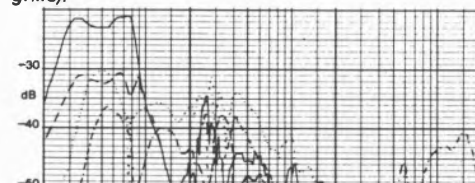
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



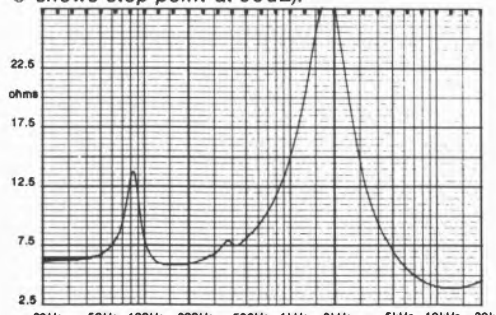
Averaged forward characteristic response in room at listening position.



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, O shows stop point at 96dB).



Impedance (mod Z).

RECOMMENDED

Wharfedale Laser 90

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF
Tel (0274) 61131



One of the new-generation *Laser* range, the 90 is a compact 20litre sealed-box system. A light steel frame supports the bass/mid range unit, which is fitted with a modest motor system and a flared pulp cone. The tweeter is Wharfedale's own 19mm polyamide soft dome unit, which has recently undergone considerable in-house refinement. A commercial-quality crossover divides the frequency range at around 3kHz.

The enclosure is built of 15mm chipboard material with an exterior covering of walnut-effect vinyl with the grille assembly based on a moulded plastic frame. This is trimmed by a light grey edge which at a distance resembles satin alloy, but the metallising is less convincing on the rather flashy plastic trims used for the drive units.

Sound quality

We obtained the best results with this speaker

when it was positioned on open stands. It scored a little above average, which was a good result considering the price.

In a general sense the 90 sounded quite smooth and well balanced, with good control at both frequency extremes, a thing unheard of with earlier *Laser* models! Some coloration was evident, notably a degree of boxy hollowness and a 'cardboard' quality to bass percussion, together with some mild treble sibilance.

Stereo images were fairly clear with reasonable depth, and recorded acoustic, and some central focus was demonstrated in the later plane, but on occasion the image was over-wide tending to localise at the box positions.

The bass possessed average extension and was a bit coloured, but firmer than usual. Overall the panel felt this speaker to be relatively relaxed and unfatiguing.

Lab results

At the reference 1metre distance, the *Laser* 90 frequency response was exemplary and only slightly modified by the grille being in place. The bass was accurately tuned to -6dB at 50HZ and pair matching was also pretty good, the sensitivity a little above average at 87.5dB/W.

Out at 2metres, which is a more representative listening distance, the uniform characteristic was maintained, showing a slightly 'rich' tendency. In general a good set of off-axis responses was produced.

In the listening room the well balanced trend was continued with quite good bass integration down to 50Hz.

Distortion was about average at the 96dB sound level, measuring 0.3 to 1.0% third harmonic and 0.4 to 5.0% second, the latter poorest in the comparatively harmless low frequency region. Improved results were obtained at the lower 86dB test level, and classed as good.

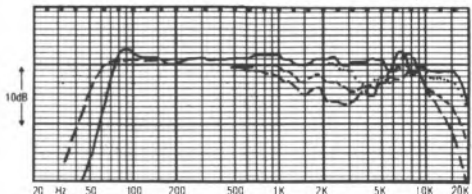
The impedance characteristic was well controlled, happily meeting the 8ohms standard and thus the 90 was classed as a very good amplifier load. Easy to drive, the sensitivity-versus-power handling equation will allow maximum sound levels of up to 103dB/A.

Summary

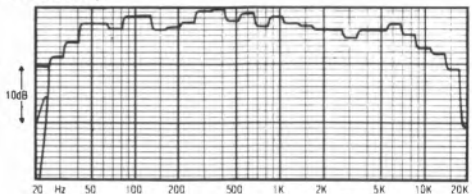
This smooth and well-balanced model gave a decent all-round performance at quite a competitive price. One of Wharfedale's most civilised inexpensive models for a long time, the 90 achieves a recommendation.

GENERAL DATA

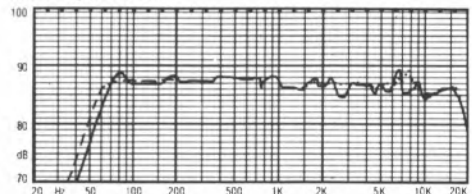
Size (height x width x depth).....48 x 26.5 x 25cm
 Recommended amplifier power per channel
 (for 96dBA minimum per pair at 2 metres).....(15)—100W
 Recommended placement.....open stands
 Frequency response, within ± 3 dB, at 2 metres53Hz to 17kHz
 Low frequency rolloff (-6dB point) at 1 metre.....50Hz
 Voltage sensitivity
 (ref. 2.83V, or 1W into 8ohms at 1 metre).....87.5dB
 Approximate maximum sound level (pair) at 2 metres103dBA
 Impedance characteristic (ease of drive).....very good
 Forward response uniformity.....good
 Typical price per pair, inc VAT.....£95



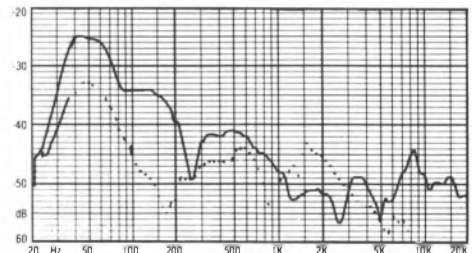
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



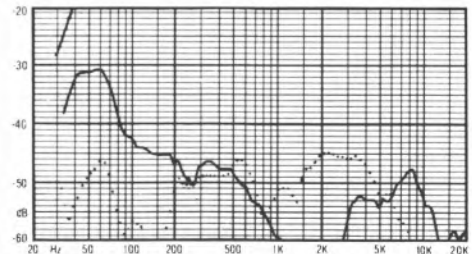
Averaged forward characteristic response in room at listening position.



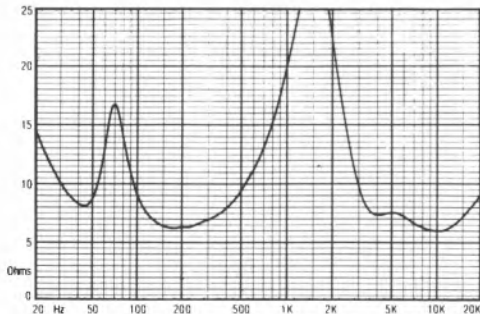
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF, dotting shows response without grill.



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.



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Wharfedale TSR 106.2

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF
Tel (0274) 61131



Though a completely new model, the *TSR106* carries, for the sake of completeness, the '2' suffix now found on all Wharfedale's current *TSR* models. The *106* is a middle price, medium sized 22litre sealed box system, built of 15mm undamped chipboard. Internally some bracing is employed, while the bass unit magnet is tensioned to the rear panel by a slim steel bolt, and there is a well-packed interior filling of polyester wadding.

Built on a light die-cast frame, the 200mm bass mid unit employs a deeply-flared polypropylene plastic cone, fitted with a decent-sized high-power motor system. The frame brings the driver slightly forward of the panel, helping to reduce the depth displacement relative to the tweeter, which is Wharfedale's own ferro-fluid damped 19mm soft polyamide plastic dome.

A complex nine-element commercial-quality crossover is used, while the bass alignment is 206

given a third order using a resistively-damped series coupling capacitor to the bass driver, the final rolloff returning to 12dB/octave after a brief approach to an 18dB/octave rate.

The enclosure is well finished in walnut veneer, and a foam grille is the expected standard, although this was not available in time for our tests.

Sound quality

Scoring rather below average, the *TSR106.2* was free of serious faults and yet conversely, it seemed to possess few virtues. The response was reasonably uniform as well as quite well balanced, bass being fairly good, but lacked extension in subjective terms. In the midrange some boxiness plus a pinched nasal quality was reported, while the treble sounded mildly breathy and 'whistley' on occasion.

Stereo images had rather a bland effect and did not contain much depth or natural acoustic, but frontal focusing was reasonably good.

In general the panel found this an uninspiring design, this true for both analogue and digital material.

Lab results

At 1metre on axis, the sensitivity was rather below average at 84dB/W, with the bass rolloff at 50Hz, -6dB, typical for the size and system sensitivity. Output was rather uneven in the 1.5kHz to 5kHz range. With a 150W maximum power rating, moderate maximum sound levels of up to 101dBA a pair were judged possible.

At 2metres the response showed better integration although the 2kHz 'lumpiness' still remained — perhaps this is the origin of the 'nasal' or 'pinched' vocal effect? Very good off-axis responses were demonstrated however, with ± 3 dB limits met from 55Hz to 18kHz. The room-averaged response was in fact quite good and certainly no worse than a number of more highly-rated speakers, so the whole story was by no means told here.

At 96dB sound pressure level, the third harmonic distortion rose rapidly at low frequencies, reaching almost 10% at 40-60Hz, which was rather high. Second harmonic was rather better at an average of 1%, and indeed above 150Hz, third was very good as well. With the sound level reduced by 10dB to 86dB, distortions improved and generally averaged around 0.3%.

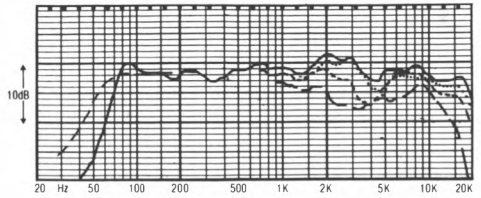
The basic impedance was 14ohms, with no minima poorer than 7.5ohms, and the *106* was thus an excellent amplifier load.

Summary

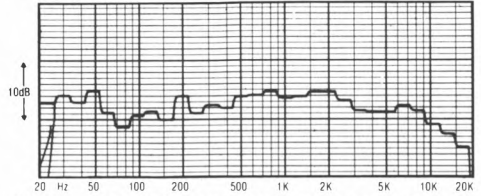
At £180 the pair, the *TSR106.2* did not achieve a good enough result on the listening tests to merit recommendation. However this is not to say it is a bad speaker, just rather ordinary and, in *Hi-Fi Choice* terms, not sufficiently competitive to achieve a high rating.

GENERAL DATA

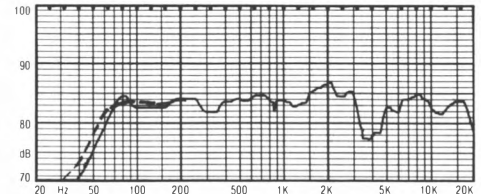
Size (height x width x depth).....	48 x 29 x 25cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(20)—150W
Recommended placement.....	open stands
Frequency response, within ± 3dB, at 2 metres	55Hz to 18kHz
Low frequency rolloff (— 6dB point) at 1 metre.....	50Hz
Voltage sensitivity (ref. 2.83V, or 1W into 8ohms at 1 metre).....	84dB
Approximate maximum sound level (pair) at 2 metres.....	101dBA
Impedance characteristic (ease of drive).....	excellent
Forward response uniformity.....	very good
Typical price per pair, inc VAT.....	£180



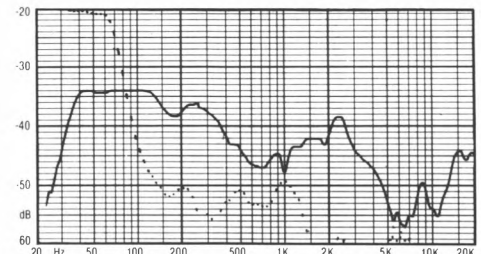
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



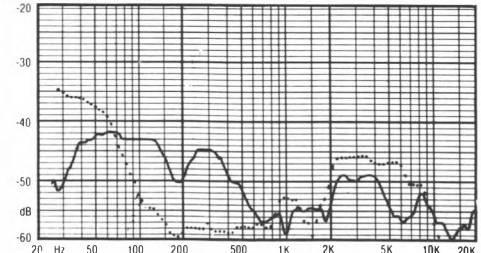
Averaged forward characteristic response in room at listening position.



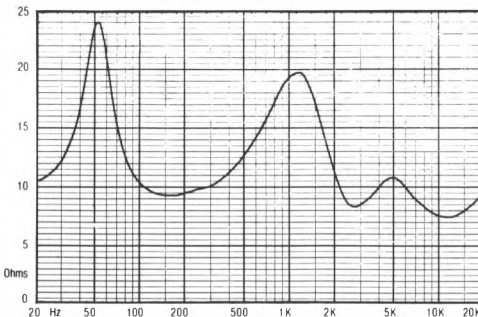
Reference sine wave response (1m on axis, 2.83V input shows sensitivity). Dashing corrects for chamber LF.



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.

Wharfedale TSR108.2

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF Tel (0274) 611131



200mm bass/mid unit was fitted with a Wharfedale mineral filled (talc) polypropylene cone and a generous magnet. The chipboard enclosure panels were finely veneered in real walnut, and damped internally by bituminous cladding. A top grade acoustic foam provides volume absorption. However the grille was less desirable, placing significant side panels near the tweeter and worsening the diffraction properties of the enclosure. Not shown on the printed graph, the grille's removal improved the smoothness of the treble between 6 kHz and 14 kHz on the sinewave reference, and also gave better image focus in the upper frequencies. Fortunately the speaker looks quite presentable without the grille in position.

Lab performance

Charted at 1 m on axis (with grille), the family of curves illustrate the settings of the treble output control from '7' to '3 o'clock', with '12' at an indicated flat. Above 150Hz this speaker was pretty smooth and well balanced, and better still with the grille removed. The reduced sensitivity resulted in more bass excess than before, namely a 4dB lift at 100Hz. The low frequency cutoff is lowered to -6dB, 40Hz, which is a good extension for the volume.

At 2m the characteristic response showed an axial curve integration that was marginally less favourable, although the general uniformity was laterally good. The vertical axis was less promising, with 15° above showing a peak/trough effect of moderate severity between 2kHz and 6kHz.

The room average response was rather prominent in the bass, which is caused by coincidence of speaker excess and room mode maximum. Good output was still present at 40Hz, while above 500Hz the forward trend was quite favourable. Still it might be difficult to escape subjectively from the general excess of bass.

A minor fault was shown on the distortion graphs at 230Hz, whereby the manufacturer had inadequately tightened the bass unit screws resulting in a resonance; on re-adjustment this particular feature subsided. The chart was dominated by fairly innocuous 2nd harmonic distortion at the 1-2% level, with 3rd harmonic rather less at 0.3-0.6%. At 50Hz 2nd and 3rd were equal at 5.0%, which is a reasonable value. Little change occurred in distortion on the 100W pulsed test, but some compression was noted at 500Hz. With an impedance characteristic comfortably meeting the 8 ohm standard, and with mild reactive effects, the 108 was judged a very good amplifier load.

Previously reviewed, the 'Mk 1' 108 showed promise but possessed significant flaws which barred it from recommendation. It has since been extensively revised, and now has an improved frequency response in the midband, and a revised mounting for the treble unit (which puts it on the front panel rather than down an absorbent pit as was previously the case). Bass extension has been increased, while the sensitivity is reduced by 2.5dB.

This is a 30 litre enclosure reflex-loaded by a substantial 80mm diameter/130mm deep ducted port; the duct resonance occurs at 47Hz, and the main driver resonance at 68Hz. The 6-element crossover includes one resistor plus a variable treble control on the front panel. With the latter set to the nominal 'O' or flat position, the treble was considered to be excessive (this was found with all the Wharfedales we tested); in our view a '10-11 o'clock' position gave the best results.

Built on a substantial rectangular casting, the

Sound quality

Capable of sustaining up to 150W peak programme on electric bass guitar and with a good result on the 100W pulsed test, a 150W maximum power rating was suggested, with 20W as a sensible minimum. Fairly high sound levels of 103dBa were possible from a pair.

Despite a fully recognised and acknowledged bass prominence, the listening panel thought so highly of the rest of the frequency range that consistently high marks were awarded. It scored well on the live sound comparisons, appearing comparatively neutral and notably transparent, with a convincing manner. Slight sibilance and 'boxiness' were also noted, with a 'chesty' effect on speech.

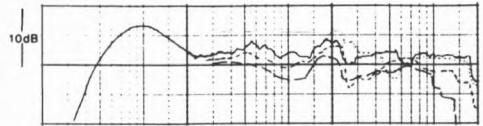
On the stereo programme the bass extension was appreciated despite the upper bass richness, and aside from a rather 'slow' bass character, this model seemed to be comparatively free of vices. Stereo image quality was well above average with good precision (especially with the grille off) as well as promising depth. Although mild 'plummy' and 'boxy' effects were noted, these were not serious.

Summary

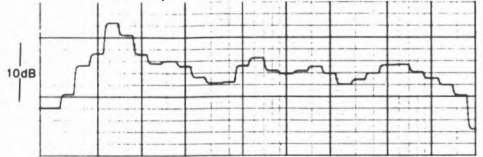
Though the *TSR108.2* has lower sensitivity than its predecessor, and the bass is less even and well defined, it offers a good standard of midrange and treble quality at an attractive price. Easy to drive, well finished in natural veneer, and capable of decent sound levels, the *108.2* was awarded a Best Buy in the last edition – however, with stiffer competition this time, and also bearing in mind the requirements of digital programme, it must unfortunately lose that distinction this time.

GENERAL DATA

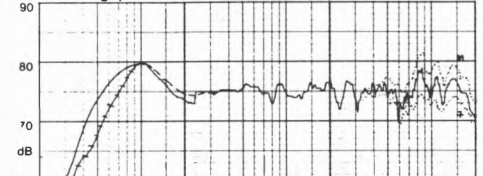
Size (h x w x d)	57.7 x 31 x 28.8cm
Weight	14 kg
Recommended amplifier power per channel (for 96dBa per pair at 2 metres minimum)	(20)–150W
Recommended placement	open stand clear of walls
Frequency response within ± 3 dB (2m)	130Hz to 18kHz
Low frequency rolloff (-6 dB) at 1m	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m	85.5dB/W
Approximate maximum sound level (pair at 2m)	103dBa
Impedance characteristic (ease of drive)	very good
Forward response uniformity	very good (grille off)
Typical price per pair inc VAT	£240 when reviewed, now £270



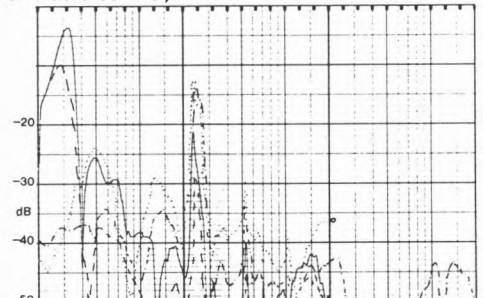
Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



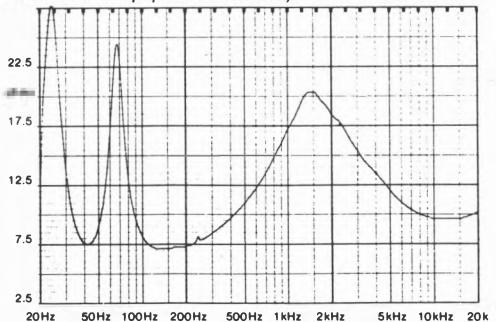
Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response variations of treble control).



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



Impedance (mod Z).

Yamaha NS1000

Natural Sound Systems Ltd, Greycaine Road, Watford, Herts
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 210

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 lispingness 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.

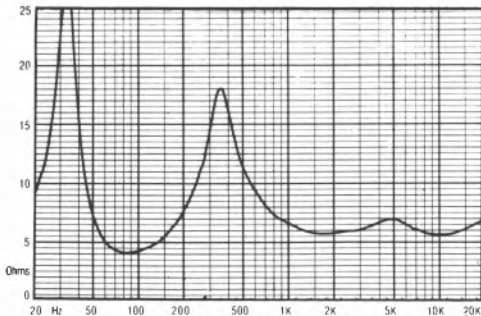
The speaker had a peak power capacity of up to 200W and high sound levels were possible from a stereo pair — up to 108dBA in a typical room!

Summary

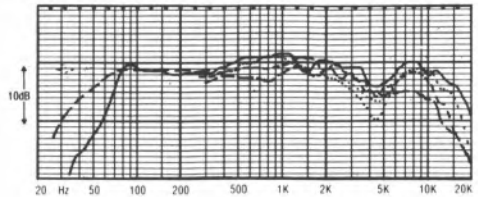
The long-lived *NS1000* remains competitively priced. Superbly engineered and finished, it can provide powerful, clean, articulate and extended bass despite its compact dimensions, and also sets a good standard elsewhere. Stereo images were well formed, the distortion was excellent and available sound 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

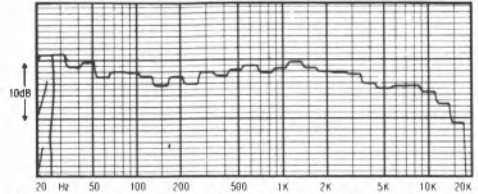
Size (height x width x depth).....	67.5 x 37.5 x 32.5cm
Recommended amplifier power per channel (for 96dBA minimum per pair at 2 metres).....	(10)—200W
Recommended placement	30cm from wall on rigid stands
Frequency response, within 13dB, at 2 metres	50Hz to 16kHz
Low frequency rolloff (— 6dB point) at 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



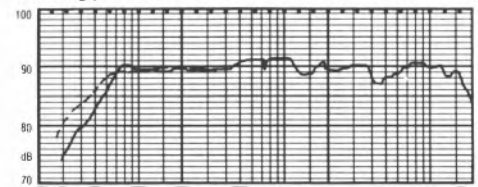
Impedance (mod Z). Impedance characteristics give an indication of amplifier loading.



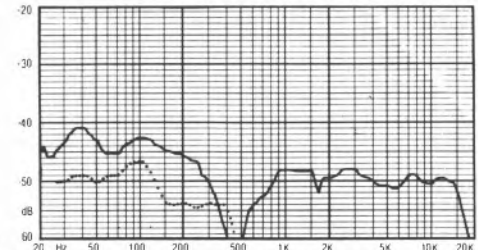
Forward characteristic response (1/3 octave at 2m, dotted 15° vertical, small dash 30° lateral, long dash 45° lateral).



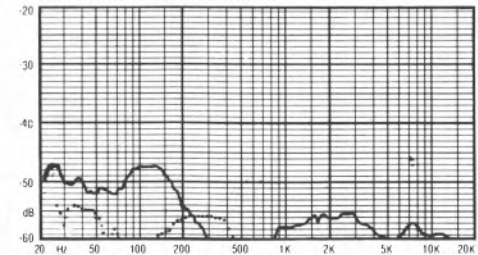
Averaged forward characteristic response in room at listening position.



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



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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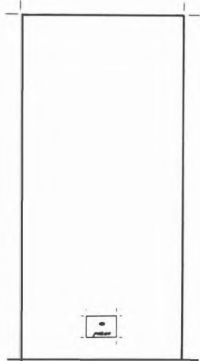
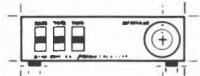
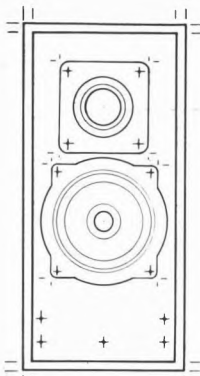
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While within the pages available we always try to include as many new reviews and up-to-date models as possible, we have review data on many speakers which are still available but whose reviews we can no longer print in full. These are included in summarised form here. Note that inclusion in the summary section does not necessarily imply that a product is in any way inferior to those whose reviews are reprinted in full, as many models here did well in earlier tests.

ARC 101A/P (£320)

Using a plug-in crossover which can be removed and replaced by amplifier connections for active operation, the ARC 101 gave a promising performance in earlier editions and was in fact a recommended model last time round. ARC subscribe to the philosophy of rigid cabinet construction, and on test the 101 revealed good detail and lively transparent sound, relatively neutral and with good imaging. Revisions to the design have resulted in a *Series 2* version and unfortunately our deadlines prevented us from assessing the latest production models this time round. Again, worth looking into by those interested in active loudspeaker systems.

B&W DM12 (£225)

A high-power compact design, this model showed moderate coloration with some midrange bias and 'boxiness', a slightly dull treble countered by a degree of extra 'zip' at the upper frequency extreme. It gave somewhat uneven subjective results but was nonetheless judged good for its size and price, especially taking into account its very good construction and the inclusion of protection circuitry.

B&W DM14 (£325 inc stands)

With an elaborate integral wood and steel stand, the DM14 offered an essentially clean sound, although not the most neutral-sounding speaker in this price range. Criticisms included a degree of 'boxiness' and 'thickening' in the midband, while the treble could become a touch abrasive. Stereo presentation was quite good, sounding best when the speakers were over-angled so that their axes crossed in front of the listener. Again, well engineered and finished.

B&W DM16 (£550 inc stands)

Unusually styled with sloping front and integral stand, this is the largest of the trio of B&Ws which did well in the last edition but are now gradually being phased out of the range. The DM16 again is designed to withstand high input power, electronic protection preventing damage, and showed only mild colorations in our subjective tests. The frequency balanced was judged to be neutral, but the bass could have done with more 'tautness' and precision. Its superb engineering and finish, with a more 'furnished' appearance than most speakers, may well appeal.

B&W DM7 II (£425)

Predating the DM12, 14 and 16, the DM7 illustrated B&W's willingness to experiment with slightly unorthodox loudspeaker cabinet designs, having its tweeter mounted on the top surface of the cabinet, protected by a dome of wire mesh. The other drive units are a 200mm bass unit and passive ABR. This medium sized stand mounted model gave a generally fine lab performance with useful sensitivity and bass extension, marred by a somewhat recessed presence, which left the mid-treble a little 'exposed'. Sound quality was rated average throughout, with 'boxy' and 'hollow' colorations noted, plus a tendency to emphasise disc surface noise. A competent rather than inspired performer at its £400-odd price tag.

Castle Richmond II (£105)

Firmly recommended in *Choice* some years ago, this long-lived and successful Castle speaker may still be found although it has been effectively replaced by the *Tyne*. Among its virtues is a usefully-high sensitivity (90dB), which suited it well to budget systems, and was not obtained at the expense of low frequency extension or a 'difficult' low impedance. Criticisms of sound quality included comments on a 'thin', 'bright' balance, so shelf mounting is appropriate, as recommended by the manufacturer.

Castle Kendal II (£165)

Another Castle replaced by a new model after a long and popular run, the *Kendal* in fact achieved a Best Buy in the last two issues. Criticisms on subjective tests included a masking of depth information and a lack of smoothness in the bass, but in general the results were good — and in this design, combined with good sensitivity (89dB) and power handling, allowing high sound levels to be achieved.

Castle Conway IIA (£425 inc stand)

Still current in the Castle range, alongside the new models tested for the first time in this issue, the *Conway* is quite a large speaker and in the latest IIA form comes with integral stand. Both measured and subjective results proved to be of a fine standard and the model was rated Best Buy in the last two issues. It gained a top class rating for stereo imaging, with depth,

SUMMARY REVIEWS

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 a clean, extended bass.

Castle Howard II (£550)

In many ways this model is an enlargement of 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. Despite the slight reservations with respect to its cheaper stablemate, the *Howard* merits consideration.

Celestion 662 (£500)

This very large loudspeaker gave a similar performance in many respects to the 551, and recommendation was only withheld because of the fairly high price. The response showed the treble and presence regions were somewhat

suppressed, and the most appropriate description for the sound quality was 'pleasant', the 'good' overall rating being assisted by the extended, powerful bass and general smoothness despite the noticeably 'rich' balance. Sensitivity at 88dB is slightly above average, power handling generous and the impedance characteristic is very easy to drive, permitting high sound levels with larger amplifiers.

Chartwell/Rogers PM55 (£115)

Well-built for a relatively inexpensive speaker this model was sold under the Swisstone-owned brand of Chartwell. Technical features of interest include the polypropylene cone and decoupled mounting of the bass/mid unit. On test the PM55 did not really live up to its promise, with criticisms of a 'thin' midrange quality, combined with an excessive warmth in the lower ranges, and some 'boxy' effects.

Chartwell/Rogers PM310 (£250)

Rated very highly by the listening panel for the last edition, this larger Chartwell also offered a very good standard of finish and engineering for the money. It gave superior stereo depth, and sounded detailed and transparent, although

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some colorations, including a trace of 'plummy chestiness' — perhaps related to the touch of 'BBC Monitor downtilt' noted in the response curves — with a lack of bass clarity and some treble 'zing' and 'fizz' were criticised. Although potential buyers should note that this speaker has some idiosyncracies, it achieved a good overall standard.

Dean Mini-Monitor (£179)

Promising in many ways, the Dean Mini-Monitor in its original form was reviewed last time round, when it was described as an honest attempt at the 'quality miniature' market by this then quite young British company. Its failings really boiled down to a combination of low sensitivity and limited maximum sound level, with a rather 'rich' balance noted on audition, along with some upper-treble 'sizzle' and emphasis of hiss. Unfortunately Dean were not able to supply the new season's models in time for our deadlines this time — but we understand that the *Mini-Monitor* has undergone considerable development in the meantime.

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.

IMF Super Compact II (£205)

This substantial and beautifully crafted 3-way compact had a respectable lab performance, marred by indications of crossover saturation at high levels in the midband. Sound quality rated a little below average overall, with the bass quality liked but midrange 'boxy' colorations and stereo 'focusing' adversely commented upon. Sensitivity rated a little below average.

Infinity Qe (£168)

The unusual film-type orthodynamic tweeter used in this model provided a 'difficult' amplifier load, while certain coloration and aggressive effects and some distortion were noted. However sensitivity (89.5dB) and power handling were high, and the general response and clarity was to a good standard. The design only just failed to achieve recommendation when it was tested a couple of editions ago.

JBL L110 (£600)

An interesting design with low distortion, clean extended bass and good clarity, the high UK price precluded recommendation. The speaker was easy to drive, gave above average sensitivity (90dB midrange, 87dB overall) and stereo imagery, and an overall 'good' sound quality rating, though not without some criticism of 'hardness' and 'wiriness'. Panel responses were less consistent than usual, suggesting that this design may well satisfy some but irritate others.

KEF Celeste IV (£120)

A Best Buy model in the last two editions, this was KEF's first recent attempt on the budget speaker market, and remains a fine balance of smart appearance, good technical performance, and average sound quality, at a below average price. However, it is now overshadowed by newer KEF models.

KEF Caprice II (£150)

Shallow enough in front-to-back depth for shelf mounting, the *Caprice* is quite a tall speaker, in fact a cheaper version of the 103.2 design. It was highly rated by the *Choice* panel in the last edition and in fact preferred to its more expensive brother. It proved to be a clean, neutral-sounding and compact speaker of good dynamic range, sensibly wide response and cost-effective engineering.

KEF R103.2 (£260)

With a larger, real-wood veneered cabinet and protection circuitry built in, the 103 contains otherwise similar ingredients to the more recently-introduced *Caprice*. On audition it was judged a little 'bland' — less 'lively' than the *Caprice* — and yet colorations were at a minimum and stereo imaging was good. It offers a smooth, slightly 'rich' sound, reasonable sensitivity, plus very good finish and engineering quality.

Lentek Monitor X (£550)

This large transmission line design had a well extended bass, but showed limited power handling in this region, had a below average sensitivity, and an impedance which was also on the low side. Sound quality was rated somewhat below that for the cheaper S4, with a rather 'dulled' sound, lacking transparency. A somewhat disappointing result for the highish price and bulky dimensions.

Monitor Audio M84 (£240)

This substantial two-way floor-standing model is attractively designed with an integral stand. In many respects it gave a good performance, but was nevertheless flawed in terms of

SUMMARY REVIEWS

frequency response, with midrange prominence and depressed presence. The sound quality was quite promising, but marred by 'dullness' associated with the frequency response. Overall the *84* merits consideration but not recommendation, and may suit some systems.

Pioneer HPM500 (£170)

With three drive units, an adjustable treble-output control and a combination of high sensitivity and high power handling producing very high maximum levels (111dB!) the *HPM500* perhaps typifies the high 'perceived-value' speaker offered traditionally by mainstream electronics manufacturers. The sound quality did not please the panel who noted cabinet resonances as well as coloration, a defocused stereo image, a thin and 'hard' sound on piano with a false echo effect. Despite these criticisms, some degree of presence and excitement could be identified, and so this speaker could possibly appeal to a rock enthusiast – in any case, it would be fine for parties!

ProAc Studio 3 (£977; AlNiCo magnet version £1265)

ProAc is the more specialised and upmarket sister company to Celef Audio, producing elaborate and expensive speakers in relatively small numbers. The *Studio 3* was well received in previous editions, being praised for a light, airy characteristic free of the 'boxy' or 'wooden' effects common with conventional speaker designs, for extended, powerful bass and very good stereo imaging. Unfortunately we were unable to obtain the latest ProAc monitor-class speaker, the *EBS*, for this edition, but on past experience this limited-production model could be worth auditioning by anyone about to spend £1400 on a pair of loudspeakers.

Rogers Reference System (£860)

This system mates the LS3/5A speaker with two large subwoofer units with associated active filter and power amplification, and is notably successful in improving some of the limitations of the miniature BBC monitor design. The overall performance is very good, though the maximum level which can be attained (96dB) is comparatively modest for such an expensive system. Definitely worth considering for those 'hooked' on the *3/5A*.

Sansui J11 (£90)

A true 'miniature' design, the *J11* showed a strong step in the frequency response, so while the reference sensitivity was 86dB, it was nearer 90dB above 2kHz, while the bass was curtailed below 200Hz, indicating that the speakers

would be happiest against a wall or amongst books. The 'thin' character resulted in an only 'acceptable' rating for sound quality, though stereo and clarity were both good. If this degree of miniaturisation is required by the user, the *J11s* had their good qualities, but represent too great a compromise in hi-fi terms.

Sony SSG4 (£300)

This substantial three-way design gave a generally competent but unexceptional performance, with frequency response imbalances affecting the sound quality ratings somewhat. Good sensitivity (90dB/W) must be offset slightly by the only average rating for impedance and a highish bass rolloff point considering the size of enclosure. Overall a competent design that tends to suffer a little in comparison with the cheaper *SSG1 II*.

Swallow CM70 (£180)

This design gave promising auditioning results, rating above average despite some frequency response imbalance which emphasised the mid-range. Capable of producing high sound levels, sensitivity was significantly below average (84dB) so a large amplifier may be preferred, though as a load it was easy to drive. Worth auditioning, as the panel results were not entirely consistent, the speaker was favoured on disc programme and only just missed recommendation.

Tangent Excelsior (£90)

This modestly priced compact enclosure is attractively styled, but was not favoured on the listening tests and showed a rather uneven frequency response. Sensitivity was high, but at the expense of bass extension, while both distortion performance and construction quality gave cause for concern.

Tannoy Stratford (£125)

This design incorporates Tannoy's costly pressure horn tweeter, along with a high-sensitivity polypropylene-cone 200mm bass/mid unit. On subjective results in the last issue *Stratford* fared only moderately, with a number of colorations noted and overall criticisms of 'thin' sound and audible cabinet effects. It does however offer a usefully high sensitivity (90dB) which would allow high sound levels using quite modest amplifiers.

Tannoy SRM12X £600

A professional monitor for studio use, this speaker was frankly a little out of context when reviewed in *Choice*, as monitor requirements are rather different to those of domestic hi-fi, but its inclusion at least allowed us to look at one speaker using the famous Tannoy dual-concen-

tric unit, in its redeveloped 305mm form. Theoretical advantages of the dual-concentric principle include good driver integration, with perfect off-axis symmetry. In the event, the panel, accustomed to the more subtle and refined reproduction of domestic hi-fi systems, were critical of the *SRM12X*, considering it hard and aggressive in character. While the speaker could not be recommended for domestic use, it fulfils the primary requirements for high-level monitoring in studio applications – with a sensitivity of 93dB, and power handling of 500W, it is capable of an estimated 113dBA maximum sound level!

Videotone GB3 (£50)

This small bookshelf design gave a distinctly uneven frequency response with limited bass and was rated poor overall on the listening tests. Sensitivity was low (82dB), and although the load was easy to drive, the level of coloration does not really suit it to hi-fi applications.

Wharfedale E70 (£440)

Now gradually being replaced by the *Mach* range, Wharfedale's *E Series* were styled and

marketed in 'hi-tech' fashion and it is now possible to buy kits based on these models which also include 'flight-case' metal edge protection for genuine PA use. Despite the very high sensitivity (94dB) the *E70* did not particularly like being driven hard (the *Mach* range appear to offer improved power handling), while the asymmetrical driver array produced some unacceptable stereo effects. Overall sound quality was about average with praise for clarity but criticism of 'fizz', brightness and other colorations. Though easy to drive, this design achieved high sensitivity at the expense of bass extension and output; nonetheless, some critical listeners have found significant merit in the overall result.

Yamaha NS590 (£300)

This model gave a very similar standard of performance to the similarly-priced *Sony SSG4*. Sensitivity was high (90dB/W), but the bass rolloff also on the high side considering the cabinet volume. Listening tests were reasonably encouraging, but reflected the aberrations in the frequency response which mar the overall performance, and preclude recommendation.

WARNING

When choosing a pair of speakers, don't just rely on someone else's opinion. Form your own ideas with a good demonstration from a selection of speakers in your price range.

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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 £275 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.

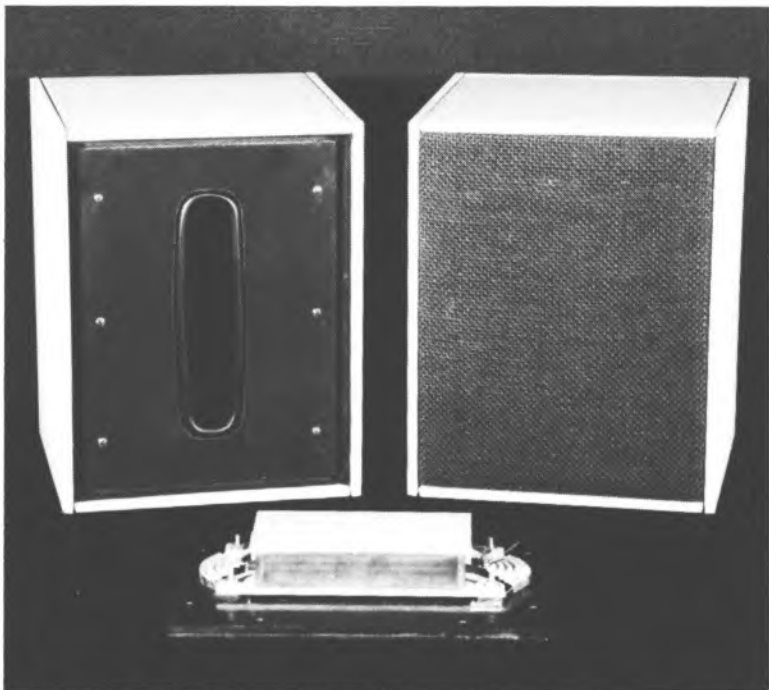
In fact, it would appear that most speaker manufacturers are welcoming the introduction of CD as at last providing the industry with a consistent frame of reference for comparisons, plus a uniformly high programme standard for all dealers and eventually all homes to benefit from.

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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The absence of crossover networks adds to the phase coherence of the system and the narrowness of the diaphragm ensures a wide horizontal dispersion and well defined spatial image. Lastly, the enclosure which is made up of ceramic plates, decoupled from each other and from the drive unit ensures that a minimum of colouration is added to a very neutral drive unit.

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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 this 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.

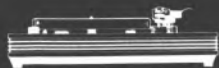
With digital programme the clarity is effortless, with negligible distortions and 'hyped up' balances are unnecessary — for example, if a speaker is smooth but a little bright it stays that way using digital material, and doesn't turn 'nasty'. Conversely, if the speaker is a little rich or dim, again 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.

Digital programme the subjective evaluation of the frequency response at the bandwidth extremes easier, and defects in or omissions in the low bass or high treble were also easily perceived.

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



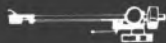
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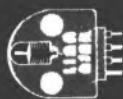
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a room boundary wall, can all dictate that small variations in the axial response will be essential to ensure the best subjective result.

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 19-20mm 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 of cabinet size.

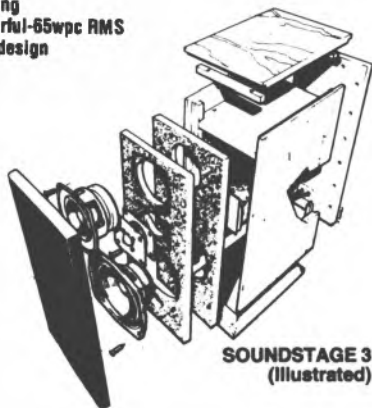
We found that these essentially two-way systems could span a price range as wide as £90 to £500, the results dependent on the designers' intended application, care and ingenuity.

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 £700 system price range.

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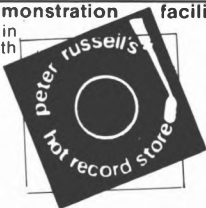
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BEST BUYS AND RECOMMENDATIONS

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 standards in the marketplace.

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 very good value for money, and considering the very high performance standard attained by a number of inexpensive speakers in this issue, the Best Buy price limit has been drawn at £275 a pair. Above this level we feel the 'law of diminishing returns' excludes such listing, and so the better examples costing in excess of the £275 level have been included in the Recommended category 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.

There still remains a further category which attempts to include those systems of particular merit at every price level, which we feel do not offer good value but which still have something special to offer, be it an ability to be shelf or wall mounted, or a particular affinity with analogue programme be it rock or classical. High sound levels or the ability to drive large rooms successfully can also be important. These models are therefore listed as **Worth Considering**.

One point the reader should bear in mind is the possibility of local price variations or special offers; our final conclusions rely a lot on typical retail selling prices, and obviously variations in these must be taken into account by the would-be purchaser.

BEST BUYS: UNDER £100

On the assumption that some KEF *Coda IIs* (£90) are still available, and that the *Coda III* (£99, untested but briefly auditioned) is no worse than its predecessor, there are five Best Buys in this category. The KEF *Coda* and *Castle Clyde* (£95) are now joined by the *Keesonic Kub* (£82), the newly-introduced *Mission 70* (£79)

and the *Mordaunt Short MS20* (£90).

The *Keesonic Kub* is the smallest of the group and will happily endure bookcase or wall mounting, giving good results especially with richer sounding cartridges. The *Mission 70* is somewhat larger but will also survive wall mounting, though it prefers stands. Sensitivity and maximum loudness are improved over the *Kub*. Re-auditioned this year, the *Clyde* offers good finish, high sensitivity and a surprisingly smooth sound for the price.

Both offering a slightly bigger enclosure size and performance, the KEF and the *Mordaunt Short* are two very civilised and well-balanced performers, giving fine value for money. The KEF is in vinyl walnut, the *Mordaunt Short* all black.

RECOMMENDED: UNDER £100

The recommended category includes quite a number of models under £100. These are the *Celestion 100* (£79) and *110* (£99); *Castle Clyde* (£85); the *Marantz LD30* (£99); *Monitor Audio R252* (£99) and *Wharfedale Laser 90* (£95).

Celestion's 100 is a smaller model offering good sensitivity, with a rather lively sound, while the *110* offers increased subtlety and power in a larger enclosure, joined in this respect by the superbly finished *R252* and the highly civilised *Laser 90*. The *Marantz LD30* offers a different view, with an extended response, and a rather rich distant balance which was still liked by the panel.

BEST BUYS: UNDER £200

It was gratifying to see such a strong performance in this sometimes neglected price sector, which included no less than five Best Buys — the *AR 48LS* (£199); *Heybrook HB1* (£120); *Mission 700S* (£130); *Monitor Audio R352* (£150); and last but by no means least the *Tannoy Mercury* (£120).

First of these in order of ascending price, the *Heybrook HB1* proved to be a slightly bright-sounding, sensitive model of great transparency and dealt honestly with the programme used. The *Mercury* was richer sounding but also gave a very fine performance at the price. *Mission's 700S*-look set to repeat the success of their 700 predecessor, in providing a winning combination of sound, and sensitivity, packaged in real veneer, while the *Monitor*

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BEST BUYS AND RECOMMENDATIONS

Audio *R352* is a larger, superbly finished system of great integrity and power. The AR, by virtue of competitive pricing, is the least expensive of the larger three way systems, and incorporates a 250mm bass driver in contrast to the smaller 200mm units fitted to those models mentioned so far in this category.

RECOMMENDED: UNDER £200

A number of models were found worthy of recommendation here include both the **Castle Lincoln** (£135) and **Pembroke** (£175); the **Goodmans Mezzo** (£135); the **Heybrook HB2** (£199); the **Monitor Audio MA66** (£185); the **Mordaunt Short Carnival III** (£130); and the **Rotel RL915** (£180).

The *Lincoln* and *Pembroke* are typical of Castle's 'house style' — well-engineered speakers of good all round performance. Heybrook's *HB2*, which established the company's reputation a few years ago, is still a deservedly popular model. The *Carnival* offers a smooth, light-natured sound, in an individual, well-furnished package, while the *Mezzo* gives a lot of sound and speaker for the money, including lights, controls and a 250mm reflex loaded bass unit of fine power handling. The *MA66* is an older-style speaker in tonal balance, more suited to analogue records but still demonstrating a good standard, while Rotel's *RL915*, with plate glass top, provides a clean bass and an open, lively sound.

BEST BUYS: £200 TO £275

The field thins out here with only two Best Buys — the **Rogers LS7** (£260), which provided an exceptional sound — dynamic, transparent and with fine stereo, good sensitivity and a top-class finish; and the **Spendor Prelude** (£210) which was very similar in most respects, except for a slightly poorer performance on coloration and mid-range clarity, and in having a vinyl rather than a veneer box.

RECOMMENDED: £200 TO £275

Recommended systems comprise the **Celestion SL6** (£260) a diminutive but highly musical performer of low sensitivity but fine stereo; the **Spendor SA1** (£210), another sophisticated miniature with low distortion as well as extended bass, and the **Sony SS G1** (£210), now a mite long in the tooth but still a lively and powerful three-way performer. The **Audio Pro B240** subwoofer (£250), a Swedish-built product of very high quality, also continues to be recommended.

RECOMMENDED: ABOVE £275

Foremost here is A&R's **Arcam One** (£299), an active convertible passive speaker which gave an impressive sound on test. A musical, lively and transparent performer, its versatility with respect to matching electronics could be an important factor.

Audio Pro's 4.14 (£750) is a complete active system with a very good performance a highly extended bass and fine engineering quality. It is also digital-compatible.

If a superlative miniature speaker is required and price is no object then seriously consider the **Celestion SL600** (£599). Possessing great subtlety, and low coloration, it can provide a very satisfying stereo performance, conceding very little to far larger and costlier designs.

Gale have also pulled their socks up with the new **Gale GS 402** (£430), a fine powerful speaker which is easy to recommend. The new **Spendor SP1** (£470) carries a firm recommendation, offering an improvement over the *BC1* in level sensitivity, bass and coloration.

The new **IMF HPCM** (£530) is a finely-crafted traditional three-way design offering a good all round performance with an extended bass.

The sensitive, well tuned and excellently finished **Lentek S5** (£410) continues to be recommended while the **Meridian M2** (£700, active) is a welcome addition to these pages, being a distinctive, slim and compact system with an integral stand of matching appearance.

The latest MkII version of the **Rogers Studio One** (£390) also qualifies for recommendation, though both this and the longer established **Spendor BC1** (£380), seem more dated than before, especially in terms of sensitivity and bass damping — both systems now sounding heavy footed in the low frequency range.

Spendor's SA2 (£320) also offers quite good value with superb build quality, but it is outclassed by Spendor's own cheaper **Prelude**.

At higher price levels, three speakers hold sway, namely the **Yamaha NS1000** (£600), the **JBL 150A** (£1000) and the **Quad ESL 63** (£1150). The Yamaha is confidently recommended especially for digital programme, while the JBL is a large floor standing model with good stereo and superb bass extension. The electrostatic **Quad ESL63** is a full range system which, if carefully positioned and matched to other equipment will offer an accurate sound, still demonstrating the finest 100Hz-to-10kHz midrange yet available. Serious auditioning, preferably at home, is however recommended before purchase.

OVERALL COMPARISON CHART

	Dimensions (cm)			Bass enclosure internal volume (litres)	Max sound level in 100m ³ 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 AR8LS	35.5	23	18	—	102dB	90dB	90Hz	10-50W	average -	v. good
Accou. Res. AR18S/AR18LS*	42	24.5	17	10	107dB	89.5dB	60Hz	10-75W	average -	average -
Acoustic Research AR28LS	51	28	22	19	104dB	89dB	55Hz	10-75W	good	good
Acoustic Research AR48S*	64	35.5	28	38	105dB	88dB	40Hz	15-100W	good	good
Arcam One (A&R Cambridge)	47	27	33	—	104dB	88dB	55Hz	15-150W	v. good	good
Audio Pro 4-14*	52	32	26	18	109dB	variable	30Hz	active	v. good	v. good
Audio Pro B240*	37.5	37.5	18	26	107dB	—	27Hz	active	v. good	—
B&O S80 II	53	26.5	26	25	96dB	83dB	55Hz	25-100W	average -	poor
B&W DM10*	48.5	25	23.5	19	103dB	88dB	55Hz	15-100W	good	good
B&W LM1	24	15.5	20	2.5	101dB	86.5dB	80Hz	15-100W	average +	good
B&W 802	104	37	30	45	105dB	85.5dB	37Hz	15-200W	v. good	excellent
BBC LS35a	30	18.5	16	5.5	93dB	81.5dB	57Hz	30-50W	average +	v. 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 Lincoln	44	22	27	15	100dB	88dB	53Hz	15-50W	v. good	good
Castle Pembroke	55	27.5	30.5	32	103dB	88dB	46Hz	10-100W	v. good	v. good
Celestion Dilton 100*	33	21	18.5	7	100dB	88dB	76Hz	15-50W	average	v. good
Celestion Dilton 110*	44	25	24	15	103dB	88dB	60Hz	10-100W	v. good	v. good
Celestion SL6	37	20	25.5	12	98dB	82.5dB	55Hz	30-150W	good	excellent
Celestion SL600	37	20	25.5	12	90dB	83dB	55Hz	30-150W	v. good	excellent
Gale GS402	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
Goodmans Graduate	70	27	40	39	102dB	85.5dB	38Hz	25-150W	good	good
Harbeth ML*	34.5	21.5	19.5	9	96dB	84dB	70Hz	20-50W	average	good
Harbeth R III*	63.5	32.5	30.5	50	102dB	87.5dB	46Hz	15-100W	good	v. good
Reybrook RB1	47	29	23	22	104dB	90dB	55Hz	10-80W	average	good
Reybrook RB2*	41	23	23	12	96dB	84dB	60Hz	30-100W	good	excellent
Reybrook RB3 II	62.5	33.5	28.5	37	106dB	89dB	44Hz	15-200W	good	v. good
IMF RPCM	67	29	37	35	105dB	86.5dB	40Hz	20-200W	v. good	excellent
IMF Compact Monitor 3	57	29	28	25	100dB	85.5dB	48Hz	20-100W	v. good	v. good
JBL L15	37.5	24	20	10	102dB	87dB	55Hz	15-100W	v. good	v. good
JBL L98	60	36	30	40	107dB	89dB	40Hz	10-200W	average +	average
JBL L112	62	33	34	22	109dB	88dB	43Hz	15-400W	good	average
JBL L150A*	105.5	43	33	110	111dB	89dB	32Hz	10-500W	v. good	v. good
KEFonic Kub	29	18	21	7	99dB	85dB	63Hz	20-75W	average	average +
KEF Coda II/Coda III	47	28	22	7	104dB	88.5dB	50Hz	10-100W	v. good	excellent
KEF Carina	60	30	25	30	104dB	89.5dB	52Hz	10-75W	v. good	good
KEF R105.4*	93.5	35	38	40	107dB	85.5dB	46Hz	20-500W	v. good	excellent
Koss Kossaire 110*	58.5	35.5	27	35	105dB	90dB	51Hz	10-50W	poor	poor
Lentek S5*	66	26.5	41	48	107dB	88dB	44Hz	15-250W	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
Marentz LD30	42	27	28	23	100dB	85.5dB	47Hz	20-100W	good	v. good
Meridian M2	50	18	38	17	102dB	active	45Hz	active	good	v. good
Mission 70	35	21	21	13	101dB	87.5dB	60Hz	15-75W	v. good	v. good
Mission 700S	46	26	26	22	104dB	89dB	57Hz	10-100W	v. good	excellent
Mission 737	54	25	27	24	103dB	86dB	48Hz	20-150W	v. good	v. good
Mission 770S	61	27	30	30	106dB	88.5dB	59Hz	15-200W	good	good
Monitor Audio R252	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 MA66*	58	30	29	33	101dB	86dB	42Hz	20-100W	good	v. good
Mordaunt Short MS20	42	25	20	14	102dB	87dB	55Hz	15-75W	good	good
Mordaunt Short Carnival	42	25	20	14	103dB	87.5dB	54Hz	20-100W	v. good	v. good
Mordaunt Short Pageant III*	62	26.5	30	25	105dB	86.5dB	41Hz	20-200W	v. good	excellent
Quad ESL83*	92	66	27	—	99dB	84dB	34Hz	25-100W	excellent	average -
Revox Symbol	110	46	39	—	111dB	93dB	43Hz	10-200W	average +	good
Richard Allan RA8*	39.5	26.5	27	14	98dB	85dB	50Hz	25-50W	average	average +
Rogers LS7*	56	27	28	30	106dB	88dB	48Hz	10-200W	v. good	v. good
Rogers Studio One MkII	63.5	30.5	30.5	43	104dB	86.5dB	36Hz	20-200W	v. good	v. good
Rotel 915*	57	30	26.5	28	104dB	87dB	43Hz	15-150W	v. good	excellent
Sony SSG1	60	33.5	30	37	105dB	89dB	50Hz	10-100W	good	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 SA2	50	26	28	28	105dB	88dB	48Hz	15-200W	good	v. good
Spendor SP1	63.5	29.5	30.5	44	103dB	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	12-100W	good	good
Visionik David 7000 (with Sub 3)	24.5	16	17	3(50)	105dB	90dB	43Hz	10-100W	average	v. good
Wharfedale Laser 60*	41	26	23	17	96dB	86.5dB	55Hz	20-30W	average +	good
Wharfedale Laser 90	48	26.5	25	20	103dB	87.5dB	54Hz	15-100W	v. good	good
Wharfedale TSR106.2	48	29	25	22	101dB	84dB	50Hz	20-150W	v. good	v. good
Wharfedale TSR108.2*	57.5	31	29	30	103dB	85.5dB	40Hz	20-150W	good	v. good
Yamaha NS1000	67.5	37.5	32.5	55	108dB	90dB	40Hz	10-200W	v. good	v. good

* = revised and reprinted

OVERALL COMPARISON CHART

Coloration	Amplifier loading impedance	Peak distortion per-100W	Swept distortion per-96dB	Overall subjective quality	Stereo image quality	Typical price (\$/pds)	Value judgement	
poor	good	good	good	poor	average	\$75	—	Acoustic Research AR8LS
acceptable	average	average	average	average	average	\$90	—	Accu. Res. AR18S/AR18LS*
poor	good	average	average	average	average	\$120	Worth considering	Acoustic Research AR28LS
good	average	v. good	good	good	good	\$250	Best Buy	Acoustic Research AR48S*
v. good	v. good	average +	average +	v. good	v. good	\$299	Recommended	Arcam One (A&R Cambridge)
v. good	active	v. good	v. good	v. good	v. good	\$750	Recommended	Audio Pro 4-14*
good	—	—	excellent	good	—	\$250	Recommended	Audio Pro B240*
average -	v. good	good	average +	average +	average +	\$225	—	B&O S80 II
average +	average	v. good	v. good	good	good	\$90	Recommended	B&W DM10*
average +	average -	good	v. good	average -	average -	\$200	Worth considering	B&W LM1
good	v. good	v. good	v. good	average +	good	\$850	Worth considering	B&W 802
average	excellent	average -	average +	average -	good	\$210	Worth considering	BBC LS3/5a
average -	average -	good	average	average -	average -	\$100	—	Boston A40
average +	good	average	v. good	average +	good	\$60	Best Buy	Castle Clyde*
average +	v. good	good	good	average	average +	\$135	Recommended	Castle Lincoln
good	v. good	good	good	good	good	\$175	Recommended	Castle Pembroke
average	average	good	average	average	good	\$70	Recommended	Celestion Dilton 100*
average +	good	average +	average +	average +	good	\$99	Recommended	Celestion Dilton 110
good	average +	average +	average	good	v. good	\$270	Recommended	Celestion SL6
excellent	average +	average +	average +	v. good	excellent	\$599 (inc)	Recommended	Celestion SL800
good	average -	v. good	good	v. good	average +	\$430	Recommended	Gale GS402
average +	good	good	v. good	good	average	\$130	Recommended	Goodmans Mazzo
average	good	v. good	v. good	average -	average -	\$520	—	Goodmans Graduate
good	v. good	average	average	average	average +	\$190	—	Harbeth ML*
v. good	good	average -	v. good	good +	good	\$345	Worth considering	Harbeth HLIII
good	average +	good	average +	v. good	v. good	\$129	Best Buy	Haybrook HB1
good	good	average -	good	good	good	\$195	Recommended	Haybrook HB2*
average	v. good	good	average	average	good	\$420	Worth considering	Haybrook HB 3 II
good	average -	v. good	good	v. good	v. good	\$550	Recommended	IMF HPCM
average +	average -	average	average +	average	average +	\$275	Worth considering	IMF Compact Monitor 3
average -	average -	good	v. good	average -	average -	\$210	—	JBL L15
average	good	v. good	excellent	average +	average	\$580	—	JBL L86
average	average	v. good	v. good	good	average +	\$700	—	JBL L112
good	average	v. good	excellent	v. good	good	\$1150	Recommended	JBL L150A*
average +	good	average +	average +	average +	average +	\$82	Best Buy	Keosonic Kub
good	v. good	v. good	average	v. good	v. good	\$80	Best Buy	KEF Coda II/Coda III*
average -	good	good	average +	average -	average -	\$140	Worth considering	KEF Carina
v. good	excellent	v. good	average +	v. good	excellent	\$630	Worth considering	KEF R105.4*
poor	v. good	average	average +	poor	poor	\$190	—	Koss Kossfire 110*
good	average	good	v. good	good +	good +	\$385	Recommended	Lenke SS*
average	average	good	average +	average +	average +	\$196	Worth considering	Linn Kan*
average +	poor	average	average	average +	average +	\$552	Worth considering	Linn Sara
average	good	average	average +	average +	average +	\$99	Recommended	Marantz LD30
good	active	v. good	average +	good	v. good	\$700	Recommended	Meridian M2
average +	good	average	average	average +	good	\$79	Best Buy	Mission 70
good	v. good	average +	good	good	good	\$129	Best Buy	Mission 700S
average -	good	v. good	v. good	average -	average -	\$240	—	Mission 737
average	average -	v. good	good	average	average	\$330	Worth considering	Mission 770S
average +	good	average +	good	average	average +	\$99	Recommended	Monitor Audio R252
good	v. good	good	v. good	good	good	\$150	Best Buy	Monitor Audio R352
good	v. good	good	good	good	good	\$198	—	Monitor Audio MA66*
good	v. good	average	average	good	v. good	\$89	Best Buy	Mordaunt Short MS20
average +	good	average -	average	average +	good	\$130	Recommended	Mordaunt Short Carnival
average +	good	average	average +	good	good	\$300	—	Mordaunt Short Pageant III*
v. good	v. good	v. good	v. good	v. good	v. good	\$1000	Recommended	Quad ESL63*
poor	average -	v. good	average +	average -	average -	\$920	—	Revox Symbol
average	v. good	poor	average -	average -	average -	\$125	—	Richard Allen RAA*
v. good	v. good	good	v. good	v. good	v. good	\$260	Best Buy	Rogers LS7*
good	v. good	good	v. good	good	good	\$380	Recommended	Rogers Studio
average	v. good	v. good	average +	average	average	\$200	Recommended	Rotel 915*
good	good	good	v. good	good +	good +	\$210	Recommended	Sony SSG1*
good	excellent	average +	v. good	good	good	\$210	Recommended	Spendor SA1
average +	v. good	good	v. good	good	good	\$210	Best Buy	Spendor Prelude
average +	v. good	good	v. good	good	good	\$320	Recommended	Spendor SA2
good	v. good	v. good	v. good	v. good	v. good	\$470	Recommended	Spendor SP1
average	v. good	v. good	v. good	average +	average	\$900	Worth considering	Spendor SA3
good	excellent	good	v. good	v. good	good	\$120	Best Buy	Tannoy Mercury
average -	average -	average	average	poor	average +	\$124 (\$112)	—	Vigonik David 7000
average -	average -	average	average	average -	average -	\$80	Worth considering	Wharfedale Laser 50*
average	v. good	average	good	average +	average +	\$95	Recommended	Wharfedale Laser 90
average -	excellent	good	v. good	average -	average -	\$180	—	Wharfedale TSR108
good +	v. good	good	average	good +	good	\$240	Worth considering	Wharfedale TSR108.2*
good	average -	v. good	excellent	good +	good	\$600	Recommended	Yamaha NS1000



SUGGESTED SYSTEMS

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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

CHOICE'S CHOICE IS

SPALDINGS

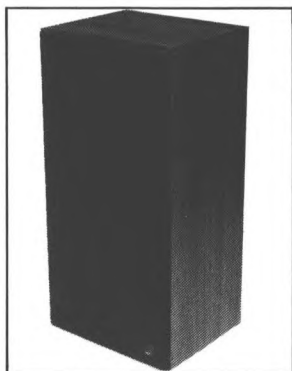
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MORDAUNT-SHORT MS20

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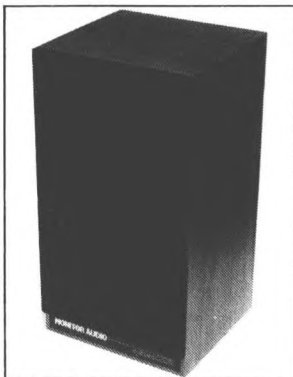


MISSION 70

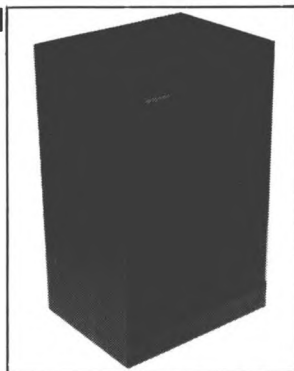


HEYBROOK HBI
(pictured right)

KEF CODA 3
(pictured left)



MONITOR AUDIO MS20
(pictured above)



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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 (μ 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 *crosstalk*.

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.

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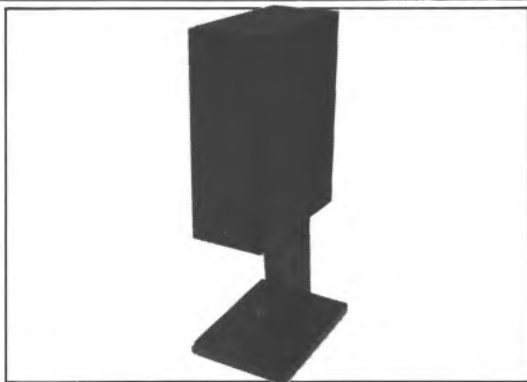
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